Kaizen

15 Hour Basic Course

SESSION 2

Continuous Improvement Course

Instructor's Guide

I. Opening the Meeting

Welcome everyone back to the beginning of session two. Thank them for their attendance and participation.

- Create an informal atmosphere. Try telling a joke. Put the trainees at ease.

- Introduce visiting attendees as necessary. Today we have (name) of the (area/dept.) at (location).

- Discretely inform visitors or non class participants that they are welcome to listen but to please refrain from comments or other actions that will disrupt the proceedings of the class.

A. Review Of Session 1

We will begin today by starting to review the main points of yesterday's session.

Show TP 2 - 1 "Review Of Session 1"

Show the TP and review the following main points by asking questions.

1) Role of Supervisor and Problems In the Work Site
    a) There are many problems
    b) Leading improvement is an important role of the T/L

2) Importance Of Cost Reduction
    a) Circumstances Surrounding the Company
    b) Pursuit Of Profit
    c) Production Methods & Cost

3) How to View & Think About Kaizen
    a) Methods Of Increasing Production
    b) Work & Waste
    c) Definition Of Waste & Types Of Waste
    d) Understanding Efficiency

4) Continuous Improvement Procedure
    a) 6 Steps For Kaizen
    b) Step 1: Clarify the Goal: Discover Need For Improvement

B. Today's Schedule

Next I will briefly explain the contents of today's schedule. We will be covering:

1) Kaizen Procedure: Step 2 "Analyzing the Current Situation"
2) Basic Ways Of Analyzing the Current Situation
3) Motion Analysis
4) Work Element Analysis
5) Time Study
6) Standardized Work Review

II. STEP 2: Analyzing The Current Situation

Once we have identified areas or points needing kaizen, it is next important to fully investigate the current situation. Yesterday we focused on clarifying the goal of kaizen, today we wil move into Step 2 of Kaizen: Analyzing The Current Situation

Show TP 2 - 2 Step 2: Analyze Current Situation

One of the primary factors that determine the success of kaizen is the extent to which you have correctly grasped the facts surrounding the current situation. If you don't have the facts accurately describing the situation you will be unlikely to obtain good results, and upon occasion may fail to improve anything.

Conducting kaizen in manufacturing requires a good understanding of the situation. Even if we can not obtain complete and perfect information we must obtain enough information so that we can safely advance without fear of failure.

I will now cover with you some of the main points to be aware of when conduction kaizen.

A. Basic Preparation For Performing Kaizen

1) Get The Facts From The Source

In beginning to grasp the current situation there are three basic items you must strive to include in your analysis of the current situation. One, above all go to the *actual location* to get your facts. Don't rely upon hearsay or rumor. Go the actual source of the problem. Two, check the *actual object* that you are investigating. Don't rely upon other people, other parts, or other materials to provide you with all the information. Third, strive to get the facts at the *actual time* the problem is occurring . Like the scene of a crime, if you can the see the problem first hand, you won't have to spend hours later trying to guess what actually happened.

The old saying "Seeing Is Believing" is 100% true when conducting kaizen. This statement stresses the importance of seeing the actual object, at the actual location, at the time it occurs. Most subjective conjuncture is eliminated when we are able to see with our own eyes what the problem is. Instead of relying upon words, a motto of kaizen is always to analyze the *actual object, at the actual location, at the actual time.*

B. Posture When Observing The Current Situation

1) Don't be swayed by preconceived notions.

All supervisors in manufacturing have lots of experience, thus we have preconceived notions about the way things are. How many times have you heard someone say "We have always done it this way, so what's the difference?", or "We tried to fix that once, but the same old issues kept cropping up?" . Often we fail to really listen to Team Members, or Managers because we have a preconceived notions that something won't work.

Particularly when topics of emotional nature come up we rarely used our full senses of reason to rationally investigate. It is almost impossible to accomplish accurate analysis including all the key points when we are not calm.

2) Thorough Observation

The more experienced we are the more we tend to judge things based upon experience. Everyone knows the advantage of experience, but in conducting kaizen, experience alone will not solve problems.

Usually, difficult problems have multiple causes. Often these causes are complex and hard to really see. In these cases, experience alone is not enough. Solving complex problems means going beyond the obvious and digging deep into the details. If we fail to identify the real problem, our improvement efforts will often stall.

Because of this, we need to conduct very thorough observations of the problem. When observing an area be prepared to look beyond the obvious.

3) Calm Attitude

The third item we will address under correct posture is possessing a calm attitude. Remember, kaizen is not a competition. However, no matter what the situation, when you are leading an improvement effort you are likely to run into problems if you lead it as an emotional event.

If you lose your poise during kaizen, it is difficult to make rational judgments with a high degree of precision. Be sure to separate feelings and people from problems when observing the current situation.

C. Analytic Thinking

When conducting the current analysis phase of kaizen, a very analytic mind is necessary. An analytic mind refers to someone who can state the facts as they are, not overlook anything, and make accurate observations.

Show TP 2 - 3 "Analytic Thinking" and explain the following items

1) State The Facts As They Are

Stating the facts as they are means recording events as they are for current operational methods etc. This means not pushing your own opinion, or own supposition into your observations.

One very effective way to observe the facts as they are is to video tape them. This method is very effective, and can be observed over and over again. When conducting current state observation I highly recommend using video camera when possible.

2) Don't Overlook Anything

In observing the plant floor no matter how closely you look, it is a struggle to take in everything correctly. If you follow the guidelines that we outline later in this class the odds are that you will be less likely to overlook important points or details.

Depending upon what you are looking at your technique will vary. However in all instances it is not possible to visit the plant floor 24 hours per day. We will have to practice looking at the plant floor in a short period of time and obtaining all the critical information we will need. All information is potentially critical so try not to overlook anything.

3) Analytic Thinking

Analytic thinking means that you have sufficiently studied the subject and are able to quantify, classify, and to detail the situation. I will now explain more about what it means to quantify, classify, and to detail when conducting kaizen.

To quantify means to express things in terms of numbers or amount related measurements. The opposite quantitative is qualitative. An example of a qualitative statement is when you say “Company A has many defects”. A quantitative statement is that “Company A has 25 defects out of 500 parts”.

It is important for you to understand the following points:

-In daily manufacturing we usually rely upon qualitative statements
Ex. “We are running good today”
“We have a lot of bad parts from the supplier”

-In Kaizen, the above qualitative statements are not enough
-Only quantitative statements give us enough detail to accurately proceed.

- Give an example of how quantitative statements are more effective.

Next we will discuss classifying, or in other words, how to organize data into categories. For example let us investigate the instance of “5% defects”. Even knowing that we have 5% defects is not enough information for us to proceed towards improvement. The 5% figure has to be broken down into further categories for it to have greater meaning.

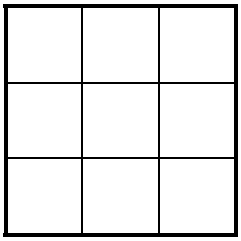
For instance one part can be classified many ways in terms of defects:

-Part dimensional accuracy
-Surface finish
-Surface class
-Cosmetics
-etc.

All of these represent categories of defects that once understood and investigated can take you closer to the root cause of the problem. Unless you classify data it is usually impossible to identify the actual current state, and improve the situation.

Last I want to discuss the concept of detailed analysis. Depending upon the subject it is often necessary to become extremely detailed in investigation.

 Write On Flipchart: Draw the object below and ask how many squares there are.



The closer you look the more you see. If you truly count just squares you should come up with 14. If you counted rectangles there are as many as 36 hidden in the picture. (See appendix in back for explanation)

This was just one example, but it illustrates the difficulty of how hard it is to be detailed in investigation. What looks obvious is often much more complex than we realize. However, with training and practice we can obtain more skill in being detailed.

Obtaining skill in being detailed is like becoming an experience worker. When a veteran operator performs a job it always looks smooth and easy. To obtain this high level of skill a lot of effort and practice was required.

However, if we conduct a detailed observation, the difference between more skilled and less skilled individuals becomes clear. The main point I want to emphasize is:

Skill = Good Method + Practice

If you closely observe skilled workers and their work you can often isolate what in their method is superior, and if you understand proper Job Instruction methodology you can then teach those methods to others in a very short period of time. Studies have shown that skill can be roughly attributed to 80% good method, and 20% practice. Thus in driving manufacturing improvements we need to first focus on the method.

As we have just covered, you can develop an eye to see in detailed fashion and accurately analyze the current state of any manufacturing operation.
This concludes our discussion of posture and attitude for observation and analysis.

D. Techniques For Analyzing Current Methods Of Work

In this next section we will be learning some techniques for analyzing current methods of operation. Depending upon the goal or target, there are various tools used to analyze how we work. We will now cover some of the more basic of these techniques.

Show TP 2 - 4 "Various Analysis Techniques" and explain them briefly.

Technique	**Purpose**
Motion Analysis*	Detailed Analysis Of Operator Motion Used To Eliminate Waste In Motion
Element Analysis*	Detailed Breakdown Of Work Element Use Analyze Necessity Of Each Element
Time Study*	Time Analysis Of Each Work Element Used To Determine Time Related Factors
Operation Analysis	Analysis Of Percentage Of Value Added Work Considers Man vs. Machine Work
Process Analysis	Analyzes Manufacturing Process Determines Ratio Of Process 4M's
Standardized Work	Analyzed Efficient Manpower Allocation Combines Human Work & Machine Work

In addition to the above types of analysis there are various types of support work that often have to be done. Since this is not a course in industrial engineering we will not cover them in great detail. Only the first 3 items will be practiced along with a basic review of Standardized Work.

When considering the topic of current state analysis you can break techniques up into two categories. The first category is the flow of operation where the product is physically altered. This is called the "Process". The second category is the means by which a person works on a product. This is called the "Operation".

In this course we are chiefly dealing with the operational aspect of continuous improvement. For this reason we will predominantly cover the topics of motion analysis, and work element analysis, and time study in great detail.

E. Motion Analysis

As I briefly mentioned in the last section, motion analysis is a way of breaking down a job into its most basic motions. It represents the most detailed level of visual observation that can be done.

There are different ways to do motion analysis, but in this course we will use the most basic and user friendly version for supervisors in manufacturing. Once you have mastered motion analysis it will be much easier to identify non essential motions in manufacturing. The specific technique we will study is called the Threblig Analysis Method.

1. Purpose Of Motion Analysis

The chief purpose of direct motion analysis can be summarized as follows.

a. Improvement Of Motion

A major objective of motion analysis is to quantify and detail the current movements made to complete job. Comprehension of all the movements give us many ideas in how to establish a focal point for continuous improvement.

b. Establishment Of Motion For New Work

When launching a new program or changing over to a new process the need to establish the motion for the job occurs. In this case it is often necessary to analyze the new work in order to determine the major operational steps for manufacturing. For repetitive manual work this type of analysis is extremely important.

c. Obtain Greater Motion Awareness

In general this course is about improving your ability to make improvements. By focusing in on motion you will become more adept at the following:

-Quickly notice wasteful motions in work methods
-Develop skill in quickly determining if a change has resulted in less waste
-Become accustom to thought processes that lead to correct application of kaizen

In summary, by studying motion analysis we will become more analytic and efficient in our observation and improve our own overall capability.

2. Into To Therblig Analysis Technique

Having now covered the purpose behind motion analysis, I would now like to proceed with an actual example of Therblig Analysis. Therblig Analysis was developed by a man named Gilbreth, and consists of 18 symbols used to analyze motion down to a minute detailed level.

Show TP 2 - 5 "Example Of Motion Analysis" and explain the following.

I will explain and show you how something as simple as picking up a pen out of a box and placing it on the table and be analyzed in greater detail.

The actual motions performed to complete this sequence are as follows.

Motion	Symbol
1. Reach Out Hand	Transport Empty
2. Grasp Pencil	Grasp
3. Pick Up Pencil	Disassemble (from table)
4. Carry Pencil	Transport Load
5. Set Down Pencil	Assemble (to table)
6. Let Go Of Pencil	Release
7. Return Hand	Empty Transport

In motion analysis we observe motion, analyze it using Therblig symbols, and attempt to improve the motion. Using this technique can lead to very thoroughly analyzed improvement opportunities. However, it is not without it flaws. For one, it is not a very quantitative since it contains no time element. To get at time we would have to conduct another study. But for now we are just going to concentrate on Therblig Analysis and how to use the symbols.

Show TP 2 - 6 "Therblig Symbols" and explain the following

I am going to have you practice and memorize these symbols.

- Explain each of the symbols
    1) Write the symbols one at a time on flip chart.
    2) Explain how to write and the meaning on flip chart
    3) Explain the function of each symbol
    4) After covering all symbols ask for questions.

- Have the class memorize the symbols
    -Have them practice by themselves using their handout (2 - 3 minutes)
    -Next test their knowledge. One by one write symbols on the board. For the first nine anyone can answer then test certain people randomly.
- Practice using the symbols

-Read practice item #1 (read symbols in order slowly) and have the class write the corresponding symbols
-Walk around the class and check how everyone is doing
-Have them practice on own time difficult symbols
-Read practice item #1 again a little quicker, and with some change in order
-Check and have them practice difficult ones on their own.

- Proceed to next even if not all people have got it 100%.
- Encourage everyone to practice. When we do shop floor observation it will be hard to do without having memorized the symbols.

3. Basic Pattern For Motion Analysis

Next I will cover some of the most basic patterns we will encounter for motion analysis on the plant floor. Quite often there is a basic pattern of consecutive motion that the operator follows in their job. It is this basic motion that we will next try to learn. I will use an example to help you understand.

- Distribute the motion analysis paper Type A 3 per person Type B 5 per person.
- **Show TP 2 - 7A "Blank Therblig Sheet (A)"** & explain how to use
- **Show TP 2 - 7B "Blank Therblig Sheet (B)"** & explain how to use
- **Show TP 2 - 7C "Basic Pattern - 1"** & demonstrate motion
- **Show TP 2 - 7D "Basic Pattern - 2"** & demonstrate motion
- **Show TP 2 - 7E "Basic Pattern - 3"** & demonstrate motion
- Ask Questions

4. Observation Practice For Motion Analysis

Up to this point we have covered the basic meaning of the Therblig symbols and how to write them. Next I'd like to do some actual practice observation. Observation is a skill that comes with practice and effort. This exercise will be a simple one. I'd like everyone to observe, then we will discuss the results of your observation.

- Prepare the room for motion observation
  - -Clean off the tops of table
  - -Ready paper to write on

- Explain the observation process
  - -Tell the class you will do the observation 10 times. Have them watch the first few times carefully
  - -This is just to practice and improve. I don't expect perfection.
  - -Don't talk to others. Just make your own observations.

- Demonstrate exercise #1 "Assemble nuts & bolts"
  - -Silently, assemble the nuts & bolts as in TP 2 - 7F. Be consistent.
  - -Have them fill in the work elements column and Therblig column
  - -Check the progress of the class.

- Check the results of exercise #1
  - -While the class is working, write the observation form on the board.
  - -Have 2 people come forward to fill in the columns.
  - -Present the more complete result of the 2 people, and one by one correct any mistakes.
  - -Have the class compare their notes to the correct answer.
  - -Answer any questions.

Show TP 2 - 7F "Answers To Nuts & Bolt Assembly Exercise"

Motion analysis is a very old detailed observation tool that can be powerful in analyzing work methods. It has been existence since its development in the United States in the early 1900's. However, it is a bit difficult in the beginning, and some people give up out of frustration. If you take the time to master it, it will be very useful to you. Please take time to observe some of your own areas more closely. This practice will give you greater "motion awareness" as I discussed earlier.

5. Focus Of Kaizen Based Upon Motion Analysis

After you have completed Therblig motion analysis you still have to consider how you are going to make improvements upon the work.

Show TP 2 - 8 "Motion Analysis Summary"

- Describe how to look at the observation report
- Mark value added motion is only a couple symbols

Show TP 2 - 9 "Motion Analysis Kaizen"

Here is a simple example of using motion analysis and Therblig symbols to identify and eliminate waste. The left hand side shows the motion before kaizen where both hands where not used efficiently. The right hand side shows a more streamlined method where both hands move to pick up the item, both hands grasp, carry and position, assemble, release, and return original position.

Note that there are fewer symbols and motions made to the right indicating the greater efficiency.

Up to this point we have studied the Therblig technique for motion analysis. But I don't want you to think that you can go out and do Therblig analysis on any type of operation. In some cases you may be better off doing time studies or element analysis.

The following will serve as a guideline as to when to do motion analysis.

a. When investigating detailed actual motion.
b. When jobs are very repetitive. (If the job is not repetitive, motion analysis won't do you much good)
c. When there is a very short cycle time, and many small tasks are being done.
d. If cycle time is very long, motion analysis can be applied but you may need to break the job down into smaller pieces.

In each of your respective areas, I am certain that you will have some opportunity to apply Therblig analysis. Please experiment with it and try to improve your motion analysis.

F. Work Element Analysis

The next area we will cover today is work element analysis. Work element analysis is something you may already be familiar with in your work areas. Often documentation on work standards such as operator instruction sheets is written at this level of detail. Looking closely at the work elements of a job is one way to investigate continuous improvement.

1. Purpose Of Work Element Analysis

When analyzing the current situation and methods used in manufacturing, work element analysis can be used in almost every area. Any job can be broken down into smaller elements so that the truth can be analyzed.

By understanding the elements that make up a job we can identify waste and the optimal work flow. Used correctly this type of analysis can help you quantitatively, and accurately grasp the situation.

2. Work Element Analysis

I am going to show you some examples of work elements. Remember, however, that the correct size of the element to use when conducting element analysis is debatable. I will try to represent the general agreed upon philosophy for conducting element analysis. In element analysis we try to break up the work motion into units one by one that make up the job. The elements thus often comprise several Therblig motions, and will be a little different flavor from the previous section on motion analysis that we just covered.

A typical example of work elements in a job is:

1. Obtain part from raw material
2. Carry part to the machine
3. Take finished part out of machine
4. Set raw material in machine
5. Push start switch
6. Put finished good in container.

Now as I said earlier, there are no concrete rules on how to determine work elements. After a while, you will learn to develop a feel for how to break down a job into work elements based upon the purpose of your task. Here is an overhead that shows you some examples of "good" work elements, and some "poor" examples as well.

Show TP 2-10A "Examples Of Work Elements" and explain the contents

The top examples in this overhead are quite good. However the ones on the bottom are not proper for usage in work element analysis. Do you see why? It may help you to also understand the concept regarding the correct size of analysis unit to be used.

Show TP 2-10B "Size Of Analysis Unit"

This overhead shows you a telescopic view of how jobs can be broken down into incredible detail. For example, start at the left side of the overhead labeled "Job". Here it says "Make Part A". However we can break this task of making part A into greater detail. In this example, making part A consists of "Assembling B & C" and "Assembling D & E" and putting these two together. We can go deeper however. The process of assembling B & C together, can be identified as "Placing B & C together" and then "Screwing B & C together". Screwing B & C together can be further broken down into more detailed motions like "Pick Up Driver", "Insert Screw", and "Tighten Screw". Even the act of picking up the screw driver can be further broken down into motion elements such as "Stretch out arm", "Grasp the driver", "Lift & disengage from holder", "Pull driver down to part", etc.

Usually in work element analysis we do not go into the level of detail displayed on the right side of the overhead. This starts to get too detailed and comes close to some of the basic motions we studied in motion analysis. For Work Element Analysis we will stay around the center of the overhead in the box labeled "Work Element" or sometimes go a little deeper like the elements under the Motion box.

If you are a little confused, don't worry, it will become clearer as we go on. I have an example for you to try and identify work elements on your own.

Show TP 2 - 11A "Layout For Work Element Analysis Practice"

3. Proceeding with work element analysis

The overhead shows you a layout for a manufacturing operation that we will simulate. As the layout shows we have locations for Raw Material A & B. A Punch Machine that is actually a hole opener, and a Spot Welding Machine that is actually a stapler. Use your imagination, please. Also we have an inspection

table and a chute for loading parts into a package. I will silently conduct the operation 10 times. At the conclusion you will tell me what the work elements are.

Show TP 2 - 11B "Work Element Analysis Sheet"

While you observe the demonstration I want you to fill in this observation sheet. It will help you identify the steps I conduct, and identify areas for improvement. We will also be using these sheets on the plant floor in the next session.

Instructions On How To Fill Out The Sheet

1) In the first column, you will write down the number of each work element in sequence.
2) In the next column, you will write down the actual work element. For example pick up part, pack part, etc.
3) In the next column, you will write down specific problems, if any, that relate to to safety, distance, dimension, quality, or ease of operation.
4) In the next area you will notice the 5W's and 1H. If you notice something that is not efficient note it in the appropriate column and jot down any alternative ideas you may have. For example:

Why?	Why are we doing this element? Is it required?
What?	What is the necessity of this element?
Where?	Is this the best place to do this element?
When?	Is this the best time to do the element?
Who?	Is this the best person to do the element?
How?	Is this the best way how to do it?

5) Lastly, you will see the column entitled ECRS. ECRS stands for Eliminate, Combine, Rearrange, and Simplify. Ask yourself can any of the elements be eliminated, combined, rearranged, or simplified? We will cover this topic in more detail later in session 4.

Note To Instructor:

1) Set up the work area in front to look like the overhead.
2) Be very distinct with your motions so that some people will see many steps and others will only see the basic elements.
3) Run the demonstration 10 times silently. Have class just watch 2-3 times then start writing down the steps. Repeat if necessary.
4) Ask the class how many work elements they observed. You should get a variety of answers from 6 to 16.
5) Write all elements from lowest answer on flip chart.
6) Write all elements from highest answer on flip chart.
7) Discuss the differences with the class.

Remember, there is no correct answer for this exercise. Depending upon your purpose, and the level of investigation, the degree to which we break down an operation will vary. More elements will usually capture more waste.

Show TP 2-11C "Sample Answers For Work Element Analysis"

These are just sample answers they probably don't exactly match what you wrote on the flip charts. However they will serve to illustrate my point. If you wrote down work elements like in sample answer 2 you can probably more easily identify waste like in elements 2, 4, 6, etc. Being more detailed forces you to look more clearly at work elements and is a good practice when looking to reduce seconds.

However, Sample Answer 1 has some merits as well. If you were looking to write a work standard, teach Job Instruction, or do a time study, sometimes fewer work elements is better.

Neither answer is wrong. In summary, my main request is that you put considerable thought into how detailed you write down the work elements. Too general a statement and you will miss all the little problems or opportunities for improvement associated with that step. Too small a element and you may miss all the bigger issues around it. Spend a fair amount of time thinking about what is the appropriate level of detail for you to analyze the situation you are investigating.

If you have been paying close attention you may have noticed that this form we introduced "Work Element Analysis Sheet" is not only used in Step 2: Analyzing the Current Situation. By focusing on problems in categories such as safety, distance, dimensions, quality, and ease of operation, as well as looking at ways to ECRS (eliminate, combine, rearrange, and simplify) we are edging closer to Step 3 of continuous improvement "Generating Original Ideas".

The basic pattern for conducting work element analysis is as I have just outlined. The philosophy and thinking behind it when conducting an observation of the current state is no different from motion analysis. This concludes our coverage of the topic of work element analysis. We will practice more in upcoming sessions.

G. Time Study

Next we will cover the basic points of time study. In later sessions we will actually go out on the plant floor and make some time measurements. For this reason we will need to practice a little in advance in the basics of using a stop watch.

1) Time Reflects Motion

When we do a job, the element of time is greatly affected by how we do the job.

- Use an example to explain how changes in time reflect the method by which work is done. For example:

  -Time differs by your actions at the vending machine for example
  -Time differs when filing down a sharp edge depending upon how coarse or fine of a file you use.
  -Time differs when an experienced person performs an operation versus when an inexperienced person does.

Like in these examples time acts like a shadow, and reflects the time we are taking to perform a job. Time will be affected by the sequence we perform the work, materials and tools we use, as well as how we prepare. For this reason, time in an unbiased judge on how we are performing a certain task and we frequently use time as a basis for comparison when making improvement.

Always remember that the current time taken to do something is not necessarily the best. The time required to do a task is not a fixed item that can never be changed. As job conditions change, so should the time required to complete them.

Later on the plant floor we will take some time studies and see what conditions we can affect. In attempting to do kaizen it is often necessary to shorten the amount of time taken at one or more processes. We will learn to look more closely at these processes, break them down, and see what can be improved.

2) Time Measurement Instructions

I now want to spend a little time instructing on how to conduct time measurements. In time study we will take whatever size of element that we divided the work up into and record them for analysis.

Time study is a useful skill to have because we need it to fill in the manual and auto times on Standardized Work Charts. Also it becomes very useful when measuring other work elements in greater detail as well.

We have already covered the basics of work element analysis in Kaizen Step 2: Current State Analysis. Now I'd like to briefly review.

In element analysis we look to break jobs down into smaller steps such as "Pick up Part", "Carry Part", "Assemble Part" , "Push Button" etc. These elements may comprise several motions.

Let's review by practicing an actual problem. This operation will consist of "Walking from a chair to a white board, writing a letter, and returning to the chair".

- Demonstrate the work sequence.
  -Instruct everyone to record the work elements.
  -Do the motions slowly and consistently
  -Do the motions silently 3 times. Repeat if necessary.
  -Ask 2 people to identify the work elements.
  -Ask the class who has the most elements, who has the fewest.

Show TP 2-12 "Work Element Identification For Time Study"

Work Elements & Timing Points

Again there is no right answer for this exercise, however, these constitute a basic level of work elements for us to analyze by time.

Before doing a time study it is critical for all of us to agree up the work elements. If we don't agree, we will be measuring completely different work elements, and our individual measurements will have no meaning.

Another critical aspect of conducting time studies is where to insert the measuring points. For each element you must have a clearly defined and agreed up start and stop point. We call these points measuring points.

For example in the operation I just performed the act of walking to the white board can vary by a few seconds depending upon where you start measuring from. If you don't carefully determine where you start measuring from your data will be inconsistent and unreliable. We typically define a measuring point as where the work element clearly ends.

Measurement Practice.

Next I would like to explain a little about actual measurement methods. There are various ways to conduct time studies. I will explain the most basic of the accepted methods. The most basic type of time study is called the consecutive time method. In this study you start the watch once and read the times off of it consecutively. For example, at the respective measurement points you might read off 5", 12" 18" …. Consecutively and write them down on your time measurement form.

After you have timed several cycles you can then go back and calculate the individual times or in other words the difference between each element.

- Distribute Time Measurement Forms
- Answer questions about time measurement

Let's go back to our previous example.

Show TP 2 - 12 "Work Element Identification For Time Study"

Not every work element can or should be measured by itself. Some elements we identify are going to be too small to accurately measure, and others maybe too big. We often have to adjust. In this example, I'd like to recommend that we combine the 8 steps down into 4 groups for ease of measurement. Let's combine 1 & 2 together, 3 & 4 & 5 together, 6 & 7 together, and have 8 by itself.

- Circle the 4 groups clearly.
- Demonstrate each element
- Show with clear emphasis each ending point of the 4 groups
- Confirm with the class where they will stop / start measuring
- Confirm class comprehension after demonstration

3) Observation & Time Study Practice

If there are no questions I would like to conduct a little practice problem in time study. This example is useful because it consists of consecutive motion, has several elements, and is fairly difficult.

Show TP 2 - 13 "Time Observation Form"

- Explain how to record measurements
  -Write down the four groups of elements
    1) Stand Up & Walk to Chart
    2) Pick Up Marker, Write, & Put Down Marker
    3) Return To Chair, Sit Down
    4) Sitting
  -explain how to record the seconds

- Demonstrate how you will start the exercise
  -Clearly indicate the start time
  -State when done with a motion

- Explain you will perform operation several times
  -perform as needed several times

- Ask if there are any questions about the exercise

4) Conduct Actual Measurement Practice

- Conduct the exercise being very consistent with your actions
- The final cycle stops when you stand to start another
- Not much time is in this section to practice. If necessary report results.
- Conduct the cycle at least 2 times.
- Calculate the measurement results.

5) Organize the Measurement Results

After you have demonstrated the cycles calculate the individual times and fill in the correct column on the overhead.

- Write a form on the board, or else use overhead TP 2 - 13 and fill in the individuals measurements.
- Compare answers from around the class
- Wide variance in answers shows lack of clarity on either work elements or measurement points.

Time Measurement Practice Problem 2

Show TP 2 - 11C "Sample Answers For Work Element Analysis"

Next I will perform an operation that is a little more manufacturing like. For this example we will go back to our punch hole, spot weld, inspect and pack example. Please watch my motions. The purpose of this example is time measurement so I will give you the work elements this time. Use the elements in sample answer 1.

Preparation

- Distribute blank sheets of time measurement forms
- Explain how to fill out the form
- Have the class fill in the work elements on the form
- Conduct by consecutive measurement method
- Clear everything off the table except the OHP
- Put all necessary items on the table top for the layout
- Review the layout
- Review the operation
- Decide the number of elements for measuring
- Clearly indicate the measuring points

Starting now I will perform the operation 5 times. The first time I will do the cycle slowly while explaining. Do not time the first cycle. Mentally confirm the contents of the work elements and the watch for the measurement points. Starting with the 2nd time through start measuring. Normally, work on the plant floor is done in continuous fashion. But here in the class room since we are trying to practice I will stop at the end of each cycle. So you just have to measure 1 cycle continuously each time.

Start The 2nd Exercise

- Objective of the first time through
  - -Have the class confirm the elements and their start points
  - -Just use one of each sheet.
  - -After the 1st time through stop and confirm the measurement points

- Runs 2 through 5
  - -Confirm that all conduct correct measurement methods
  - -Watch the whole class carefully to see if they are following

- Repeat as necessary until majority of class is finished
- After completion summarize the classes results
  - -Have the class calculate the cycle times
  - -Have the class calculate their individual times

- Ready next materials & OHP

Show TP 2 - 13 "Time Observation Form" & explain the following;

1. Have class calculate all the individual times
2. At the bottom fill in the cycle times
3. Enter the times at right using the most repeated time
4. Walk around the room and check while the class fills their own out
5. Write the elements and their numbers on the board or use TP 2-13
6. Compare measurement results
7. Write most representative answers on the board or TP
   - -Ask 4 - 5 people their measurement results
   - -For large disparities ask others what they got

8. **Show TP 2 - 13 "Time Observation Form (Filled in)"** & Summarize

9. Evaluate the measurement results with comments
10. Ask the class their impressions about the time study
11. Encourage everyone to practice in their spare time in their own areas.
12. Clean up the materials and erase the board.

Basic Instructions For Time Measurement On The Plant Floor

On the plant floor the types of things you will be measuring are not this easy. Often people man more then one station and there are many work elements. Depending upon the item produced there may be differences in motion and other extraordinary work that gets performed.

If you prepare and observe correctly however, you won't have any problems making efficient time studies. The following procedure I am going to outline is not the only one nor will it always work, but it will serve as a good reference for you in the future.

Show TP 2 - 14 "Basic Instructions for Time Study" & explain

Step 1 Observe the work area. Learn the cycle and motion.

Observe until you know with out having to look what the operator will do next, where they will go next, and what motion they will perform

Step 2 Write down the work elements

Analyze the work elements and write them down one by one. Adjust the level of detail of the elements as necessary

Step 3 Measure the entire cycle a couple of times

How many times you measure depends upon the stability or variance in process. Usually we measure ten times, but five is enough for stable processes. Note the maximum and minimum times.

Caution: more measurements do not mean greater accuracy, especially for unstable processes.

Step 4 Calculate the individual splits of each work element.

For extremely brief elements you may need to combine them with other elements either preceding or following them. Measure continuously.

Step 5 Find the most repeated times. Adjust individual & cycle times.

Write down the most repeated times. Also be sure to investigate the difference between the cycle time you measured in step 3 and the work elemental times you measured in 4. When the total of the work elements measured is greater than the shorter of the cycle times you measured you may want to adjust down some of the larger elemental work times.

Caution: You have to be very careful whether you decide to take the shortest cycle time, an average, or the most repeatable time. Most lean companies advocate taking the shortest cycle time. The shortest cycle time represents the instance when everything went right without waste. This cycle represents what we are trying to achieve on a sustained basis. Anything that gets in the way represents a problem to be solved.

For now in Toyota we will take the most repeatable time. But common sense must be used. If the repeatable time has substantial wait time or awkward motions included we must eliminate them as we go.

Step 6 Measure / Re-conform unmeasured work elements

If there are any unmeasured elements go back and get their time now. In step 4, I suggested that you initially combine very short elements with other. Go back now and calculate them individually

Step 7 Off Line Work Measurement

There are certain types of work that do not occur within every cycle. They are performed only periodically throughout the day. For example quality checks, gauging parts, cleaning fixtures, changing pallets, adjusting equipment, labeling etc. are all instances of off line work.

These types of jobs affect production output and must also be the focus of kaizen. Thus it is necessary to measure them as well.

This concludes the explanation of shop floor measurement procedures. Please take the time to practice taking some time measurements in your own areas and improve your skill in this important area. Remember that taking thorough time measurements is a fundamental part of Kaizen Step 2: Analyzing the Current Situation accurately, with data, stating the facts as they are.

H. Standardized Work

Standardized work can also be used as a tool for kaizen. When used for improvement purposes Standardized Work can be used to determine the most efficient method for an operator to perform their work. Primarily this means manufacturing by the method that builds in quality, safety, and low cost.

Standardized work incorporates time elements in the form of takt time, efficient work sequence, and standard work in process. Thus when we observe a job that has been standardized it is quite easy to analyze the current situation.

In this course will we use Standardized Work forms for the purpose of stating the current situation and investigating improvement opportunities. Looking at the forms will often tell us where points for improvement are, and how big they are as well. For example investigating the work sequence will tell us walking distance and time, wait time, and return time. This will also make it easy for us to identify the non standardized points out side of the work cell.

As you can see, standardization of work is extremely important for analyzing the current situation. For this reason creation of standardized work is one of the first items we are implementing in the Toyota Production System.

Briefly, I'd would now like to review the various forms of Standardized Work. Here I'd like to distribute a hand out to you summarizing the various forms of Standardized Work.

- Distribute the handout and explain the following.

Show TP 2 - 15 "Process Capacity Sheet" Read definition & Function

Show TP 2 - 16 "Standardized Work Combination Table" Read Definition & Function

Show TP 2 - 17 "Standardized Work Chart" Read Definition & Function

III Closing The Session

How well you do the current state analysis will largely determine how successful you are in Kaizen. It is extremely important to gather all the necessary information to accurately grasp the situation

Today we mainly studied motion analysis, and work element analysis as ways to analyze current work methods. Depending upon the subject, you have to choose your tools of analysis. The majority of the time motion analysis and work element analysis will be enough to get you through most situations.

The important things I want to stress about this session are that in analyzing any current methods you have to go to the actual place where the work is being done, and look at the actual objects being used. On top of this keep in mind what it means to be analytical, quantitative, categorical, and detailed. If we just go forward on hunches and second hand rumors we will not be able to achieve any real improvement. Get the facts.

Remember that when analyzing work elements of a job, all things; manual work, machine work, conveyance work, etc. can be broken down into work elements. There is no rule as to how far to break things down into for elemental analysis. Use your common sense and what best fits the needs of the situation.

Also remember that in conducting motion analysis you need to practice to be able to pick up the details of work motion. The more detailed you learn to look the more waste you will find. Today we learned the Therblig symbols for motion analysis. Practice using them again and again on your own.

This concludes our study of session 2 and Step 2 of Kaizen: Current Methods Analysis. In the couples hours we spent studying, we only gained some basic knowledge of the subject matter. To obtain true skill and improve, we must practice like any other discipline.

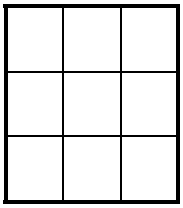
If you take the time to practice these items on your shop floor, I guarantee you will be able to find many ways to improve.

Tomorrow we will start with session 3 by going to the plant floor and practicing some of these observation tools. In your spare time review the basics of work element analysis, and motion analysis.

Thank you for your time and effort. Please be on time tomorrow.

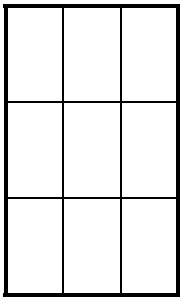
APPENDIX

How many squares?



Square Size	#	Total
1	9	9
4	4	4
9	1	1
		14

How many rectangles?



Rectangle Size	#	Total
1	9	9
2	12	12
3	6	6
4	4	4
6	4	4
9	1	1
		36