Lesson 6

Standardized Work

Without stability and standardization, we have no basis for improvement. In this lesson we will introduce standardized work, the key countermeasure used to develop and sustain work standards that ensure repeatability and predictability in our processes.

A good coach will have a "playbook" which all team members are expected to understand and follow during the game. The playbook will outline the number of players needed, and specify what each player will do during each play so that the team's efforts are coordinated and synchronized as play unfolds. The coach will have helped the team learn and practice the plays, often for some time before they are refined enough to be used in competition, and a good coach will work with his/her players to change the playbook over time as more is learned, experience is gained, and as conditions under which the team must play shift.

Think of standardized work as the "playbook" for workers, the methods that are defined, developed, proven and trained on to ensure specific outcomes are attained by people on a daily basis. It will spell out the number of workers needed and what each needs to do, and in what order, to make sure that customer expectations are met. Like the sports team, workers must have a clear understanding of the purpose of the playbook, be trained and practiced on these methods in order to be successful with them, and feel they have input into improving and adjusting the plays as they gain experience with them.

Sadly, this playbook does not exist in most organizations. For example, when asked if two people trained to do the same work will perform the job the same way, the overwhelming answer is "no" from most workers presented with this question (my informal poll over the last 8 years). This is a very interesting point given that many of our organizations are regulated by procedures, policies and/or oversight agencies such as the FDA or ISO that set an expectation for consistency and following a "standard way". The reality is that when we get down to the specifics of how tasks are done and how many people are needed, procedures, policies and governing guidelines do not generally provide the detail necessary to ensure repeatable, predictable quality, cost and time outcomes each time the work is done. For this, we need to develop and use standardized work.

Standardized work is the "best way we know TODAY" to do the job to ensure desired outcomes are met. Please realize that standardized work can and should change over time, as more is known and as conditions warrant it. Re-read the

previous sentence. It implies that there is not any one single BEST way to do a job, but a way that is the best fit with our current knowledge of the process, business circumstances, customer demand, and people involved. This thinking may be counter to traditional industrial engineering practice, where experts decide on the "best way" and are the only ones who are allowed to design work or change it. **In e², workers are expected to develop and change standardized work on the shop floor. Supervisors and Managers are expected to hold people accountable for following standardized work and must provide support and time needed to create and/or change the standards.**

There are many benefits to customers, workers and managers when standardized work is in place and being followed regularly. Pascal Dennis[xxvii] summarizes them as:

1. **Improved Process Stability.** Stability means repeatability and the ability to meet quality, cost, lead-time, safety and environmental targets every time.
2. **Clear start and stop points for each process.** These, and knowledge of the customer's rate of demand (Takt Time—see below for further explanation of this concept) and cycle times, allow us to see if things are on track, ahead or behind, and to divide work among people in an equitable way.
3. **Organizational Learning.** Standardized work provides a way to preserve know-how and helps avoid the problems that can occur if work methods are not documented and key employees leave.
4. **Audit and problem solving.** Standardized work makes it easier to assess the current condition and identify problems.
5. **Employee involvement and Poka-Yoke (mistake-proofing).** Workers are expected to be involved with standardized work creation and changes, and therefore can be encouraged to point out opportunities to employ simple, error-proofing devices.
6. **Kaizen**. Standardized work provides the baseline against which we measure improvement.
7. **Training.** Standardized work becomes the basis for employee training.

Process stability is a prerequisite for standardized work. For example, if line stoppages are chronic, equipment is problematic, or material issues or shortages are considerable, it will be impossible for people to work to standards. Therefore, it will be necessary to focus on and remain aware of process stability throughout your improvement journey. Many of the specific countermeasures, or tools, such as 5S, Visual Systems for Management, Total Productive Maintenance, Jidoka, and Just-in-time techniques help support process stability.

There are three elements of standardized work:

1. **Takt Time:** the rate at which we must produce a product or service to meet **customer demand.**
2. **Work Sequence:** the best way and order we know today to do the work.
3. **Standard-work-in-process:** the amount of inventory necessary to allow takt rate to be met and the worker to be successful in performing to the standard each time.

Let's discuss each of these elements in a bit more detail.

1. Takt Time

Takt comes from the German word for baton, as in the baton used by the conductor of a symphony. Consider the role of the conductor; he or she is keeping time with the baton so that all the musicians are synchronized, thus ensuring that the combined efforts of the musicians results in correct and pleasant sound being delivered to the audience (the customer).

Likewise, in our business we need to understand what the pace of demand is (how often does the customer need a product or service), so that we can design and staff our processes to meet that demand and ensure that our resources are synchronized and coordinated to do so productively and efficiently. We are also interested in knowing how much this will cost, how long it will take and what level of quality can be achieved so that we can plan appropriately to meet customer needs.

With standardized work we should always begin with a calculation of the Takt Time before proceeding further. The formula for Takt Time is shown below.

Takt Time =
(Available Work Time) ÷
(Quantity Required by Customer)

Example:

420 minutes net available per work shift / 210 units needed by customer per shift = Takt Time of 2 minutes.

Another way to say this is: one unit needs to be completed every 2 minutes in order for the customer to be satisfied at the end of the shift.

With Takt Time, we are simply computing a rate of demand in order to understand at what rate a process or value stream needs to run in order to satisfy customers. Standardized work methods will be designed based on Takt Time and will, using actual process cycle times (the time to perform the work steps), establish the sequence of

work steps that is needed to result in the best outcomes balanced against resource usage. The standard will reflect the best "way" to do the work under the current process circumstances. When the Takt Time value is not known or well understood, it should not be surprising that processes may under or over produce and/or not be optimal in terms of work balance, productivity and resource usage.

NOTE: One of the simplest things you can do as you proceed on your e² journey is to **make all employees familiar with the concept of Takt Time and help them develop local methods to quickly and easily assess how their process is doing relative to operating at Takt rate.** This is in essence what Standardized Work seeks to do. Implementing strong visual management systems is one way to help folks recognize how process output is comparing to Takt rate.

For example, if Takt Time is 2 minutes, we would like to see a product moving to completion every two minutes.

A common method for helping people to understand takt in a process is to post an hourly output chart in the area. By having workers track progress against hourly goals that reflect achieving Takt Time on a shift-by-shift basis, workers not only know the hourly expectation, they now have a simple means to see when meeting the goal is at risk and can suggest or take a countermeasure to get back on track when the rate is in jeopardy. This is also an excellent tool for supervisors and managers. It provides a quick, visual means for them to check progress any time they go to the shop floor.

Once Takt Time is determined, it will be necessary to understand cycle time, the actual time it takes to do the work steps. When Takt Time and cycle time are known, it is easy to calculate staffing levels required to operate a process. The formula for calculating the required number of workers is as follows:

Number of workers required =
(Total Cycle Time) ÷ (Takt Time)

Example:

Assume it takes 120 seconds to perform the operations necessary to build a sub-assembly. The customer requires one sub-assembly every 30 seconds (Takt). Therefore: 120/30 = 4 workers required to meet customer demand in this process.

This same idea can be used to calculate numbers of machines needed to meet customer demand. However, since Standardized Work is focused on the work of people, we will keep the discussion to people in this lesson.

Often people confuse Takt Time and cycle time. They are NOT the same thing at all. Takt Time is a measure of demand rate and cycle time is a measure of the actual time to produce something. Make sure you are clear on the difference between these two concepts before moving on.

2. Work Sequence

Once Takt Time is known and the work has been studied (typically through time studies done in the workplace, with workers who are experienced in the work) to determine cycle time, efforts must be made to define a single work sequence to ensure consistency and repeatability in terms of time, cost, quality, safety, etc. In this way, we ensure that workers are trained and following a set order of tasks, a repeatable sequence that can be accomplished within the Takt Time. From our example above, where the process requires 4 workers, this would translate into defining the steps and their order that each worker would perform every 30 seconds (their cycle of work each Takt Time interval).

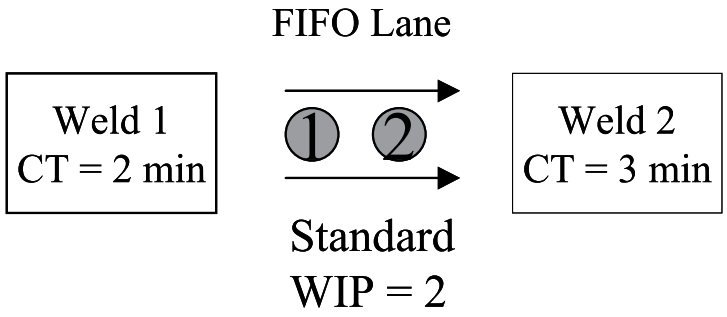
The work sequence defines what is done first, second, etc. Using tools such as an Operator Balance Chart, Work Combination Sheets and Standard Work Analysis Charts, the work sequence and associated measures can be documented and posted at the work place as a visual aid for the workers and as a management tool for supervisors to hold workers accountable to. We will talk more about these three standardized work charts later in this lesson.

The idea is for every worker to follow the standard work sequence EVERY time the work is done, regardless of day of the week, shift, or who is assigned to the job. If for any reason the standard can't be or is not being followed, it will be important to "ask why 5 times" and to perform problem solving.

3. Standard-Work-In-Process

The final element of Standardized Work is standard-work-in-process, or the amount of inventory necessary to maintain the required work rate. Think of standard-work-in-process as the minimum amount of inventory needed to allow the worker to keep working despite process issues that exceed Takt Time.

For example, suppose the Takt Time for the welding process shown on the next page is 5 minutes, but the part must cool for 10 minutes before the second and final weld can be made. The cycle time for weld 1 is 2 minutes and the cycle time for weld 2 is 3 minutes, meaning one person can do both welds in the 5 minute Takt Time. But how do we deal with the cooling issue and still allow the worker to meet the 5-minute Takt Time? By placing two pieces of standard work-in-process between the first and second welding steps, the operator can do weld 1 on a piece, set it down at the back of the FIFO (First in – First out) lane between weld 1 and weld 2 steps, pick up a cooled piece of work-in-process by taking the piece marked 2 (closest to weld 2), from the front of the FIFO lane, weld it, and the process cycle is complete within the 5 minute Takt Time. By inserting the two pieces as standard-work-in-process between weld steps 1 and 2, the worker is able to complete the weld cycle every 5 minutes, meeting Takt Time, continuing to do value added work (welding) while the partially welded parts are cooling in the FIFO lane.



Welding process with Takt Time = 5 minutes

Tools for Measuring Standardized Work

- **Time Observation Form**–sets cycle time for current condition and provides input to the other documents
- ***Process Capacity Worksheet**–determines capacity of each process step
- ***Standardized work layout**–shows current sequence of operations, as well as safety and quality issues and WIP levels
- ***Work Combination Worksheet**–separates "person work" from "machine work", and captures walking and delays
- ***Operator Balance Chart**–compares the time of work steps for each worker in an area against each other and the TaktTime

**All relevant work area information is available to employees through these 4 documents*

Now let's shift to some of the key charts and tools that are used to document Standardized Work. The graphic at the right lists the primary tools used in measuring Standardized Work. Let's review each.

It will be necessary to gather and analyze cycle time information for work steps in order to develop Standardized Work and balance work across workers. The Time Observation Form is used to assist with this. An example of a Time Observation Form is shown on the following page.

Time Observation Form

This form is a data collection form, used to observe and record specific time data for multiple iterations of a set of work steps. A good stopwatch will be needed to make it

easy to capture times for each step. Also, a video camera can be very helpful in getting the data to fill out the chart since you can play back, stop and capture times easily on a video player. The idea is to watch many cycles of the work being performed by different workers who are trained and experienced in doing the job, so that everyone can agree that a fair and reasonable assessment of the time to do different tasks is arrived at for the standard. **Make sure workers play a big role in watching and capturing the times and work steps included in the time observation sheet in order to be certain the exercise is an accurate reflection of work required and to create buy-in for next steps. If workers feel that "others" have decided the best ways and times, it is a sure sign it will be difficult to implement Standardized Work.**

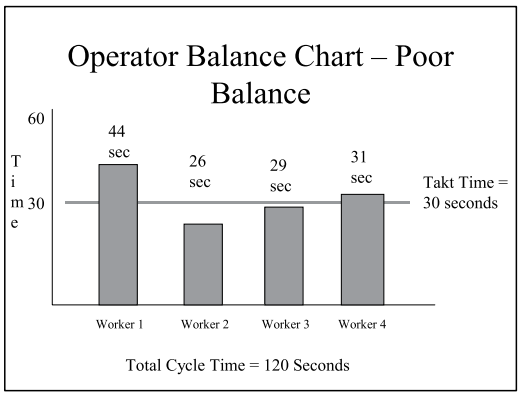
	Operation:	Shift:		Date:		Recorder:													
		Times																	
	Element	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Fluctuation.	Lowest
#																			Repeatable
1																			
2																			
3																			
4																			
5																			
6																			
7																			

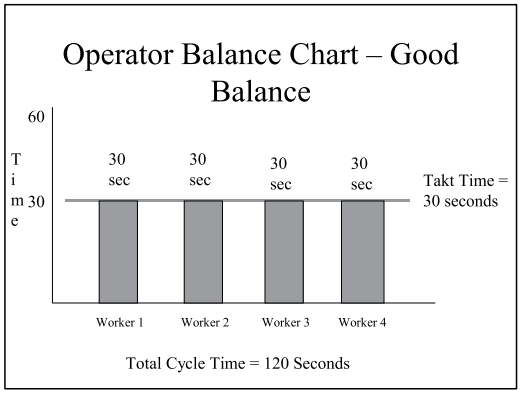
After watching many full cycles of the work, begin to break the total cycle of work into its respective steps. Write these work elements on the form and record the times for each element in the chart. Then determine how much fluctuation exists in the times (range between longest and shortest times) for each element and determine what the lowest repeatable Seconds time is for each step (for example, in two out of 16 instances observed, the part was inserted into the die in 6 seconds). The purpose of examining fluctuation and lowest repeatable times is to stimulate discussion about why variation exists and what conditions made it possible for the shortest times observed. When setting the standard times, you will need to allow for success by creating the required conditions for speed and consistency.

Once you have plenty of data for the overall work task as well as the individual elements of that task, analyze the data to set reasonable "standard" times for the overall task and each element within the task. These numbers will then become the inputs into the other key Standardized Work documents that we will now discuss.

Operator Balance Chart

An Operator Balance Chart is used to apportion work amongst workers when multiple workers are required to staff a process. Remember our example above where 4 workers were required to meet the Takt Time of 30 seconds for a process that has 120 seconds of cycle time? Let's use this example to understand how an Operator Balance Chart Works. In order to meet the demand, each worker needs to complete his/her work in





30 seconds or less. Take a look at the balance chart shown. If work is split among the workers as shown will they be able to meet the customer's demand? The answer is no, because worker 1 and worker 4 cannot do their work within the 30 second Takt Time. Worse yet, worker 2 will often be waiting for work while worker 1 is falling behind. And where would we expect to see inventory accumulating, perhaps before worker 1? The work balance chart makes it very easy to see these kinds of problems. A more efficient use of workers and the balance needed to assure customer demands are met is shown in the chart below. We can use the Time Observation Form to uncover ways to create the best balance across workers by examining how long each work element takes, the order that tasks can be performed, and looking at what combination of elements can be given to each worker to best balance work. Please note that the number of workers required will change as Takt Time changes or as other conditions require it (for example, when someone calls in sick). Therefore, you may need a variety of "playbooks" that define different ways to balance work and standardize work. When these scenarios have been considered, documented and trained on in advance, it makes it very easy to adjust to changes in demand or if a worker calls in sick, etc.

Process Capacity Worksheet

The next measurement tool we need to talk about is the Process Capacity Worksheet. This tool is used to calculate the capacity of each work step that must be performed, helping to point out potential bottlenecks and improvement opportunities. The chart at right shows the input data necessary to complete a Process Capacity Worksheet. A sample of a Process Capacity Worksheet is also shown below. The total capacity column is the key information provided by completing the document. This value is determined by using the formula:

Input Data for Process Capacity Worksheet

Data needed to determine the capacity of each process step

A. **Walk Time – time to walk between operations**
B. **Person Time – manual work**
C. **Machine Time – automatic machine time**
D. **Time to Finish = B + C**
E. **Pieces/change = Pieces run before machine is maintained**
F. **Time to maintain machine**
G. **Time per piece = F / E**
H. **Total Capacity = Operable time per day (e.g.27,000 sec) / (D + G)**

Total Capacity =
Operable Time ÷
(Time per piece + Time/piece
burden for changeovers)

Example:

If manual work is 20 seconds and machine time is 30 seconds, the Time per piece is 50 seconds. However if the machine has to have a drill change every 200 pieces and it takes 20 seconds to change the drill, then the time per piece burden is 20/200, or an amortized time of .1 seconds per piece.

Now we can calculate capacity to do this work each day

Total Capacity =
27,000 seconds available per day /
(50 + .1 secs.)
= 538.9 pieces/day

(sample worksheet below)

Example Process Capacity Worksheet

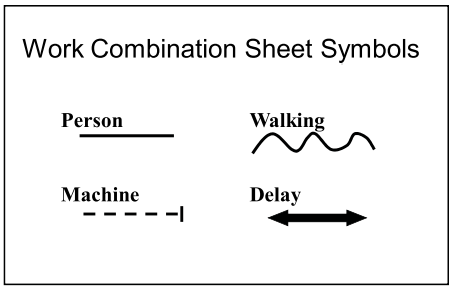
Part #					Date: / /			Page ____ of ____		
Description								Team Member		
Step #	Process Description	Machine Description	Walk Time	Base Time			Tool Change Time			Total Capacity
				Person Time	Machine Time	Time to Finish	Pieces/ Change	Time to Change	Time/ Piece	

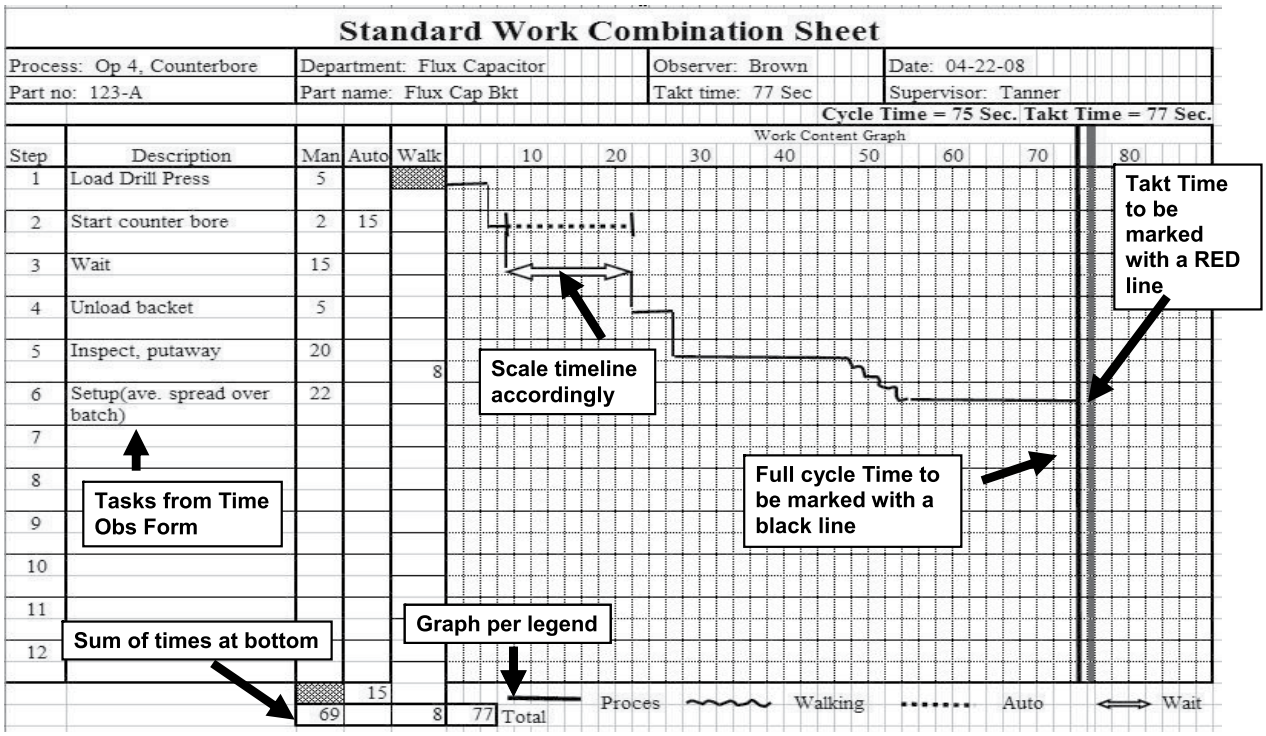
Work Combination Worksheet and Standardized Work Layout

<u>The next two Standardized Work documents are the most important</u>, and are generally the ones posted and referred to, by workers and supervisors, where the work is done. These two documents include all the information needed to do the work and to verify that the standard is being followed simply and easily. They are the Work Combination Worksheet and Standardized Work Layout.

Let's talk about the Work Combination Worksheet first. This document is filled in by starting with the times settled on from the Time Observation Worksheet exercises

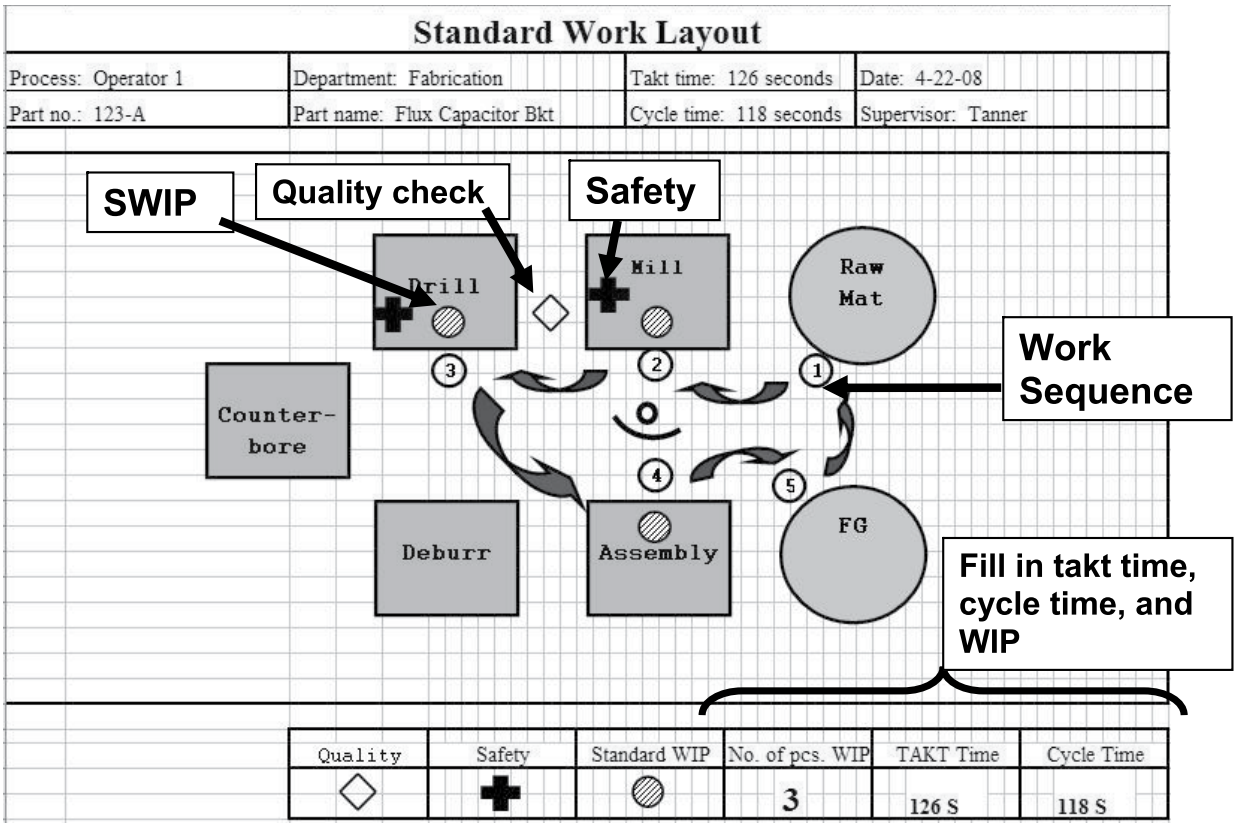
discussed above. However, further breakdown of times into four categories, work, walk, machine time and delay, is recorded and visually shown on this chart. It also shows the order of steps performed on the chart. Workers are trained to follow the sequence shown on the chart and are expected to complete the tasks within the total time shown on the Work Combination Worksheet. They know when they need to walk, when they need to interact with machines (e.g. to load/unload a work piece), what they should do when a machine is cycling, and when a delay or rest period is expected in the cycle. An example of a Work Combination Sheet is shown below.





Standardized Work Layout

The final Standardized Work Document we need to discuss is the Standardized Work Layout. This tool provides a visual depiction of the work area and work route the operator takes as he/she goes about performing work steps. It also shows where key safety concerns must be considered, where quality checks must be done in the work cycle, and indicates how much standard-work-in-process is allowed and where it exists in the work area. A sample Standardized Work Layout is shown below. In the example, the worker's standard work begins at #1, raw material, and the work sequence is complete at #5, finished goods. The worker then returns to #1 to begin the sequence again.



When the Work Combination Worksheet and Standardized Work Layout are posted at the work area, it is very easy to tell if things are on track and if the standard is being followed. A supervisor can verify this in a matter of seconds, just by watching a worker and comparing what is observed against the two documents. If for some reason a worker is not following standardized work, the supervisor can "coach" the person using the documents right then and there. Posting the documents at the work area also allows new workers to become independent and more confident sooner; if a worker forgets what to do next, he/she can refer to the standard work documents and quickly get back on track. The two documents also make it very easy to see if the area is in a 'ready' condition for workers. For example, if the documents show that 6 work pieces should always be on-hand between work elements 3 and 4 and only 1 is there, then something is wrong.

The topic of Standardized Work is worthy of its own, standalone course. It takes training and considerable practice to learn the nuances of accurately segmenting and measuring work content, uncovering pre-existing waste before standardizing, calculating required standard-work-in-process quantities, and using the various documenting tools and charts to appropriately define and implement effective standardized work. It will be imperative for you to study this important topic in more detail as you proceed with e². In this lesson we are simply providing you with a basic understanding of what it is, the three necessary elements and some sense of the tools that are available to help in its development and documentation.

In the final analysis, Standardized Work is the means by which work is balanced across people and defined in a way that sets our most valuable resource up for success. It should be posted and visible at worker stations and it should be simple and easy to confirm that workers are adhering to the standardized work sequence. It is a valuable tool to uncover problems and helps identify improvement opportunities, but only if workers are actively involved with its development and maintenance, and only when managers hold workers accountable for following it.

Practice Exercises:

Do the exercises below to increase your understanding of Standardized Work and related concepts.

1. Pick one work area in your business—a work cell, a department, etc. Calculate Takt Time for the area. Watch the work to determine cycle time(s) to perform the work steps in the area. Calculate number of workers required to meet Takt Time. How does this number compare to the staff currently assigned to the area?

2. Go to GEMBA and pick one area to observe workers doing their jobs. Pick a process where the work is fairly repeatable (i.e. the person does the same things over and over quite frequently). It can be either office or factory—most processes have repeatable activities. Watch at least two people do several cycles of the same work. Look for differences in motion, order of steps performed, tools used, documentation used, etc. Do they do things in the same way? Did each individual follow the same steps every time he/she did the work or did he/she alter the way of doing things? What are the similarities and the differences between and among the cycles of work you observed? Were there any differences in the quality, cost or time between the methods observed? Write down what you saw. Think about what could account for any differences you saw and make some notes.

Exercise Reflection

Talk with another colleague about what you learned from your Standardized Work practice exercises. Discuss your thoughts about what factors contribute to any differences in the work you observed.

Gauge Your Learning

If you are using it, test your learning from Lesson 6 using the online-assistant.