Factors in Determining Training Curve Length
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Operator Training

Operator training can be broken into two main areas – General and Job Specific. General training can include familiarization with a work environment, a factory environment, and familiarization with operating machinery. Job Specific training includes familiarization with operating an identified operation and the equipment required for that operation. It also includes time to develop muscle memory for the motions required, and then to develop stamina. Various factors affect how much time each of these components will require, which include the experience of the trainee, the complexity of the machine, the complexity of the operation and the trainee’s ability.

General Training

To give an example of training time, an individual who has never worked requires more adjustment time than someone who has held a job before. An individual who has previously worked in a factory will require less time than someone who has never worked in manufacturing. A person who has never worked on a machine will require more time than someone who has operated machinery before. If an individual has never operated a machine, the noise and the speed may make the trainee very cautious and possibly afraid. Compounding training time variances is the level of complexity of the machine. Large machines are more imposing than small machines, multiple needles are more frightening than one needle machines. Because each trainee is different, the time for general training can vary greatly.

We can begin to identify standard times for machine related training. The operator learns to thread, clean, operate, and control the machine. The length of this phase will be determined by machine type. For example: a buttonhole or bartack machine may only require one day of training how to operate the machine before moving on to operation specifics. An overlock machine may require several days of practicing on the machine before being ready to learn an operation. And, a multi-needle chain stitch machine with a knife may require even more. The standard number of machine training days is determined by management and applied equally to all trainees who have to learn that machine.

In the case of a job transfer or retraining, machine days will apply only if there is a change in the machine type. During this time the operator will learn the basic method of operating the new equipment. If the trainer feels that the individual does not need the full amount of machine training time, the trainee may be allowed to progress into learning the operation before completing the maximum allowed days.

Job Specific Training
General training places the emphasis on the environment and the basic operation of the machine. Job Specific training includes familiarization with the equipment and motions required to perform a specific operation. The emphasis now shifts to the learning of method skills and the importance of producing good quality. Again, the time required will vary, depending on the complexity of the operation and the trainee’s ability.

The beginning of Job Specific training marks the beginning of the training curve. The trainer should explain what the learning curve is, how it contains daily and weekly goals for the operator, and also how the operator’s performance and progress are measured against the curve. The operator should understand the importance of progressing at the rate prescribed by the curve, but efficiency should not be stressed to the extent that it becomes the operator’s primary objective. The focus of the training during this phase is on METHOD AND QUALITY.

If the trainer sees that the operator is trying to build speed before enough method skill has been developed to perform the operation properly, they should discourage this tendency immediately. It can only result in bad quality. This should be stressed to the operator with the assurance that by concentrating on developing skill, the desired speed will eventually develop.

If the trainer sees the operator using any excess motions or trying to “short cut” the method, this should be stopped before it becomes a habit. Training curves have not been developed to include learning and unlearning bad habits.

The trainer should inspect the first five bundles that the operator produces and show how to properly repair defects, and how proper handling will prevent them. The operator should be expected to repair the defects thereafter. Training curves assume that the operator has been instructed in how to repair their own work.

At the end of each day the trainer will calculate the operator’s efficiency and let the operator know if the goal for the day has been met. No curve day should be considered as having been completed unless the operator spends at least four hours performing the operation that day.

This intensive emphasis on each motion that the operator performs should not be required beyond the first 10% of the assigned curve days. By this time the operator’s motions should have become reasonably consistent, not erratic and uncoordinated. The early portion of the training curve is focused on learning to perform the operation correctly. Later more emphasis is placed on building work pace while smoothing any rough places that remain in the method. In the “home stretch” of the training process, the operator has learned all that the Trainer can teach about the method. The correct method and good quality should have become a habit to the operator by this time. It is now time to apply theses skills toward achieving 100% efficiency, and the Trainer becomes more a motivator than a teacher.
The skills required to perform a sewing operation are directly related to complexity. Management must evaluate all jobs in their facility using the same system. The purpose of such grading systems is to recognize similarity and variability between operations and assign a comparable value to each. In this way each operation is treated fairly.

In some factories, the same training curve is assigned to all operators on all jobs. This does not reflect the reality. A job that takes 6 weeks to learn will still take that long, even if management has only assigned a four week curve. The negative effect is that the trainee feels as if they have failed and may quit. Once training has been invested, a company will want to keep its operators.

Companies should develop training and retraining curves for each operation in its facility. Every inexperienced trainee should be placed on a training curve with daily goals that start at zero percent. A retraining curve is used when the trainee has had prior experience in the industry. These curves start with higher daily goals. The actual starting percentage will depend on how many of the skills on the previous job are duplicated on the new job.

Factors Affecting the Length of Training Curves

The following represents some items that will affect the length of a training curve. Individual products should be considered in determining which are applicable.

1. The number of alignments - The number of alignments in this category are related to the shape of the part(s) being sewn, and the difficulty and accuracy required. Seams may be curved, straight or require opposing curves. It is much easier to sew a short straight seam than a long one. It is easier to align simple shapes than oddly shaped parts. It is easier to join two straight edges than to fit opposing curves together. Additional plys require additional alignments. Some fabrics require multiple alignments because they curl, are slippery or are very flimsy. Any extra handling or control requirements require extra time to learn.

2. The complexity of the machine - A variety of equipment is used in the apparel industry, from simple to complex, and in some cases, no equipment is required. Some machines only require the operator to flip a switch, others may require computer programming. The more complex the equipment is to operate, the more time will be required to learn how to master it.

3. The amount of body coordination required – The more body parts that the operator must coordinate together, the longer the time is needed to develop that coordination. Does the method require simultaneous motions? Are both feet required for controls?

4. The use of folders or attachments - Some machines have special features or multiple attachments, each one adding another layer of complexity, such as felling to produce a lap seam. Each hand controls fabric through a different folder and there are multiple dimensions that must be maintained in alignment.

5. The potential danger to the operator under normal use - There are few jobs in apparel that pose serious injury, but in the case where an injury to the worker could occur, the operator must learn the proper safety procedures, and must learn how to perform the motions in a manner to prevent injuries. The best practice is to provide machinery that
is foolproof. That means that there are safety features that will protect the worker unless they do something carelessly, like operating a straight knife without a mesh glove. An operator who uses an iron will always have the potential for burns. Extra time must be allowed during training to learn the safety procedures and to perform the job in a safe manner.

6. The potential danger to the product under normal use - There are times when garments can be damaged through negligence. For example, cutting the garment with scissors, piling garments on a dirty floor, or spilling coffee. The area that requires extra training time refers to the potential for damage during normal work practice. The more serious the consequence, the more careful the operator must be. A machine with a knife always has the potential to damage the fabric due to poor handling. Thick seams may have the potential of getting caught under the needle causing a hole. A snap or rivet machine will sometimes cut the fabric due to defective parts. The quality standards should accurately and realistically reflect the potential damage.

7. The potential damage to the machinery under normal use - Breaking a needle may not be considered damage to the machine since it applies to almost every operation and requires minimal cost to replace a needle. More commonly, operators may operate a lockstitch machine without fabric under the needle, place the bobbin case in incorrectly or raise the machine foot while an overlock is running – breaking loopers. The value of the levels in this category can be directly linked to the cost to repair the damage.

8. The diversity of fabrics being handled - There are some situations where an operator stays on the same fabric during the entire training period. Practice opportunity is easier to achieve in this environment. However, some facilities produce a variety of different products in a variety of different fabrics. Every variation may require different handling methods. Every new handling difference requires extra time to learn, and less practice opportunity. Just because the fabric is different, it does not mean that the handling needs to be different. The diversity has to be evaluated on an individual basis to determine how many different categories are required.

9. The variation of method within the operation due to style differences - The days of mass production of the same style have practically vanished. Now, it is not uncommon to be faced with a variety of different styles during training. Some style variations have little effect, such as a difference in seam lengths. Consider the frequency of variation and the impact of the variation. Sometimes the variation is quite different. For example, a set sleeve operator may be required to learn raglan, split raglan, set in sleeves, or some stylish design feature. Depending on the degree of variation, extra time may be required during the learning period.

10. The number of different parts being handled - The more parts an operator must position, the more complex the operation becomes. The more parts that must be handled, the longer it will take to learn the motions and the sequence of motions. The size of the part also affects the difficulty in handling. Large parts are more difficult to handle than small parts because they require extra motions. Every additional requirement must be learned, and time has to be allotted for the operator to develop these skills.

11. The quality tolerances on the operation - The tighter the tolerance, the more control or decision making is required. The more control required, the longer amount of time is needed to develop that control. Consideration must also be given to how well the
tolerances are enforced. If the operator is required to be within 1/32” of the stitch line, but they do not get the work back when the tolerance is exceeded, the operator never really takes the time to adhere to the tolerance. However, if management and quality personnel are constantly enforcing tolerances, the operator must have time to develop the required skills.

12. The location of the operation on the finished product and its effect on presentation. Consider when thread runs out and the operator must start a new stitch line a little behind the previous one. In a lining or hidden area, this fix may be unnoticeable, but on a collar it may be significant. In high quality rainwear, if a repair falls on the front area of the collar, the stitches must be removed to the back of the neck before it is re-sewn. No tie-ins are allowed in certain locations. If the seam is a lockstitch, each stitch must be removed individually or the fabric could be damaged. If the seam is a chain stitch, it is simpler to unravel the entire stitch line and re-sew the seam.

13. The mental requirements of the operation – decision making, and concentration - If an operator only loads/unloads an automatic machine, less mental effort is required than if the fabric must be manipulated constantly during the operation.

14. The physical requirements of the operation – weights lifted, exertion levels - Consider the task of marathon running. The runner must build his stamina before he is able to run long distances, starting with shorter runs and gradually increasing the length of each run as his body adapts to the effort. The longer the distance, the more time it will take to build up to the distance goal. Effort is also required in sewing operations. The amount of effort required depends on how much of the job is performed by the equipment; how carefully the operator must concentrate, and how much weight is handled. It requires more physical effort to manipulate a coat than it does a T-shirt. Like an athlete, a sewing operator must develop the muscles and become accustomed to the operation. The more effort required, the longer time it will take to become accustomed to the operation.

15. How often the method pattern is repeated, permitting practice opportunity - Part of the time required is related to acquiring a muscle memory for the motions. How many repetitions have to occur before the motions become automatic? The faster an operation is, the more repetitive. The more repetitive the operation is, the more practice opportunity. The more practice opportunity, the quicker an operator will be able to achieve standard performance. Remember also, that some operations are more repetitive than their cycle time would indicate. For example, there are two sleeves on a garment so the motions are performed twice with each cycle. When sewing buttonholes, there may be multiple buttonholes on the same garment, and the same motions are repeated multiple times within each garment. The longer the cycle time, the less practice opportunity, the longer the time required to train on that operation.

Other factors may be required to address specific issues with the company’s product(s). The method of instruction can have an effect on training length. A trainee placed in the line with little supervision can learn bad habits that must be unlearned and relearned. Improving the training environment will reduce training time. Every operation in the plant would score the same points so it would not contribute to differentiating between them.
Evaluation Team

The facility can create a category for each of the factors listed above that apply to a specific situation, or additional categories. The system would have to be the collaboration of various individuals within the facility. Quality, engineering, management, human resources, etc. should all be represented. Working together as a team categories can be chosen that apply and the levels within the categories.

Documentation

The team should keep a notebook that shows each step of the development process and any modifications made. Notes should be kept on the reasoning behind the selections, which will be a great resource when evaluating new operations. If a modification is made, the reasons should be documented. Once the system is finalized, a notebook will be used to keep all the operations together. A copy of each final operation evaluation should be placed in individual operation files as well.

Creating a First Draft System

Within each category, a range of points are assigned based on simple to difficult levels of the category. Some categories may carry more weight than others. Some assumptions / examples follow:

- The company produces a variety of products. The system must be able to apply to all of them, from the simplest to the most complex operation.
- One category could have 5 levels ranging from 1 point to 5 points. Another category could have 5 levels ranging from 5 to 25 points because the category represented is more critical or difficult than other categories.
- One category may be the number of alignments required. One alignment might be worth one point, two alignments worth two points, and so forth.
- Limit the number of levels within each category, but make sure that the extremes of your product(s) are represented. A simple join straight shoulder operation would have fewer alignments than setting a set-in sleeve and thus would earn less points.
- Another category could be quality tolerances. An operation that requires positioning into a previous stitch line would require more accuracy than positioning an edge against an edge guide.
- One operation works with a single ply, another two plys and yet another 3-4 plys. It would take longer to learn the latter, so the points earned would be higher.

Creating an Initial Form

In order to provide consistency in evaluations, the team should design a form to record information.

At the top of the form allow spaces to indicate operation identification (name and number), the standard allowed minute value for each and the resulting repetitions per hour.
Remember that the method may be repeated twice within the operation. For example, joining two sleeve inseams repeats the same motion pattern twice, offering twice the practice opportunity. During the initial evaluations, it would be helpful to have a place to list the operator observed during the analysis. In this manner, variations in method could be observed by different operators. Also, allow room to record the analyst’s name and date of observation.

In one column list all the categories that the team has decided will apply in their facility. For example, 10 categories will require 10 rows. In a parallel column allow space for the analyst to record a point value.

At the bottom of the form allow an area to record the total point value and the related weeks to train.

Using the Draft System

The total point values on the representative operations should result in different skill levels. Each skill level represents a different level of complexity, and an increasing number of training weeks.

If a job gets one point on each of twelve categories, there would be a total of 12 points. If the category does not apply to a job in question, the operation would not earn points for that category. For this reason start the first point range at zero. There will also be a total of all the maximum points possible. If an operation got the maximum points in each of the categories, that would represent the end of the point range. You may want to allow an additional range, in the event that a future operation would require an additional category.

The number of skill levels will depend on the variety of products within the company. For example, a man’s tailored suit would represent more skill levels than a T-shirt.

The following example is for illustration only and is not meant to suggest a recommended point value or skill level.

<table>
<thead>
<tr>
<th>Point Range</th>
<th>Skill Level</th>
<th>Training Weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 10</td>
<td>I</td>
<td>1 week</td>
</tr>
<tr>
<td>11 – 15</td>
<td>I</td>
<td>2 weeks</td>
</tr>
<tr>
<td>16 – 20</td>
<td>II</td>
<td>3 weeks</td>
</tr>
<tr>
<td>21 – 25</td>
<td>II</td>
<td>4 weeks</td>
</tr>
<tr>
<td>26 – 30</td>
<td>III</td>
<td>5 weeks</td>
</tr>
<tr>
<td>31 – 35</td>
<td>III</td>
<td>6 weeks</td>
</tr>
</tbody>
</table>

The point of this example is:
- To show that increasing points result in increasing training weeks.
- To show equal increments in point ranges (in this example 5 points in each range, but it could easily be 10 points)
In this example, those most difficult job would earn a 6 week training curve, the simplest would earn one week.

The team will use their draft point system to evaluate operations within the plant/company. If there are multiple products in the same facility, the team starts with the highest volume product and a representative style within that product family. The first step is to select several operations that represent a simple, average and difficult operation.

Each team member will evaluate the operation independently, reading the categories and assigning a level to the operation within each category. Next, the team reconvenes to review the various point levels assigned by each member. A discussion is held concerning why the team member graded the operation as they did. Eventually all team members should agree on one level assignment and point value for each category for each of the three operations.

Based on these decisions, the sum of the categories will be calculated so that each operation will have a total point value.

Compare the resulting point values for the three preliminary operations to the draft chart and discuss whether the point system actually recognized three different skill levels. As the team completes the initial evaluations, the point system may need to be modified.

If the facility has previously assigned training curves to these operations, compare the ones in use to the results of the system. Does the system support the current training curves or are there huge discrepancies? For example, if a company had previously used a three week training curve for all operations, there would definitely be differences. Do the resulting skill levels reflect the complexity of the operations?

Continue Evaluations

After the initial three operations and discussions, the team is responsible for evaluating all the operations in the facility together. Again, the main product is typically the one chosen for evaluation. If the products are significantly differently, the team may have to evaluate other styles. Once the first style has been done, it will be easier to compare any additional styles to the first example, using it as a benchmark for making decisions. Notes are kept as to why certain operations were classified as they were. This will help when evaluating other operations and if the team must go back and revise earlier assignments. After all jobs have been evaluated, they are placed into a spreadsheet.

There should be columns for each of the grading categories and a total points column. The spreadsheet can be sorted on each column and the team can discuss whether there are any outliers. For example, two similar operations may have been assigned different levels under one of the categories. Or perhaps the team agreed on the level, but not on the points within the range of that level. The lists are reviewed until the team is confident that the jobs have been assigned points appropriately and logically. The team reviews the list to ensure that all the operations appear to fit in the locations that the points placed them in.
Practical Application

Some of the areas covered in this document may seem similar. They are discussed separately because there are so many variations in products and fabrics that one section may be insufficient to cover the variability.

You may discover that with a specific product or fabric, there is a variable that has been overlooked. If that is the case, a new area may be developed and the effect must be quantified using similar categories and points as benchmarks. As long as the system is applied to all operations equally, the system will still be valid.

Possible Challenges

Assumption 1 – suppose that when the initial three operations are evaluated (one for simple, average and difficult operations) you discover that – instead of falling into I, II, and III skill levels respectively, the first two fall into level two. Two things could be considered. Could the team have evaluated the simple operation too high in one of the categories as compared to an average operation? Or could the team have evaluated the average operation too low in one or more categories? These are the discussions the team will have to have and make decisions. The first three selected operations, if you have definitely selected a simple, average and difficult operation, should fall into three separate skill levels. These first three operations should be finalized before moving on to the remaining operations.

Assumption 2 – suppose the representative operations fall into levels I, II, and III as anticipated. However, the number of weeks of the curve appears too high. For example, supposing that your set sleeve operation, which calculated to a level II, has traditionally been 8 weeks, and management feels confident that the length of time is sufficient. Here a decision can be made to change the representative point ranges for each level so that Level II falls at 8 weeks. Changes in the point ranges should remain consistent. If the range for Level I is 25 points, it should be 25 points for Level II and III.

IMPORTANT NOTE: the purpose of the system is to provide recognition of similarity and variability between operations. As long as every operation is evaluated against the same criteria and point ranges, this equity will be provided. Don’t arbitrarily change just one or two operations to make them fit, or you will have distorted the purpose of the system. The suggested point ranges and weeks are there as examples. One system could not possibly fit all products, fabrics, style and even cultural differences. It is a structure to help a company bring some structure to their learning curve decisions and classifications.

Suggested Efficiency Goals for Individual Training Curves

There are multiple charts for training curves that are present in the industry, but regardless of the charts what is used, there are similarities that can be noted. If the expected
efficiencies were graphed, they would all follow a similar line curve. That is because all human beings follow a similar path of improvement when learning new tasks. Regardless if the task is folding towels, sewing, or learning brain surgery, the shape of the curve is similar. The difference is in the number of minutes, weeks or even years that it takes to accomplish the task. The more difficult the task, the longer the learning period will have to be. At the end of each day the trainer will calculate the operator’s efficiency and let the operator know if the goal for the day has been met.

Three different areas along the curve can be recognized. Initially, the basics of the task are learned quickly, so the curve in the primary phase rises sharply. The operator is learning how to sight read the work cycle pattern for the coordination required. There is more of a difference between the expected percentages.

In the transitional stage, the operator has acquired the sight reading with good rhythm and is beginning to acquire muscle memory. This is the ability to automatically move through the motions without thinking about them. As the more complicated elements of the task are learned, the line of the curve is not as steep and the expected percentages do not climb as quickly.

Eventually, the curve plateaus when the operator has acquired muscle memory and begins to operate within the limits of their individual motor ability and sight reading control. The expected percentages increase slowly as they build stamina / endurance and improve skills and speed.

Remember also that learning is directly proportional to the time permitted to practice the motion patterns. No curve day should be considered as having been completed unless the operator spends at least four hours performing the operation that day. Partial days on an operation or lengthy times absent from the operation, will cause the operator to fall back the learning curve.

The following chart shows the efficiency levels that are expected on one such chart. The training weeks included here are for three week to seven week curves. Training curves can go as high as 26 weeks.
Retraining Curves

In retraining a skilled operator, the primary or initial phase is usually not needed, or is very short. In order to determine the appropriate training curve to be assigned, consideration must be given to the operator’s previous operation and for the operation on which the
operator is to be trained. Check the skills required for the new operation and how the methods are performed. If a skill that is used in both operations is performed in basically the same manner, no extra consideration need be given. If a skill is used in both operations but performed by completely different methods, time must be allowed to learn the new skill. For skills that were not used in the previous operation, time to develop the skill must be permitted. Companies will typically evaluate all operations within their facility in relationship to retraining so that standards may be established for the curve lengths in these situations. Once this cross reference has been created, it only needs to be amended when new operations are added to the factory.

Summary

All tasks require time to learn. The amount of time is related to the complexity of the task and the skill of the trainee. Whether or not official training curves have been assigned, the trainee will still require this time and production expectations will be affected. An established system based on facts is the most accurate way to predict operator performance and plant capacities.

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