Introduction to Part IV

Once we become aware of Toyota's improvement kata, described in Part III, it gives rise to several new questions, such as:

How do we teach everyone in the organization the improvement kata?

How do we ensure people are engaged in the improvement process and utilize the improvement kata correctly in their daily work?

How will we know what skills individuals need to work on?

How do we ensure that appropriate challenges/target conditions are developed?

How do we ensure that the PDCA cycle is carried out correctly and effectively?

How will we ensure that leaders have a grasp of the true situation at the process level in the organization?

How will we pass on the improvement kata from generation to generation?

Toyota's answer to these questions is its coaching kata, which is the subject of Part IV. The purpose of the coaching kata is to teach the improvement kata and bring it into the organization. We will look into the role of managers and leaders at Toyota in teaching the improvement

kata to everyone in the organization and making that kata work as effectively as possible every day. Part IV is not about how Toyota trains production workers in their jobs. It is about how Toyota works to develop and maintain improvement kata behavior across the organization.

In Chapter 7 we will first take a brief look at *who* is actually applying the improvement kata to production processes in Toyota factories. There have been a lot of misconceptions about this. Then, in Chapter 8, we will look at *how* application of the improvement kata is taught and managed at Toyota.

Chapter 7

Who Carries Out Process Improvement at Toyota?

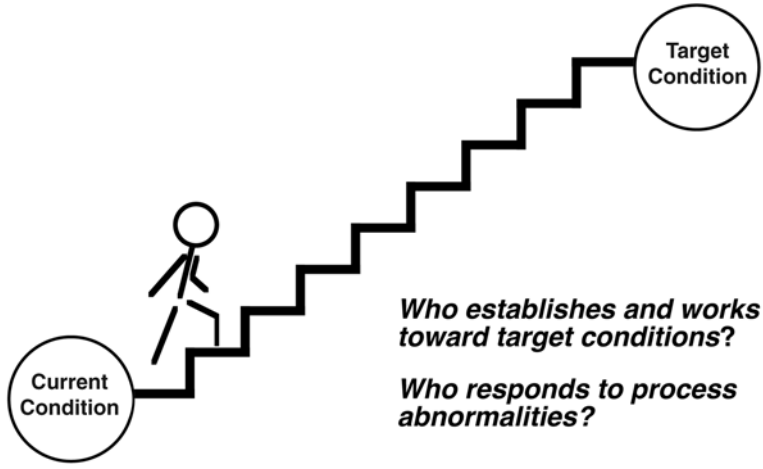


Figure 7-1. Working toward a target condition

A question that has been debated for many years is: "Who should carry out process improvements?" (Figure 7-1). Here are three common but problematic answers to that question.

1. *The process operators?* One of the widely held opinions about continuous improvement at Toyota is that it is primarily self-directed, with teams of production operators autonomously

making improvements in their own processes. Some typical comments along these lines are:

"The operators are closest to the process and are empowered."
"How can we get our line operators to solve problems?"
"How can we make continuous improvement run by itself?"

Operator autonomy is a commonly held and unfortunate misconception about Toyota's approach. It is not at all how operators and improvement are handled at Toyota. For one, it is unfair and ineffective to ask operators on their own to simultaneously make parts, struggle with problems, and improve the process, which is why Toyota calls autonomous operator-team concepts, "Disrespectful of people." It is physically impossible for production operators to work fully loaded to the planned cycle time in a 1x1 production flow and simultaneously make process improvements. Furthermore, many operators are just beginning to develop their understanding of the improvement kata and their problem-solving skills. There are currently no autonomous, self-directed teams at Toyota.

This does not mean that we should not empower or engage process operators. In fact, teaching people the improvement kata by engaging them in it is critical to Toyota's success. It only means that concepts like self-directed work teams are not such an effective way for an organization to empower and engage people.

2. *Leave it to chance?* I have not heard anyone actually give this answer, but in many cases our comments and actions—comments like these—indicate this is exactly what is happening:

"Andon gives everyone in the plant information."
"This alerts everyone that there is a problem."
"Any person walking through the area can see …"

The number of andon-style warning-lamp systems that have been installed in our factories in the last 20 years, for example, is astonishing. Yet in many factories the red lamps are lighting up and no one is responding. The basic point here is that if we

assume anyone (or everyone) is responsible, then no one is responsible.

3. *A special team?* As we have already discussed, this will not work if we want improvement to occur at every process every day. At Toyota, factory staff includes no specific continuous improvement agents. The improvement kata is embedded into every work process, and everyone is taught to work along the lines of the improvement kata.

Who Does It?

In schematic form, a typical Toyota factory's line functions are organized as shown in Figure 7-2. There are, of course, additional support

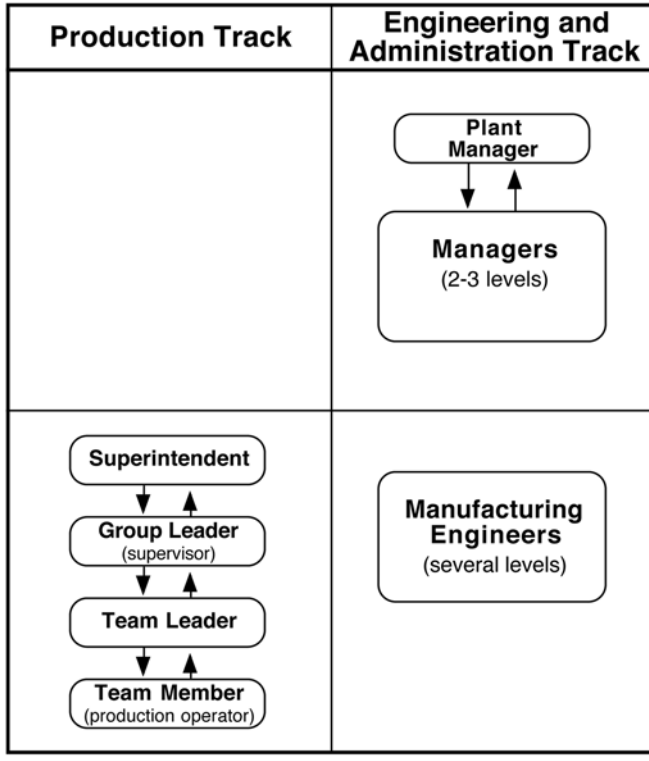


Figure 7-2. Schematic of Toyota factory line organization

functions such as maintenance and production engineering that are not shown, but this diagram is detailed enough for our purposes.[1]

In 2004, Professor Koichi Shimizu of Okayama University published a paper about continuous improvement of production processes in Toyota factories. In his paper, Shimizu classifies process improvement activity at Toyota in two categories:

- Improvement carried out by production operators themselves through quality circles, the suggestion system, and similar initiatives. Shimizu calls this "voluntary improvement activity."
- Improvement carried out by team leaders, production supervisory staff, and engineers as part of their job function.

There are some surprises in Shimizu's paper (Figure 7-3). Specifically, his research suggests that only about 10 percent of realized improvement in productivity and cost at Toyota comes from the first category, whereas about 90 percent comes from the second. In addition, the main purpose of the first category—improvements carried out by production operators themselves—is not so much the improvement itself, but rather to train production operators in kaizen mind and ability, and to identify workers who are candidates for promotion to team

Who	Impact	Purpose
Production operators themselves through quality circles and suggestion system	Only 10% of realized improvement comes from this	Training of kaizen mind and ability Identify workers to promote to team leader
Team leaders, production supervisory staff, and engineers as part of their job function	90% of realized improvement comes from this	Cost reduction via improvement in productivity and quality

Figure 7-3. Who carries out process improvements at Toyota?

Source: Koichi Shimzu, "Reorienting Kaizen Activities at Toyota: Kaizen, Production Efficiency, and Humanization of Work," *Okayama Economic Review,* vol. 36, no. 3, Dec. 2004, pp. 1-25.

leader. The purpose of the second category of improvement, on the other hand, is clearly cost reduction via diligent and constant improvement of productivity and quality.

What I have been able to learn so far about who makes process improvements on Toyota shop floors fits with Shimizu's findings. The great majority of shop floor improvement in a Toyota factory is generated by the functions circled in Figure 7-4. These team leaders, group leaders, superintendents, and various levels of manufacturing engineers are the primary people who apply, and coach application of, the improvement kata to production processes. This process improvement activity represents well over 50 percent of their work time, which is not surprising since at Toyota the improvement kata is actually a way of managing.[2]

Toyota production operators, called "team members," are of course also regularly involved in making process improvements, but these are usually improvements in the operators' immediate work envelope, which are carried out in collaboration with, and under the guidance of, the team leader. It's the responsibility of team leaders to encourage and get improvement suggestions from their team members, and, conversely, operator promotion to team leader is determined in part on

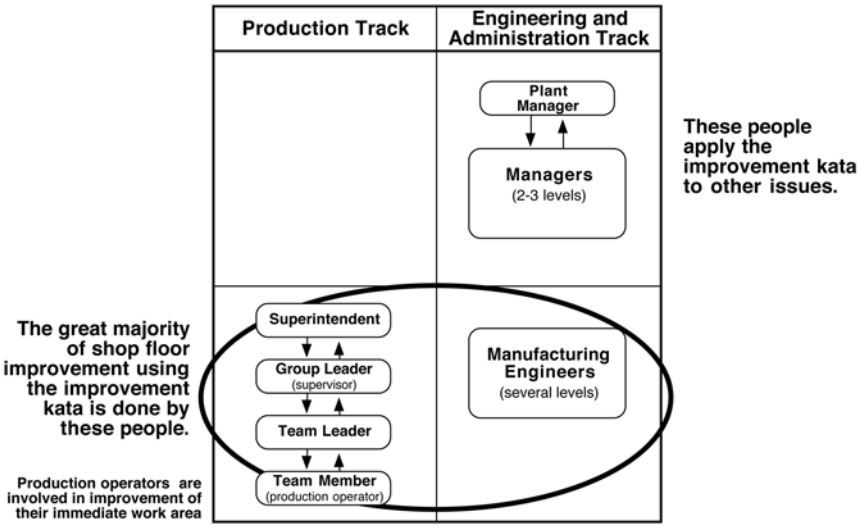


Figure 7-4. In the factory organization, process improvement activity is mostly here

how much improvement initiative and skill an operator demonstrates. Both operator and team leader, in other words, have incentive to work together on process improvement.

Working with Target Conditions

In the case of a new process or product, management sets a target cost and a target date for production. The first process target condition (that is, work standard) is typically established by the process's group leader and a production engineer. This is then given to the production team (the team leader and team members).

As the production stage begins, the production team and their group leader work to achieve that target condition, which can take several weeks. Once regular production stabilizes, then further target conditions, called "standards" or "targets," are developed:

- Group leaders, team leaders, and team members focus on target conditions in their process, and on understanding and resolving daily production problems.
- Themes, targets, plans, and initiatives are announced by senior management. These are worked down into the organization via mentor/mentee dialogues (more on this in the next chapter), and are converted into process target conditions. The conversion of outcome targets into process target conditions generally begins at the "superintendent" level. Managers at this level ensure that target conditions, improvement efforts, and projects at individual processes follow improvement-kata thinking, fit together for a flowing value stream, match with the organization's targets, and serve customer requirements.

Responding to Process Abnormalities

A common way of reacting to process abnormalities in our factories is to have production operators record them, so they can be compiled into summaries and Pareto charts. Sounds like a good idea, but it is not effective for improvement. I once listened to a plant manager proudly explaining a Pareto chart of problems and how the top problem was being

worked on. One of my colleagues said in response, "Oh, and the rest of those problems you are shipping to the customer?" which I thought was a pretty good insight.

The information provided by Pareto charts usually comes too late to be useful for process improvement efforts. By the time a problem has risen to the top of a Pareto chart, it has already caused a lot of damage and grown complicated, the root-cause trail is cold, and we become involved in analyzing postmortem data instead of understanding what is actually happening on the shop floor now. It is interesting to note how often the largest category in a Pareto chart is "other," that is, an accumulation of smaller problems.

This does not mean that Pareto charts should be abolished, but that they should not be thought of as our first choice for becoming aware of and dealing with process problems.

Here are two aspects of how Toyota thinks about dealing with process problems:

1. *The response to process abnormalities should be immediate. Why?*

   - If we wait to go after the causes of a problem, the trail becomes cold and problem solving becomes more difficult. We lose the opportunity to learn.
   - If left alone, small problems accumulate and grow into large and complicated problems.
   - Responding right away means we may still be able to adjust and achieve the day's target.
   - Telling people that quality is important but not responding to problems is saying one thing but doing another.
   - Lean value streams are closely coupled, and a problem in one area can quickly lead to problems elsewhere.

2. *The response to process abnormalities should come from someone other than the production operators. Why?*

   An example helps here. Imagine a 1x1 flow assembly cell in one of our factories with an "autonomous" team of operators. In the cell, there is a status counter that displays two numbers. One number is the actual quantity produced, which increases each

time a finished item is scanned. The second number is the target quantity, which increases automatically as each takt time interval passes.

What happens in this process when one operator experiences a problem? The cell stops. What do the operators do? They try to fix the problem so they can resume production. Say it takes a few minutes to do that, during which time the target-quantity counter continues to advance. Now the problem is fixed and the cell is able to run again. What do the operators do? Naturally they resume production, probably as quickly as possible since the line is now a little behind according to the status counter. Yet the moment the problem occurred, while the trail is hot, is the best time to learn why it happened. Looking into it later will be fruitless.

Can you see the conflict in our thinking? Do we want the operators to make parts, or do we want them to go into problem investigation? They cannot do both simultaneously. Problems are normal, and if we set up autonomous processes, there is no way the operators can be successful. These kinds of autonomous production processes seem to reflect a flawed assumption that if everyone did what they were supposed to do, there would be no problems.

In order to be able to respond to process problems as they occur, production processes at Toyota-group companies are supported and monitored by a team leader. This team leader is the designated person to respond first and immediately to any process problem. Although team leaders respond to every abnormality, each response does not trigger problem-solving activity, which is usually initiated in response to repeating problems. The process's work standard—the target condition—is owned by the team leader, who uses it to help spot abnormalities in the process. The team leader is not monitoring the process to police its failings, but to be acquainted with how it is working.

With team leaders at its processes, Toyota has—in comparison to many other factories—one official extra level of indirect staffing. This does not sound "lean," but it is an enabler for process improvement because there is someone to respond as problems occur, and the root

cause trail is still hot. As mentioned earlier, you can expose problems only to the degree that you can handle them. With its team leader approach, Toyota can handle more problems and can thus learn and improve more.

Having a fast-response system in place then gives Toyota the ability to staff its production processes with no more than the correct number of operators, which in turn quickly reveals problems. This combination represents an improving system. Conversely, manufacturers with autonomous teams of operators generally need to have extra operators in their processes, which, as already mentioned, causes work-arounds, obscures problems, and leads to a static system.

Interestingly, at Toyota, having this improvement and response system—team leaders—does not equal having more people in total compared to other companies. On the contrary. There are two reasons for this:

- Because of the team leader's presence, the process can be staffed with only the correct number of operators; no extra.
- Because there is an improvement and response system in place, beginning with the team leader, over time productivity is improved and even fewer operators are needed.

We should be careful with overly simple, quick-benefit statements such as "cut indirect labor" or "flatten the organization chart," because they can lead to suboptimization and a dangerously static system.

Notes

1. The information under this heading comes from observations and interviews at Toyota facilities, and discussions with several former TMEMNA employees.
2. Manufacturing engineers at Toyota are responsible for improvement in shop floor operations. This is different from what the words "manufacturing engineer" mean to us. Toyota also has what it calls "production engineers," who, like manufacturing engineers in our factories, are responsible for developing tools, processes, machines, and equipment.

Chapter 8

The Coaching Kata: Leaders as Teachers

Coaching Is Required

Suppose we would like to teach a team of athletes some new skills and have them do well in competition. In this case, we would certainly not expect that simply explaining a different way of doing something, no matter how well that explaining is done, will be sufficient for altering their behavior. It is not possible to objectively assess one's own performance and see what skills you need to work on. This is because we tend not to perceive our own habits and do not know what we do not know. In the case of athletes, we naturally expect them to practice under the observation and guidance of an experienced coach, and that the necessity of having a coach will not go away. If no one observes them and provides feedback, they can end up internalizing the wrong routines.

It is the same at Toyota, where the improvement kata does not happen automatically or autonomously. Toyota's managers and leaders work hard every day to both teach it and to keep improvement going in an effective manner. Since improvement and adaptation are central to Toyota's business philosophy (normal daily management = process improvement), it is not surprising that managers and leaders there work to ensure that improvement happens. What is surprising, however, is how they go about it.

The Role of Leaders at Toyota

The primary task of Toyota's managers and leaders does not revolve around improvement per se, but around increasing the improvement capability of people. That capability is what, in Toyota's view, strengthens the company. Toyota's managers and leaders develop people who in turn improve processes through the improvement kata.

> *We now accept the fact that learning is a lifelong process of keeping abreast of change. And the most pressing task is to teach people how to learn.*
>
> —Peter Drucker

Developing the improvement capability of people at Toyota is not relegated to the human resources or the training and development departments. It is part of every day's work in every area, and it is managers and supervisors who are expected to teach their people the improvement kata. The improvement kata is part of how people are managed day to day. This means, of course, that the managers and leaders must themselves be experienced in using the improvement kata.

Because the improvement kata is a set of behavioral guidelines, it is something that we learn through repeated practice. It takes conditioning to make behavioral routines become second nature, and consequently a lot of Toyota's managerial activities involve having people practice the improvement kata with their guidance. For team leaders and group leaders, this teaching occupies more than 50 percent of their time, and for higher-level managers it can also occupy up to 50 percent. Developing people in this manner is part of a manager's or supervisor's evaluation, bonus, promotion, and salary.

Training While Working On the Real Thing

We may think of taking classes and seminars to learn, but Toyota thinks of working through actual improvement challenges as how one learns. There are some classroom training courses at Toyota, but to ensure that improvement happens and that people internalize the improvement kata the primary emphasis is on doing: managers and

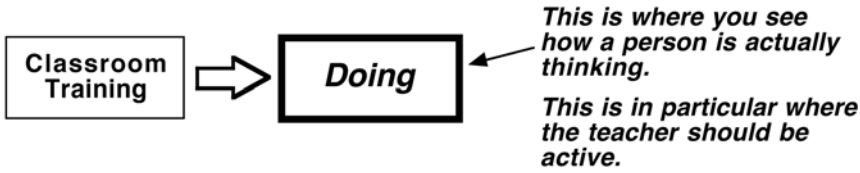


Figure 8-1. At Toyota, training and doing are not separated

leaders at Toyota teach people the improvement kata by guiding them in making real improvements in real processes. This approach is not unlike skills training in sports, where "training" means athletes performing an actual activity over and over under the observation and guidance of an experienced coach.

By comparison, in many of our companies the concept of training seems to have devolved to classroom teaching and simulation exercises. Unfortunately, classroom training and simulations cannot ensure change, mastery, and consistency. Classroom training alone, even if it includes simulations, at best only achieves awareness. We can only discern what people are actually learning and how they are thinking—and hence what they need to learn and practice next—as they try to apply in real life what they are being taught (Figure 8-1).

Toyota does not make a distinction between learning the improvement kata and improving processes. Toyota's teachers—that is, managers and leaders—observe and work with their students as those students are doing the actual activity day to day. Of course, as you might expect, at Toyota there is a kata for how managers and leaders do this.

The Coaching Kata

Toyota's kata for teaching the improvement kata is a mentor/mentee dialogue (Figure 8-2), which probably has its roots in the Buddhist master/apprentice teaching method. Like the improvement kata, the coaching kata is often not directly visible to visitors and benchmarkers. Yet the development of continuous improvement and adaptation at Toyota, through application of the improvement kata, has depended to considerable degree on such coaching.

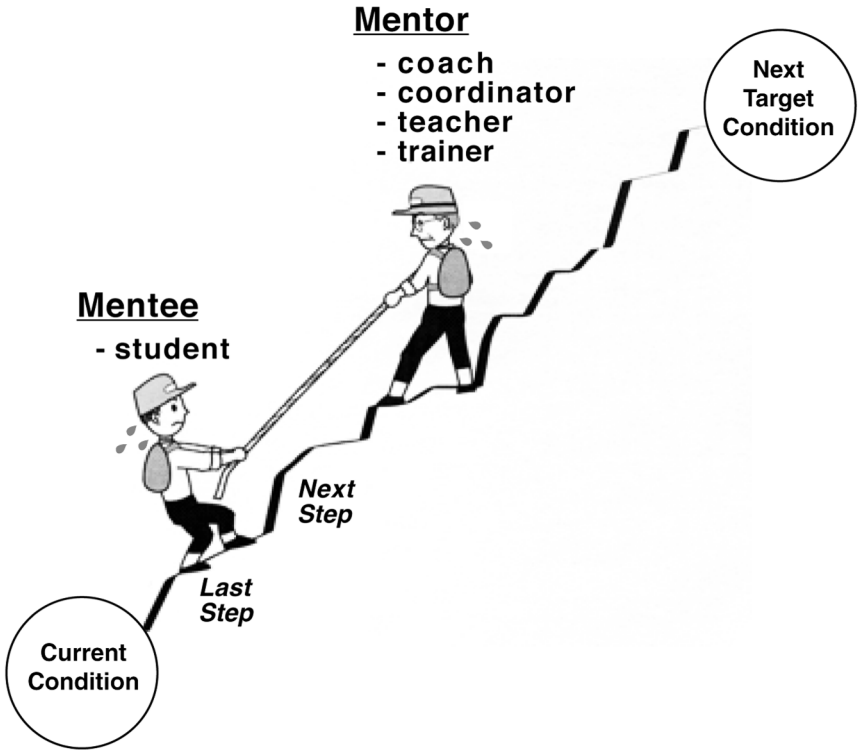


Figure 8-2. Toyota's classic depiction of its mentor/mentee approach
Note: Labels and current- and target-condition circles were added by the author.

Everyone at Toyota Has a Mentor

Mastery is the objective of any kata, and even people at higher levels in Toyota are honing their skills and working toward that goal. Like the improvement kata, the pattern of the coaching kata is also practiced at all levels throughout Toyota. Each employee is assigned a more experienced employee—a mentor—who provides active guidance through the process of making actual improvements or dealing with work-related situations. That mentor, in turn, has his or her own mentor who is doing the same. It is the buddy system, or two-man rule, with one buddy being the mentor.

These mentor/mentee relationships are not necessarily linked to the organizational hierarchy. For shop-floor operators, their mentor is their

team leader, who is in turn supported by the group leader. However, above these levels in the organization you may get mentored not only by your immediate superior,[1] but also by someone else, who may be assigned to you based on your current activities and development needs. Over the years, you will have different mentors.

It easily takes 10 years of practicing the improvement kata and the coaching kata before both become so ingrained that one can be a good mentor. This is one reason why Toyota has in the past avoided bringing managers in from outside the company, and instead preferred to develop them from within. One of Toyota's key challenges while growing rapidly is to have enough mentors.

A person's need for coaching never goes away. Regardless of how much experience one has gained, it is unlikely that anyone can become so good at discerning the reality of a situation and applying the improvement kata that coaching will no longer be necessary. The intention is that both the improvement kata and the coaching kata increasingly become second nature (automatic and reflexive) as a person rises in the organization.

The Mentor/Mentee Dialogue

The mentor (coach) guides the mentee in applying the improvement kata through a back-and-forth dialogue over a period of time, which has sometimes been compared to a game of catch:

Mentor→Mentee→Mentor→Mentee …

The mentor/mentee dialogue is utilized, for example, when a current situation is being assessed, when a target condition is being developed, and then when the routine of the five questions comes into play.

One key element in Toyota's mentor/mentee dialogue is that the intention is for the mentee to figure things out for him- or herself under guidance, which is a well-known teaching method. The dialogue often begins with the mentor giving the mentee a purposely vague assignment, need, or challenge. For example, the mentor may

ask the mentee to have a look at a problem or situation, or suggest something like, "We should wash parts within the one-by-one assembly flow at this process, rather than in batches." The mentor then asks what the mentee proposes. The mentee's answer helps the mentor discern how the mentee is thinking and what input the mentor should give next. That is why the mentor's assignment or challenge is often vague at the start—so he can see how the mentee is approaching the situation.

The mentee gives her observations or proposal, sometimes in bullet form in a single-page document (more on this later). After this is presented to the mentor, it is often pushed back to the mentee in the first cycle, with a suggestion such as, "Please think about this some more," or simply, "Why?" This is only the first of several catch cycles, through which the mentee's analysis and proposal become progressively more developed and detailed. Once the current situation has been analyzed and the target condition defined and detailed to the mentor's satisfaction, then the mentee's role becomes planning and carrying out PDCA cycles, also with the oversight of the mentor. In doing this, the mentee often has to justify actions to her mentor, and to define in advance the expected result of an action.

The point to remember here is that the mentor is asking questions of the mentee not to direct the mentee to a particular solution—although it may appear that way—but rather to learn what and how the mentee is thinking and how the mentee is approaching the situation. The mentor works to teach the mentee the routine of the improvement kata by providing step-by-step guidance, based on the mentee's reactions and responses along the way. The mentor guides the mentee through the improvement kata, but in a manner that has the mentee learn for him- or herself the routine and thinking inherent in that kata. The mentee is learning by personally gaining insight. The highest, though somewhat bittersweet, praise for a mentor is if the mentee feels he or she learned and achieved the target condition independently. As an aside, from my observations I can say that the mentor's job is as difficult as the mentee's.

A second, and clever, element of mentor/mentee dialogues at Toyota is that while the mentee is responsible for the doing, the mentor bears considerable responsibility for the results but should not give solutions to the mentee. This overlap of responsibility creates a bond between mentor and mentee, because if a mentee fails, then it is the mentor who will get the scrutiny.

If the learner hasn't learned, the teacher hasn't taught.

—Common expression, which is frequently used at Toyota

The mentee is the person who works on the problem, whereas the mentor's task is to keep the mentee "in the corridor" of the improvement kata routine. This is what is illustrated in the Toyota picture of the two mountain climbers shown earlier in Figure 8-2. Of course, to be able to guide the mentee in this way, the mentor must also be looking at the situation and often thinking one step ahead of the mentee; but no more than a step ahead. The mentor works to bring the mentee into the behavior corridor prescribed by the improvement kata, but ultimately the mentor must accept the solution that the mentee develops. Leading the mentee to a solution would block the development of the mentee's capability, that is, the purpose of the mentor/mentee dialogue approach.

Although Toyota mentors are usually not directive about solutions, they can, however, be directive about how to go about understanding a situation and developing solutions. For example, once he has heard from the mentee in one cycle, the mentor may, at times, be directive about the next step.

A third element of the mentor/mentee dialogue is that it is not just learning by doing, but that people learn when they make discoveries through small errors (see Chapter 6). The mentor expects the mentee to make small mistakes in applying the improvement kata, and it is especially at these points that the mentee will learn, and that the mentor can see what coaching input is required. In other words, the mentor lets the mentee make small missteps—as long as they do not affect the customer—rather than giving the mentee answers up front.

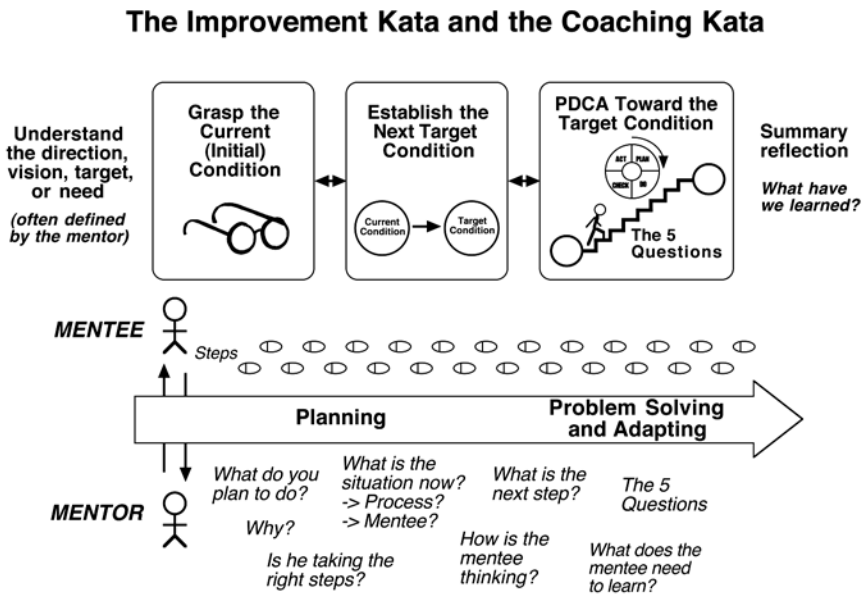


Figure 8-3. Mentor/mentee dialogue (the coaching kata) to teach the improvement kata

With the mentor/mentee teaching approach, as depicted in Figure 8-3, Toyota has developed a smart answer to the question of how an organization can teach its members the improvement kata and keep improvement going. The mentor/mentee approach has several benefits:

- Leaders can discern how a mentee is thinking and thereby determine the appropriate next step and what skills the mentee needs to practice to become a better problem solver. We do not recognize people's current skill-development needs when we tell them what to do.
- This approach—learning by doing with trial and error, under guidance—is more effective than relying on written documentation, classroom training, or telling someone what to do for passing on organizational culture—that is, developing specific behavior patterns.
- This approach develops alignment between company goals and workplace behaviors. It provides focus, direction, and control,

but with a considerable amount of leeway that helps people develop their own capability. It is not top-down or bottom-up; it is both, simultaneously. The mentor/mentee approach develops individual responsibility and initiative while also providing common direction and approach. This is what I mean when I refer to "operating in the desired corridor."

- The needs of the mentee and the situation determine the next mentoring and training that the mentor provides. This means that information is flowing both down and up in the organization. As a result, strategic decisions can be more in sync with the actual situation at the process level.

Mentor/Mentee Case Example

The best way to explain Toyota's mentor/mentee teaching approach is to show it in action. The following case example provides a close look at a Toyota-style mentor/mentee dialogue. Simultaneously, it also does a good job of demonstrating how Toyota thinks about problem solving, which is important for deepening our understanding of the improvement kata. The case example is similar to one that was used to help teach problem solving at Toyota's Georgetown, Kentucky, factory, although this one is greatly expanded.

Keep in mind that this case is just one example of a Toyota mentor/mentee dialogue. Although these dialogues typically mirror the pattern of the improvement kata in some way, they can take on a variety of forms depending on the situation. The objective here is not to give you a mechanical script for a Toyota mentor/mentee dialogue, but to give you some a sense for the pattern, or routine, and thinking inherent in the coaching kata.

Setup

Start by taking a look at the five-step problem-solving approach in Figure 8-4, called "Practical Problem Solving," which is commonly used at Toyota. This is problem solving as applied in everyday operations. I will refer to these problem-solving steps as we go through the case example.

Steps of Toyota's Practical Problem Solving

1. Pick Up the Problem: Problem Consciousness

- Identify the problem that is the priority.

2. Grasp the Situation (Go and See)

- Clarify the problem.
  - What should be happening?
  - What is actually happening?
  - Break the problem into individual problems if necessary.
- If necessary use temporary measures to contain the abnormal occurrence until the root cause can be addressed.
- Locate the **point of cause** of the problem.
  Do not to go into cause investigation until you find the point of cause.
- Grasp the tendency of the abnormal occurrence at the point of cause.

3. Investigate Causes

- Identify and confirm the direct cause of the abnormal occurrence.
- Conduct a 5-Why investigation to build a chain of cause/effect relationships to root cause.
- Stop at the cause that must be addressed to prevent recurrence.

4. Develop and Test Countermeasure

- Take one specific action to address the root cause.
- Try to change only one factor at a time, so you can see correlation.

5. Follow Up

- Monitor and confirm results.
- Standardize successful countermeasure.
- Reflect. What did we learn during this problem-solving process?

Figure 8-4. The problem-solving approach used in the case example

As you can see from the five steps, there is no magic in this problem-solving approach. The basic steps are well known and similar to what is described in many problem-solving books and training courses. Most managers and engineers I meet have already had some kind of problem-solving training and even still have the course documentation on their office bookshelf. Yet I find almost no one following the problem-solving approach properly. This is a good example of how ineffective classroom training alone is for changing our behavior.

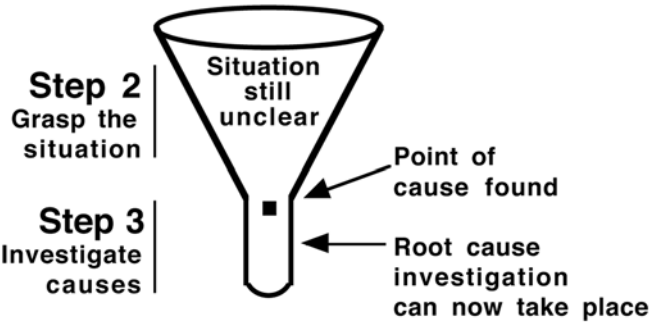


Figure 8-5. A funnel to illustrate the "point of cause" concept

Within the Practical Problem-Solving approach, Toyota often uses a funnel to illustrate the "point of cause" concept, which is mentioned under Step 2, Grasp the Situation (Figure 8-5). This concept may have arisen because Toyota vehicle assembly factories have long assembly lines. The idea is that when you become aware of a problem, you then need to trace it back up the line or value stream until you find the point where the cause may lie. Try not to go into cause investigation until you think you have found this point.

Cast of Characters

The mentor/mentee case example takes place in a section of the final vehicle assembly line, called the "trim line," at a Toyota assembly plant. The people noted in the Cast of Characters in Figure 8-6 are involved.

Cast of Characters		
Paul	Trim Shop Assistant Manager	*Your mentor*
Tina	Trim Section B Group Leader	*You*
Dan Bob Judy Mary Jeff	Trim Section B Team Leaders	*Your mentees*

Figure 8-6. Persons involved in the case example

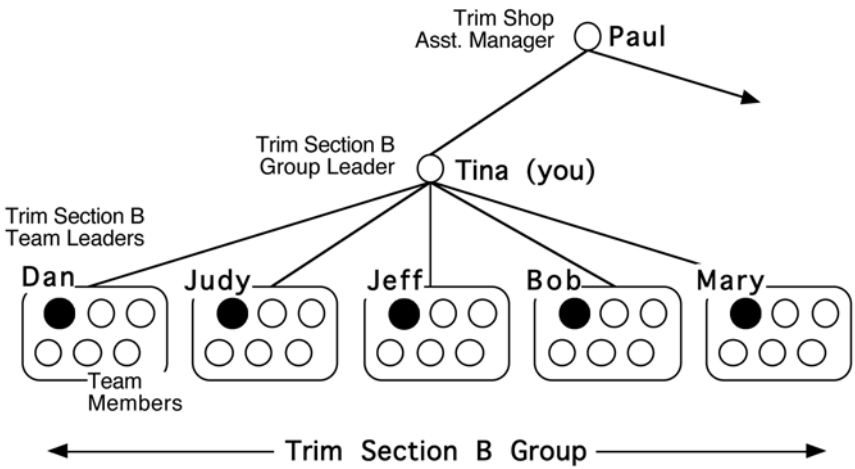


Figure 8-7. Case example organization structure

The organization looks as diagrammed in Figure 8-7, which is a typical organization structure at a Toyota assembly plant production line. This is the same Toyota line-organization structure that is mentioned in Chapter 7.

How to Read the Case

In this case you take on the role of the mentor—the Coach—whose task it is to teach the improvement kata. Your character is Tina, the group leader, and your mentees are the five team leaders: Dan, Judy, Jeff, Bob, and Mary.

The case has 11 chapters. After Chapter 1, each chapter is presented as a unit consisting of a situation (in a box) and a corresponding analysis of Tina's mentoring behaviors. Proceed through the case as follows:

1. Read the situation in the box.
2. Then read the analysis of Tina's mentoring behavior for that chapter, where I will point out several aspects of the coaching kata.
3. Wherever you are asked the question *If you were Tina what would you do next?,* write your response to this question on a piece of paper before moving on.

Summary Discussion

At the end of the case there is a summary discussion of key points on the subject of mentor/mentee dialogue and Toyota-style problem solving.

BEGIN HERE

Chapter 1

Paul, the trim shop assistant manager, met with all the trim-line group leaders (one of whom is you) to discuss a troubling trend in trim-line scrap. Scrap costs had increased 8 percent over the last two months. Paul requested that each group leader initiate problem solving in their groups to reduce scrap cost generated from their processes. He set the target of returning each group's scrap cost to its earlier level within 30 days.

If you were Tina what would you do next?

Chapter 2

After the meeting with Paul, Tina, the trim section B group leader (you), decided to analyze her scrap costs to identify where increases in her group had occurred. Tina reviewed her scrap reports from the previous four weeks to determine what part her group was scrapping most often and which of the parts being scrapped created the highest cost. She also asked each of her five team leaders to sort through the scrap records they had written in the current week to determine the same information.

The analysis showed that a side panel interior trim piece in Dan's team was the part that Tina's group had scrapped the most. Due to the quantity of the part scrapped, it was also the highest scrap expense to the group. Tina decided to target her initial activity at scrap reduction on this trim piece.

In what step of Practical Problem Solving is Tina?

Analysis

What mentoring/coaching behaviors is Tina using?

- Show me.
  Mentors prefer facts and data over opinion.
- The mentor must see deeply him/herself.
  If Tina tells her team leaders to observe their processes and then report back to her, she will not be in a position to evaluate their comments. More on this in a moment.
- Single-factor experiments.
  Tina prefers serial rather than parallel countermeasures. The goal is to learn about the work system, not just shut off the problem via a shotgun blast of countermeasures. Within one contiguous flowing production process, like Tina's group along the assembly line, mentors encourage mentees to only change one thing at a time and check the results. Changing more than one thing simultaneously increases the number of variables and makes cause and effect harder to see, which makes problem solving difficult. If you try to reduce scrap everywhere in the group, you lose sight of cause and effect and don't develop an understanding of the system.

  Tina has decided to identify and focus on the biggest problem and not unleash chaos in her group by creating multiple variables.

Inappropriate actions by the mentor in this cycle would have been:

- Simply ask the five team leaders what they think is the problem.
- Tell the team leaders that we must reduce scrap.
- Tell the team leaders to observe their processes, to go and see.

In what step of Practical Problem Solving is Tina?

- Tina is trying to identify the priority problem. She is in Step 1: Pick up the problem.

If you were Tina what would you do next?

Chapter 3

Tina decided to talk with Dan, the team leader of the team that installs the trim, to get a sense of his grasp of the situation.

Dan told Tina that he wasn't sure what was going on with the side panel trim piece. He noticed that the team had been scrapping more of the parts lately. He also knew that one of the team members on the process had complained that the parts seemed harder to install. He also felt that he had been answering more andon-cord pulls (calls for assistance) at that process lately and that they were usually related to the side panel trim.

In what step of Practical Problem Solving are Tina and Dan?

Analysis

What mentoring/coaching behaviors is Tina using?

- Leading with questions.
  Tina's task as a manager and mentor is not to solve the problem, but to develop her mentees' improvement capabilities through practice. Tina would garner no praise or credit from her superiors if she were to solve the scrap problem herself, because by doing that she would have wasted an opportunity to further develop the capability of the organization. Tina's job is to develop Dan as a problem solver.

  Since a mentor's job is to develop the mentee, they tend not to quickly tell the mentee what to do. Although mentors are experienced in problem solving, they do not point out solutions or give detailed instructions.

  The mentee is given a challenge, a problem, and is expected to make mistakes along the way, on a small scale. Those very mistakes show the mentor what behaviors the mentee needs to practice and what inputs the mentor should give. By asking

questions and observing how the mentee responds, the mentor learns what the mentee is thinking. The mentor then provides guidance to move the mentee into the corridor of thinking and acting prescribed by the improvement kata.

For these reasons, in this cycle Tina will not tell Dan to go and observe the process. She will ask Dan what next step he proposes and observe how he answers. Dan is thinking about the problem, but Tina is thinking about how Dan is approaching the problem.

The power of teaching by asking questions goes back to Socrates, but it is a difficult skill to learn. The method fails if it is used by someone in authority who is simply trying to convince others of a particular solution or answer. People can detect the difference between authentic, neutral inquiry versus an effort to persuade them. There is a big difference between using questions to get a person to come to your preconceived solution versus using questions to discern how a person is thinking and what they need to learn.

Inappropriate actions by the mentor in this cycle would have been:

- Tell Dan to go and observe his process.
- Tell Dan how to proceed.

In what step of Practical Problem Solving are Tina and Dan?

- They are about to get into Step 2: Grasp the situation.

If you were Tina what would you do next?

Chapter 4

In talking to Dan, Tina realized that he had not picked up the problem with the side panel trim even though there were indications that a problem existed. Tina realized that she needed to work with Dan to further develop his problem-solving skills.

Tina and Dan went to the scrap area to look at the most recent side panel trim pieces to be scrapped. She asked him to look at all the scrap trim pieces and tell her what he observed. The first thing Dan noticed was that a nylon clip was broken on most of the parts. He showed the clip to Tina and proposed that they call Incoming Inspection to check if the parts were being delivered from the supplier with cracks in the nylon clip.

Analysis

What mentoring/coaching behaviors is Tina using?

- Sometimes the mentor is directive about the next step.
  After hearing Dan's response, Tina proposed they go look at the scrapped pieces, rather than waiting for Dan to suggest this step. Toyota's mentoring approach is not done exclusively through questions. It is not supposed to be a guessing game for the mentee. The mentor is asking questions in order to see what the mentee is thinking. Once that has occurred, the mentor may make a directive statement regarding the next step (but not about solutions).
- Go and see. Tina went with Dan to see the situation.
  Had Dan in the past proven himself to be a highly experienced problem solver, it is possible that Tina may have let him go alone and then report back to her. But she knew from his response that he was a beginner in problem solving and needed more of her coaching help.

If Tina had sent Dan to the production process and scrap area and asked him to report back his findings without going and looking for herself, she would have effectively nullified her ability to manage further. If a mentor does not have firsthand understanding of the situation, then they cannot lead. This is an important point. Tina would have no way to evaluate whether what Dan was saying and proposing was on the right track or not. She would essentially be out of the picture and could only nod and say, "Okay, let's do that." (This points out an Achilles' heel in management by objectives as we have been practicing it.) Although Tina's job is to develop the improvement capability of her mentees, she must understand the real situation deeply enough to evaluate what her mentee is telling her, in order to see what the mentee needs to learn and what the mentee's next step is. So mentors are generally paying attention to two things: the situation under scrutiny, and how the mentee is approaching the situation.

- Observe, don't interview.
  Many of us would interview the operators in the process, to see what they think might be the problem. As we have already discussed, this only gives you people's opinions, not facts and data. Mentors and mentees must learn to see deeply for themselves and understand what is happening.

Inappropriate actions by the mentor in this cycle would have been:

- Have Dan go observe the process and report back to Tina.
- Ask or interview the workers in the process.

If you were Tina what would you do next?

(Dan has made a proposal, to which you must respond.)

Chapter 5

Tina responded that when they had finished their investigation and established that in fact it was a parts-quality problem, they would call Incoming Inspection. In the meantime she asked Dan not to jump to conclusions too soon and to look at the parts again.

When Dan looked at the scrapped parts again, he noticed that one of the three mounting studs on every part had damaged threads on its end.

In what step of Practical Problem Solving are Tina and Dan?

Analysis

What mentoring/coaching behaviors is Tina using?

- Guide the mentee to "work it back" to the point of cause.
  If Dan were to contact the parts-receiving department at this early point, it would initiate a lot of activity, but the situation is not yet understood. Imagine how much waste would result if people from many different areas were contacting Incoming Inspection so early in their problem solving. Engaging the parts-receiving department in this way is, incidentally, not uncommon.

  Mentors will guide their mentees to first grasp the condition where the problem was discovered, and then work it back from there if the evidence suggests doing that.

In what step of Practical Problem Solving are Tina and Dan?

- Tina and Dan are still trying to clarify what is happening. They have not yet found the point of cause and are still in Step 2: Grasp the situation.

Chapter 6

Tina suggested to Dan that they go and observe the side panel trim installation process. They checked the line-side parts for the damaged stud threads, and did not find any, before watching the operator perform the process.

Then Tina and Dan went to look at the work standard for the side panel trim process. The standard required that the team member pick up the part and the nut driver at the parts rack before moving to the vehicle to install the part. The driver is placed on the vehicle floor, and the part is then positioned so the nylon clips line up with holes in the body panel. The team member then knocks the clips into the panel with his hand. Next, the team member picks up the driver and loads its socket with a nut. He then installs a nut onto each of the three studs.

After watching the team member install several parts, Tina asked Dan if he noticed anything that could be a potential problem with the installation. Dan said that everything looked normal to him. He could see no deviation from the work standard.

Tina asked him to look again but this time to focus on what specific actions the team member takes to install the nuts to the studs.

In what step of Practical Problem Solving are Tina and Dan?

Analysis

What mentoring/coaching behaviors is Tina using?

- Refer to the work standard or target condition before observing a process.

  Tina and Dan checked the work standard before observing the process. Be sure to understand the way the process should be operating, so you have a point of comparison. This is why the first of the five questions is, "What is the target condition / standard at this process?"

- When the mentee makes a proposal or statement, the mentor should respond quickly.

  When I first received this advice from a Toyota person, I mistakenly thought it meant that the mentor must fully understand the situation and know the solution. Try as I might, that was something I could almost never achieve.

  Tina has asked Dan to look again at the process and focus specifically on what the team member does to install the nuts to the studs. It seems like Tina knows the solution, doesn't it? A young American working at Toyota in Japan once told me how it initially drove him crazy that his Japanese mentors would ask him questions and seemed to already have a solution in mind. "If you know what you want me to do then just tell me!" he wanted to say.

  After some time the American learned that the mentor does not, and should not, have a preconceived solution in mind. The mentor must answer quickly, but he only has to see *what the next step is*. The mentor cannot fully know the way ahead, but he must grasp the situation deeply enough to know what the next step is so he can lead his mentee to and through it. And if the next step is unclear, then the answer is almost always, "Let's go and see." In most cases the next step is in fact to get more specific facts or data. Once I learned this, my own efforts to experiment with mentoring became considerably more effective.

  Tina does not have in mind a solution to the problem. It is Dan's responsibility to solve the problem and her responsibility to develop Dan's capability to do that. But she does know that the damage to the threads on the studs is likely to be occurring when the nut is driven onto the stud. She has an inkling about the point of cause, and is guiding Dan in that direction.
- Go and see.

  Imagine in what direction this effort might be going if Tina had stayed in her office and Dan was reporting his impressions to her there. Tina could not do this mentoring if she was not at the process with Dan understanding the current situation firsthand.

- Overlap of responsibility.
  Although Dan is responsible for the doing and Tina cannot just tell him what to do, since her job is to teach Dan, she knows that she in turn bears a lot of the responsibility for the results.

In what step of Practical Problem Solving are Tina and Dan?

- Tina has recognized that the point of cause is probably where the nut is driven onto the stud, but Dan has not. Tina would be ready to enter Step 3 (Investigate causes), but since Dan is the one who has to solve the problem, they are still in Step 2 (Grasp the situation). Tina is guiding Dan to the next step in a way that allows him to learn the lesson for himself.

Chapter 7

Then Dan noticed that the team member had to install the nut through a hole in the side panel, and that the team member could not see the end of the stud to assure that the nut was correctly located. The team member had to rely on feel to determine if the nut was aligned. Dan told Tina that now he knew what the problem was. The side panel trim installation had two new team members working on it in the past month. The new team members just didn't have the feel for the nut alignment yet, and that was why the threads were getting damaged and the parts were being scrapped.

Dan suggested that they would need to do a better job of training new team members so they wouldn't strip the threads on the studs.

Analysis

No mentoring activity by Tina in Chapter 7

If you were Tina what would you do next?

(Dan has made a proposal, to which you must respond.)

Chapter 8

Tina suggested that first they should confirm the relationship between the number of scrap parts and new team members on the process. She and Dan reviewed the scrap records for the group and compared any increase in the amount of scrapped side panel trim pieces to the dates that new team members were on the process. They found a direct relationship. Each time there was a new team member, there was a significant increase in the number of trim pieces that were scrapped.

Dan told Tina that he would have a meeting with all the team members who worked on that process immediately and tell them they needed to be more careful. He also said he would retrain all of them on installing the nut.

In what step of Practical Problem Solving are Tina and Dan?

Analysis

What mentoring/coaching behaviors is Tina using?

- Show me.
  Mentors prefer facts and data over opinion.

In what step of Practical Problem Solving are Tina and Dan?

- Tina and Dan have reached Step 3: Investigate causes.

If you were Tina what would you do next?

(Dan has made a proposal, to which you must respond.)

Chapter 9

Tina asked Dan if he knew what the team members were doing when the threads stripped. Dan replied that he didn't know what they were doing but he knew they weren't doing it correctly. Tina suggested they revisit the process and take a closer look at what the operators were actually doing and what the circumstances were when the threads stripped out.

When they observed the process again, they saw the team member on the process load the nut into the driver socket. Next, the team member started the driver to spin the socket and improve the setting of the nut in the socket. The trigger is then released to locate the nut on the stud. Then the driver trigger is depressed again to install the nut on the stud. Tina and Dan didn't see anything abnormal about the way the team member they were observing did the process. This team member didn't create any stripped threads while he was on the process that shift.

Tina suggested to Dan that they observe one of the new team members on this process. Then they saw a different technique being used. This team member kept the trigger of the driver depressed while he was locating the nut on the stud.

Tina suggested that she and Dan conduct an experiment to confirm that what they had seen could create stripped threads.

In what step of Practical Problem Solving are Tina and Dan?

Analysis

What mentoring/coaching behaviors is Tina using?

- Focus on understanding the process, not on implementing countermeasures.

  Tina and Dan are at Step 3 (Investigate causes), but with his proposals, Dan is skipping over this and going right into Step 4 (Develop and test countermeasure). This is not unusual.

We often think that good problem solving means applying countermeasures. In contrast, the focus in problem solving at Toyota is on understanding the current situation so deeply that the countermeasure becomes obvious. Mentees are prevented from introducing countermeasures before they sufficiently grasp the situation.

If we introduce countermeasures before understanding the situation, we create more variables, which interferes with identifying root causes. In the worst case, the wrong countermeasure might temporarily reduce occurrence of the problem, making us believe our effort was a success.

- Focus on the process, not the people.
  Mentors know that the vast majority of problems are caused by the system within which people work, not by the individuals themselves. They assume that the operators are doing their best, that if they were in the operators' shoes, the same thing would still have happened, and that training alone does not improve a process.

  An important point to realize here is that if we did carry out Dan's suggestion of retraining the new operators, then the scrap rate is likely to decrease. However, this would not be because the root cause had been identified and eliminated, but because extra managerial attention had been paid to the process. The same problem would return again later, because the process itself has not actually been improved in any way.

  To instill this thinking in their mentees, mentors will ask questions such as, "What is preventing the operator from working to standard?" or, "Do you know what the person was doing when the problem occurred?"

  Dan is proposing training, but training in what? How does the process, the standard, need to be changed so the process is actually improved? He has not yet answered this question.
- Testing over talking.
  Conduct small-scale tests before implementing something on a broad scale. As always, seek facts and data.

In what step of Practical Problem Solving are Tina and Dan?

- Tina and Dan are in Step 3: Investigate causes.

Chapter 10

Tina and Dan took some scrap trim pieces and a driver over to a vehicle and tried installing the trim using the method they had seen at their process. They noticed a feeling in the driver when the nut was properly located. This was an important point, because the positioning of the nut to the stud is a blind operation in the installation of the side panel trim. Next they tried installing the nut using the method they had seen at the other process.

During the second trial, they kept the driver running while trying to align the nut and stud. Of the 10 tries, four resulted in stripped threads. Tina and Dan now knew that the only way to be sure the nut and stud are properly aligned is to perform the positioning with the driver in the off position.

Next, Tina and Dan went to look at the work standard for the side panel trim process again. There was no information that instructed the team member to make the positioning of the nut and stud before triggering the driver. Dan told Tina that now he could hold a meeting with the team members to discuss the results of their investigation and instruct each of them on the correct procedure for installing the nuts.

Tina directed Dan to also correct the work standard based on their findings. In addition, she asked him to report their findings the next morning at the team leader meeting and to work with the other team leaders to identity other processes in the group with the potential for having the same problem.

In what step of Practical Problem Solving are Tina and Dan?

Analysis

What mentoring/coaching behaviors is Tina using?

- Conduct small-scale tests before implementing.
- Refer to the work standard or target condition.

In what step of Practical Problem Solving are Tina and Dan?

- Tina and Dan are now in Step 4: Develop and test countermeasure.

If you were Tina what would you do next?

Chapter 11

Tina and Dan tracked the Section B scrap for the next three months and had no further occurrences of assembly-damaged side panel trim pieces.

Dan confirmed the adoption of the new standard by observing the operators and the process. The team leader on the second shift was instructed to do the same.

Tina reported her experiences in the problem solving to Paul, the trim shop assistant manager.

Why did Tina insist on three months of follow-up tracking on the trim scrap?

- To confirm that the root cause was found and eliminated.

Summary Discussion of the Mentor/Mentee Case

Now that you have gone through the case example, we can get into a somewhat deeper discussion about the mentor/mentee dialogue and problem solving at Toyota.

1. How Did You Feel as You Read Through the Case?

I have taken a few hundred people through this case example in a classroom setting, and a common feeling among many participants was some exasperation that Tina and Dan's effort to solve the problem seemed to proceed slowly. As Tina sends Dan back to look at the situation again and again, some participants start visibly shifting around in their seats. "When are they going to implement something?"

It is important to see that at Toyota the emphasis in problem solving is on Step 2 (Grasp the situation) and Step 3 (Investigate causes). If these steps are done thoroughly, then the countermeasure (Step 4)

often comes quickly and almost by itself. Conversely, if the countermeasure is not yet obvious, then it usually means that more study of the situation is necessary, rather than more thinking about countermeasures. It is a classic case of greater diligence up front being more effective and, overall, quicker. To really solve a problem, you have to understand why it is happening.

Supposedly, Albert Einstein was once asked, "You have one hour to solve a problem, how do you proceed?" According to the story, his answer was something like, "I would analyze the problem for 55 minutes and in the last five minutes I would introduce my countermeasure." The funny thing is that in our companies, we proceed in exactly the opposite manner. Within a very short time after recognizing a problem, we are proposing a variety of countermeasures in the hope that one of them will stop the problem. This is a very different approach from Toyota's, where the goal is not to implement countermeasures but to better understand the work system so we can improve it based on what we are learning about its processes.

If we throw countermeasures at a problem or have a list of countermeasures, then what that really means is we do not know enough about the situation causing the problem. Instead of causing more chaos and complicating our analysis by introducing several countermeasures, we would be better off more carefully observing the situation before deciding and acting. We have taught our managers to think about *what* will solve the problem, whereas Toyota managers like Tina are thinking about *how* their mentees should be approaching the problem.

2. How Long Do You Think the Story in the Case Took?

I do not have information about the actual elapsed time that Tina and Dan took, but most of the story is likely to have occurred, from beginning to end, within only one shift. This is a critical point, and one that has implications for how our managers and leaders organize their work days.

If mentors want their mentees to grasp the situation thoroughly, proceed step by step, and change only one thing at a time, then the

cycles from step to step should be short and follow without delay. If our managers and leaders try to fit this mentoring into their existing schedules—for example, waiting for a prescheduled weekly review to come around—it will be far too slow and mechanical. Two things will happen:

- The situation in and around the process is likely to change.
- Because it takes so long to move forward, the pressure to solve the problem increases, which causes us to skip steps and jump to countermeasures.

For effective PDCA, the mentor's review of the last step should occur as soon as possible, so you can adapt based on what you find. As described in Chapter 6, progress is by rapid small steps, always adjusting to the present situation. Toyota mentors tend to insist on a short deadline for taking the next step, and to review the result of that step immediately through short, often stand-up, meetings at the process. Turnaround time is minutes or hours, with the mentor placing particular emphasis on the next step. There is no need for lengthy discussions about activities or steps beyond that, because whenever one step is taken, the situation may be new anyway.

I have observed a Toyota mentor asking the fifth question, "When can we go and see what we have learned from taking that step?" and when the mentee responded with, "In two days" the mentor simply repeated his question until the mentee finally said, "How about this afternoon?" To that, the mentor said, "Okay, good.

3. What Would Have Happened If Tina Had Stayed in Her Office Instead of Going to Observe the Process Herself?

Tina would very quickly have not been able to give good advice to Dan if she had relied on his reports alone, rather than going to see for herself. Going and seeing keeps the mentor closer to the real condition at the process—not so the mentor can develop a solution, which is the mentee's responsibility, but so the mentor can use the details of that condition to appropriately guide the mentee into improvement-kata thinking and acting.

4. How Was Tina Teaching Dan?

Tina was teaching Dan by making an actual improvement in an actual process, rather than in a classroom. This kind of teaching occurs one-on-one on the shop floor, in contrast to periodic project reviews conducted in an office.

5. What Do You Think of the Countermeasure Dan Developed?

The countermeasure was: "Hold a meeting with the team members to instruct each of them on the correct procedure for installing the nuts, update the job instruction sheet to indicate positioning of the nut with the gun in the off position, and report the findings at the team leader meeting."

Many people who have gone through this case example wanted a more fail-safe countermeasure, such as a device that would prevent the gun from spinning while the operator is locating the nut on the stud. Yet the countermeasure in the case example is acceptable at Toyota. Why? Keep in mind that Toyota's production processes are closely managed by team leaders, who observe the process every shift and compare its operation to the work standard. If our production processes are largely unmanaged—and many of ours are—then of course we will tend to prefer fail-safe mechanisms, or "poka yoke," as they are often called. Interestingly, Toyota does not like to add too many poka yoke devices to its processes because they increase maintenance requirements, and because Toyota wants its operators to have to think as they do their jobs.

There is also another more subtle but important point here. Sometimes in our experiments with Toyota's mentoring routines the mentor would see an even better or more elegant solution than the mentee had developed. The mentor would then be inclined to propose his solution over what the mentee had developed.

At Toyota the goal is not necessarily to develop the very best solution today, but to develop the capability of the people in the organization to solve problems. The mentor gets no extra points for having a better idea than the mentee. Of course the solution must be good

enough to serve the customer, but beyond that, having the most perfect solution now is not what Toyota is thinking about. Toyota is thinking about developing the capability of its people.

Although the mentor is often a tough customer who leads the mentee through the problem solving via questioning—like Tina in the case example—ultimately the mentee is the person who must analyze the problem and develop the countermeasure. It may be tempting, especially for inexperienced mentors, to try to lead the mentee to a different solution that the mentor has in mind. But this is not Toyota-style mentoring. If the mentee sufficiently solves the problem in a way that meets the target condition, then the mentor must accept this.

Here is the point: How well the mentee does reflects the current capability of the organization, and if possible this should not be obscured, because we always want to understand the true current situation as clearly as possible. The solutions the mentees develop reflect the current level of capability in the organization, and that can be an important input for mentors. It may tell them what skill sets they need to work on next with their mentees. Artificially creating perfect solutions would disguise the true state of affairs and make it more difficult to understand what we need to do next to move our organization forward.

I hope you are having as much of an ah-ha moment right now as I did when this penny dropped for me.

Management does not need to bring solutions to problems. What management should bring into the organization is a kata for how people should act when faced with a situation. If the ability to apply the kata is developed in the organization correctly, then management will not need to worry about the outcomes. Conversely, if the results are not satisfactory, then it is the kata that is not being applied correctly.

6. Imagine This Approach Happening at Every Process in an Organization for Decades

In the case example, we are looking at an occasional stripped thread on one component of a product (an automobile) that has thousands of components, inside a huge company that makes many different

products. In that light the effort that Tina and Dan went through could seem disproportionate, like too much effort. Yet imagine small effective steps of continuous improvement happening at every process every day for 50 years, and you begin to get a sense of how Toyota has achieved the position it holds today.

7. Caution! Good Coaching Skills Take Practice to Develop

Toyota's mentoring is a unique coaching and teaching approach, and it takes practice (under the guidance of an experienced mentor) to develop such mentoring skills. I have seen a few pitfalls in experiments with developing mentors, including:

- You have to be a mentee before you can mentor. In order to accompany and guide others through the improvement kata, the mentor must have sufficient experience in carrying out the improvement kata him- or herself.
- It is difficult for new mentors to adopt the right mind-set. When you go and see, your mind should be open, without preconceived notions about what could be the situation and what might be solutions. The mentor should know very well how the improvement kata proceeds (the how), but should have an open mind in regard to the content of the particular improvement effort (the what).

  For example, inexperienced mentors often ask questions designed to get the mentee to adopt the mentor's preconceived solution. This is sort of like the guessing game: "I'm thinking of a number between 1 and 10." Unfortunately, this does not develop the mentee's capability. Remember, the mentor is asking *what* the mentee is thinking in order to discern *how* the mentee is thinking.
- Mentees often feel pressure to give an answer, even if they don't know the answer. The mentor should get himself and the mentee to the point where "I don't know" is an acceptable and valid answer. And when "I don't know" is the answer, then go and see!

A Written Document to Support Mentor/Mentee Dialogue

Cycles of coaching should ideally be frequent, short, and conducted face-to-face. In the case example, Tina and Dan's communication was all verbal. However, it is often advisable to use a simple, one-page written document in support of mentor/mentee coaching. Verbal communication alone can rely too little on data, and during verbal communication a mentee may naturally, and unconsciously, adapt what he is saying to what he thinks the mentor wants to hear.

By asking the mentee to summarize information in writing on one page *in advance of coaching,* the mentor can more clearly see how the mentee is approaching an issue and how she is thinking. This in turn helps the mentor see the next step and what coaching is required at this time. Limiting the document to one page compels the mentee to be clear in describing her analysis and proposal.

Typical items in mentor/mentee dialogue that make it onto a written document include:

- Summary of observations or current condition
- Target condition
- Proposals
- Plans
- Key points from reflections

At Toyota such one-page documents are called A3s because they are often made on a sheet of ledger-sized paper, referred to as A3-size in many countries.

The format of an A3 generally mirrors the steps of the improvement kata. They are written in a succinct, bulleted, and visual style that tells a story with data. Although the A3 is typically on one page, there can be additional pages of backup documentation. It is the "story" itself that is built up and presented on the single page.

The format of an A3 varies depending on the purpose and theme. Figure 8-8 presents the typical sections of an A3.

You may notice that in this example A3, "Current Condition" comes before the "Target Condition," which is a reversal of their order in the

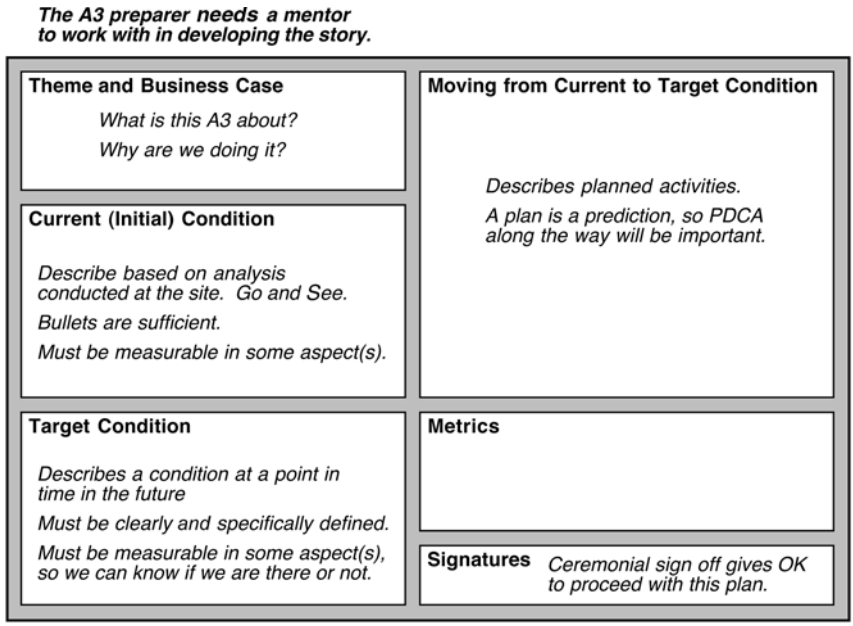


Figure 8-8. Example of the A3 format

five questions at the end of Chapter 6. The reason for this is that the five questions come into play *after* a target condition has already been defined, whereas an A3 is from the beginning, where understanding the current condition precedes defining the target condition. Each section of the A3 builds upon the previous one. The better you define the theme, the better you can assess the current condition. The better you assess the current condition, the better you can develop an appropriate target condition. And so on. As the mentee develops the A3, the mentor typically has the mentee focus on one section of the A3 at a time, and that section may be rewritten several times. That section is then the foundation for the next section.

Purpose of an A3

The purpose of A3 documents is to support the mentor/mentee dialogue. This is done by:

- Having the mentee carefully think through something.
  It is surprisingly difficult to distill our understanding about something down to one sheet of paper. Preparing a succinct and

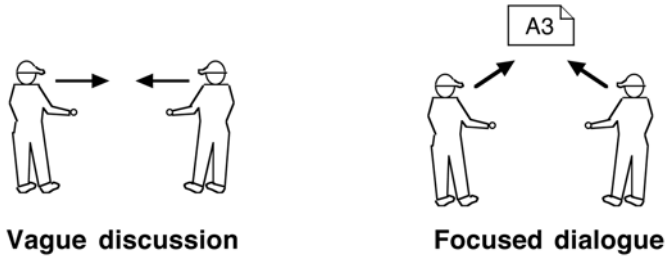


Figure 8-9. An A3 can help mentor/mentee interaction stay focused

precise A3 forces you to develop a deep and clear understanding of a situation.

I would have written a shorter letter, but I did not have the time.

—Attributed to Blaise Pascal, Johann Wolfgang von Goethe, and others

- Showing the mentor how the mentee is thinking, so the mentor can see what the next step is for the mentee, and what skills the mentee needs to develop.
- Keeping coaching focused and efficient (Figure 8-9). An A3 helps create a neutral, no-blame situation by giving both mentor and mentee a focal point. If there is an important issue, question, or lesson learned, then it should be noted in the A3.
- Achieving consensus and clear action
- Providing milestones for process checks

Lessons Learned About A3s

This is another one of those instances where we can easily miss the point while trying to copy a Toyota practice. We tend to focus on the tool—the format of *completed* A3s that we see at Toyota—rather than on the less visible *how and why* an A3 is developed and used. Upon learning that Toyota utilizes A3s, some managers and consultants have singled them out as a lean tool and suggested that people use them. The result in many cases has been a lot of paper generation and not much more than that.

There is no magic in the A3 documents themselves. The trick is in how they are used, and here are some key points in that regard from our experimentation:

- An A3 is a tool that is used within and in support of the mentor/mentee dialogue, that is, the coaching kata, which in turn is being done to teach and drive application of the improvement kata. The improvement kata in turn is applied in pursuit of a long-term direction or vision, which exists because of an organization philosophy of improvement and adaptation. An A3 by itself may not be so effective.
- An A3 is put together through a highly iterative, back-and-forth process between mentor and mentee. It is not just filled in at once and signed, because then it would just be a meaningless formality. Imagine the document being slid back and forth between mentor and mentee several times as they develop a progressively better understanding of the current and target conditions, and step-by-step build up the sections of the A3. If there are not several push-backs, then the A3 document is not being used correctly.

  Much of the benefit of an A3 lies in this process of creating it, because it forces you to work with facts and data and think through what you are doing. The objective and benefit is not so much to have a completed A3, but to go through the iterative, step-by-step process of developing it.
- It takes more time to develop a good A3 than you may think; sometimes weeks or even months.
- As already mentioned, in developing the A3, the mentor typically has the mentee focus on one section at a time, because each section of the A3 sets the framework for the next. You will probably go back and make adjustments often. Keep your eraser handy.
- Once the A3 is completed and signed it becomes a tool for making process checks as the mentee works toward the target condition. The A3 then becomes a tool to help mentor and mentee better identify problems along the way.

- A good way to start is to simply ask the mentee for a proposal on one blank sheet of paper, rather than predefining the A3 format. Wait and see what the mentee produces. Then you can discern how the mentee is thinking and guide him accordingly from there. This is like in the case example, when Tina started by giving Dan a vague assignment. She then waited for his response in order to see how he was thinking, before guiding him into the next step.
- Caution: a written document can encourage e-mail communication over face-to-face communication, or be used as a substitute for Go and See. Communication should remain face-to-face, and you should seek facts over data at the process.
- Talk less and communicate more, by staying focused on what is written in the A3. Avoid ad-lib discussion, which is typically not based on facts and data, is quickly forgotten, and therefore wastes time. If there is no data, there is no basis for discussion. Have the mentee summarize the necessary points and data *before* coaching in order to help prevent this effect.

For more on the A3 process within mentor/mentee dialogues, see the book *Managing to Learn*, by John Shook.[2]

Notes

1. I use the word *superior* here, but as we will see, in many ways it is the mentor who is supporting the mentee.
2. John Shook, *Managing to Learn* (Cambridge, Massachusetts: Lean Enterprise Institute, 2008), and www.lean.org.

Summary of Part IV

There is a significant difference between the approach and activities of managers at Toyota versus managers in our organizations. Both work with goals, targets, and outcome metrics, of course, but that is only a start for the Toyota manager/mentor, because she or he is charged with teaching. As the diagram in Figure P4-1 illustrates, the difference lies at the interface, the interaction, between manager and subordinate.

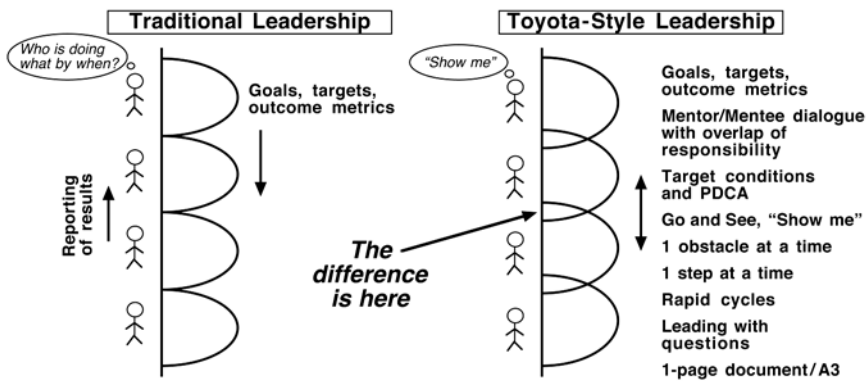


Figure P4-1. A difference, at the point where managers and the people they manage interact

The teaching requirement and the overlap of responsibility—mentee responsible for doing and mentor responsible for results—binds leader and subordinate together like the pairs of runners in a three-legged race, where the right leg of one runner is strapped to the left leg of the other. It is a game of interdependency, learning, and coordination between teammates. And lest you think this is just an exercise for some people in the organization, keep in mind that everyone at Toyota has a mentor.

In some respects what Toyota has done with its improvement kata and coaching kata is to grow management by objectives into its full potential, while in the same period of time we sometimes seem to have sought to reduce it to "manage by the numbers" or "manage by results."

In Toyota's Own Words

Toyota has a unique corporate culture that places emphasis on problem solving and preventative measures, such as making decisions based on the actual situation on the ground and highlighting problems by immediately flagging and sharing them. Toyota's management team and employees conduct operations and make decisions founded on that common system of checks and balances and on high ethical standards.

A distinctive feature of Toyota's system is that senior managing directors do not focus exclusively on management. As the highest authorities in their areas of supervision, they also act as links between management and on-site operations. Retaining an emphasis on developments on the ground—one of Toyota's perennial strengths—helps closely coordinate decision making with actual operations. Management decisions can be swiftly reflected in operations, while overall management strategy is able to readily incorporate feedback from frontline operations.

—Toyota 2004 Annual Report, page 16

With regard to Toyota's improvement kata as described in Part III, it is a scientific approach, and thus universal in nature and applicable in many organizations and to many different situations. I have utilized

it successfully many times. It works, and I have no hesitation in recommending it to you as described in this book.

With regard to Toyota's coaching kata, on the other hand, we do not yet have enough experience with it to know if that approach is always necessary for developing improvement kata behavior. Some kind of coaching is undoubtedly required in order to teach people the improvement kata, but more research—experimentation—on teaching methods is probably necessary. Perhaps Toyota's coaching kata is not the only way to do it.

The distinction between the improvement kata and the coaching kata is important, since the main objective is not "management by questions," per se, but to have members of the organization think and act along the lines of the improvement kata. Making the distinction between the two kata allows a mentor to clearly ask him- or herself:

(a) How is this person doing with the improvement kata?
And then:
(b) What coaching do I need to do now?

Is the Coaching Kata in Flux at Toyota?

The mentor/mentee approach has traditionally been Toyota's method for passing its improvement kata on to all organization members. Toyota utilized this approach when it opened its first manufacturing facility in North America, the NUMMI plant in Freemont, California—a 50-50 joint venture with General Motors that commenced production in 1984. Approximately 400 "coordinators" were sent from Japan to the California site. These were mentors who essentially took Toyota's new American hires by the hand and taught them Toyota's improvement kata through the mentor/mentee learn-by-doing approach presented in this chapter. A similar number of coordinators were later sent to Kentucky, when Toyota established its second North American production site there.

In more recent years, however, Toyota has been growing so rapidly around the world (factories in 28 countries at last count) that it is faced with a need to bring many more new employees into its way of

thinking and acting. Toyota's coaching kata—the mentor/mentee approach—has not always been able to keep up, because it requires experienced mentors, a limited resource, and it takes time.

> *. . . a vital aspect of our reinvention is changing how we choose and develop our leaders. Obviously, using only Japanese advisors cannot be done anymore. We are stretched thin here and elsewhere around the world.*
>
> —Toyota President, Fujio Cho, in a speech given in Traverse City, Michigan, August 3, 2004

Since Toyota utilizes problems as opportunities to evolve and improve, we can assume that it is in the process of adapting its way of teaching the improvement kata. On the other hand, an organization's intentionally cultivated behavior patterns are a fragile thing, and Toyota is no exception. Adapting in this area will probably work for Toyota as long as there are still enough key people in the organization who understand and have mastered the adaptive behavior pattern—the improvement kata.

What Is the Next Step for Us?

The evidence from experimentation suggests that some kind of coaching will be necessary in order for groups of people to learn to use the improvement kata, as well as to keep it operating every day at every process. If you want to integrate an improvement kata into an organization's way of doing things, then you will have to develop some kind of coaching approach. We will tackle this subject in the next, and final, chapter.

Part V

Replication: What About Other Companies?

Chapter 9

Developing Improvement Kata Behavior in Your Organization

The second overarching question mentioned in the introduction to *Toyota Kata* is: How can other companies develop similar routines and thinking in their organizations? At this point we have a basic awareness of what Toyota is doing to achieve continuous improvement and adaptiveness, as described in Parts III and IV. There is, of course, more to learn there, but we would perhaps do well to shift some of our attention away from the question of what Toyota is doing and more onto that second question. While it is interesting to study and discuss Toyota, even more important may be the experimentation, learning, and development we do for ourselves in our own situations.

Be Clear About What You Are Undertaking

Some other ways to phrase the second overarching question might be:

> How do we get everyone in the organization to think and act along the lines of the improvement kata described in Chapters 5 and 6?
> How do we get this behavior routine into an organization?

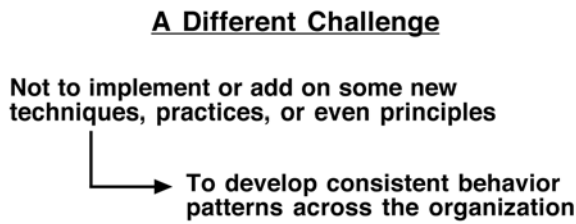


Figure 9-1. The task

How do we spread improvement kata behavior across the company so it is used by everyone, at every process, every day?
How do we learn a new way of thinking and acting?

Which is to say that before we go any further, we should be clear about the challenge. Knowing about the improvement kata that lies behind Toyota's success, and that it is about behavior patterns and developing such behavior patterns, ask yourself: *Is this what you intend to do?*

Developing new behavior patterns across an organization involves a more significant effort and further-reaching change—particularly in leader behavior—than what you may have assumed that "lean manufacturing" is about. It should be clear to you at this point that bringing continuous improvement into an organization—"lean" or the "Toyota Production System"—involves a different kind of challenge than we originally thought. Toyota's embedding of the improvement kata and the coaching kata into daily work represents more than just adding something on top of our existing way of managing. It means changing how we manage (Figure 9-1).

Organization Culture

Trying to get each person in an organization to think and act in certain ways means you are working on organization culture. Most organizations that are interested in Toyota's approach probably do not need to completely change their existing culture, but rather, to make an adjustment, like maneuvering a curve in the road, as shown in Figure 9-2. So how does one make such a change in organization culture?

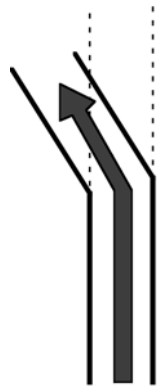


Figure 9-2. Making a shift in organizational culture

What Do We Know So Far About This Challenge?

Since the late 1980s, Toyota has successfully—though not without difficulty—been spreading its approach to local citizens at new Toyota Group sites around the world; that is, *inside* Toyota. This includes North America and Europe, and it suggests that Toyota's improvement kata should be practicable for organizations and people outside of Toyota. However, in Chapter 1, I stated the following:

> *To date, it appears that no company outside of the Toyota group of companies has been able to keep improving its quality and cost competitiveness as systematically, as effectively, and as continuously as Toyota.*

Astute readers may have already been wondering as they started this chapter: "If no company outside Toyota has succeeded in bringing such systematic continuous improvement into all processes every day across the organization, then how can anyone answer the question being raised at the beginning of this chapter and tell us how to do it?"

The fact is we simply do not yet have authoritative answers to the second overarching question, and that includes Toyota itself too. For example, Toyota's efforts to spread its approach to its *outside* suppliers have achieved many point successes in a wide variety of processes and value streams, but even those efforts to integrate the improvement kata into everyday operation across the organization at these other companies have so far not met expectations.

What I can do in this chapter is share with you what we have learned with regard to the second overarching question—which in fact is quite a lot—and how we are working on issues raised by that question.

You Need to Become an Experimenter

The goal of this chapter—and this book overall—is to set you up to experiment and thereby develop your management system in accordance with the needs of your situation. If you want to change behavior patterns and organizational culture, then it is quite likely there is no other way:

- There is probably no approach that fits all organizations. Each company should work out the details by developing its management system to suit its particular situation.
- There is great value in striving to understand the reality of your own situation and experimenting, because it is where you learn. No one can provide you with a solution, because the way to answering the second overarching question—as with any challenging target condition—is and should be a gray zone.

But we do know how to work though that gray zone. The improvement kata, the means by which processes are improved, is a way of experimenting, and we can apply it to almost any sort of process. So when I say you need to become an experimenter, it does not mean that you have to start a separate activity. We can continuously improve and adapt, train people, and develop our organization culture simultaneously, with the same activity. In fact, this describes quite well how Toyota goes about it.

There is now a growing community of organizations that are working on this, whose senior leaders recognize that Toyota's approach is more about working to change people's behavior patterns than about implementing techniques, practices, or principles. In fact, as you strive to develop improvement kata behavior and thinking in your organization, that step-by-step effort will have an effect on your techniques, practices, and principles. That is a good way to look at it.

What Will Not Work

Some of the early lessons from our experimentation were about approaches that do not work for changing people's behavior. Let us get those out of the way from the start. If you wish to spread an improvement kata (a new behavior pattern) across your organization, then the following tactics will not be effective:

- *Classroom training.* Even if it incorporates exercises and simulations, classroom training will not change people's behavior. It seems for several years now we have assumed that simply comprehending Toyota's system would automatically lead to its adoption—*because it makes sense!* This approach has been decidedly ineffective. Intellectual knowledge alone generally does not lead to change in behavior, habits, or culture. Ask any smoker.

  As mentioned in Chapter 8, the concept of training in sports is quite different from what "training" has come to mean in our companies. In sport it means repeatedly practicing an actual activity under the guidance of a coach. That kind of training, if applied as part of an overall strategy to develop new behavior patterns, *is* effective for changing behavior.

  Classroom training has a role, but the best that we can probably achieve with it is awareness. And even that tends to fade quickly if it is not soon followed by repeated, structured practicing. Classroom training should probably be kept short and provided mostly for information purposes and to participants who are about to go into hands-on practicing with a coach.

- *Workshops.* These are designed to make point improvements, not to develop new behaviors. Furthermore, as discussed in Chapter 2, results naturally tend to slip back after a workshop ends.
- *Having consultants do it for you.* Developing internal routines and capability for daily continuous improvement and adaptation at all processes involving all people—culture—is by definition something that an organization must do for itself. An experienced external consultant can provide coaching inputs, especially at the beginning, and even experiment together with you. But to develop your own capability, the effort will have to be internally led, from the top. If the top does not change behavior and lead, then the organization will not change either. More on that later in this chapter.
- *Looking to metrics, incentives, and motivators to bring the desired change.* As we have discussed, there is no combination of metrics and incentive systems that by themselves will generate improvement kata behavior and change your culture to one like Toyota's.
- *Reorganizing.* Many companies have tried unsuccessfully to reorganize in the hope of finding organizational structures that will stimulate continuous improvement and adaptiveness; for example by bringing departmental functions into value-stream-oriented organizational structures.

  As tempting as it sometimes seems, you cannot reorganize your way to continuous improvement and adaptiveness. What is decisive is not the form of the organization, but how people act and react. The roots of Toyota's success lie not in its organizational structures, but in developing capability and habits in its people. It surprises many people, in fact, to find that Toyota is largely organized in a traditional, functional-department style.

  Anything unique about Toyota's organizational structures, such as their team leader approach, evolved out of Toyota striving for specific behavior patterns, not the other way around. First figure out how you want people to act—for example, along the lines of the improvement kata—and strive to develop those behavior routines. If, then, along the way, making organizational

adjustments is a necessary or useful countermeasure, that's okay. But these should be seen for what they are: countermeasures, not target conditions. Keep your attention on the target condition of developing improvement kata behavior, and let the needs of your efforts there drive the evolution of your structures.

All these tactics have their place, but they will not generate improvement kata behavior, nor the cost, quality, and adaptiveness benefits that accrue from daily application of that kata. Culture change is not achieved through books, intellect, classroom training, discussions, or anything similar.

How Do We Change?

The field of psychology is clear on this: we learn habits, automatic reactions, by repeatdly practicing behaviors. In order to build new mental circuits, we must practice a desired behavior pattern and periodically derive a sense of achievement from that behavior. The canon that we *learn by doing*, by experiencing, has given rise to the well-known and widely accepted change model depicted in Figure 9-3.

Much of what we do is routinized and habitual. Repeated practice—conditioning—creates neural pathways and, over time, an organization's culture. This change model is particularly important with regard to the improvement kata because several aspects of that kata are

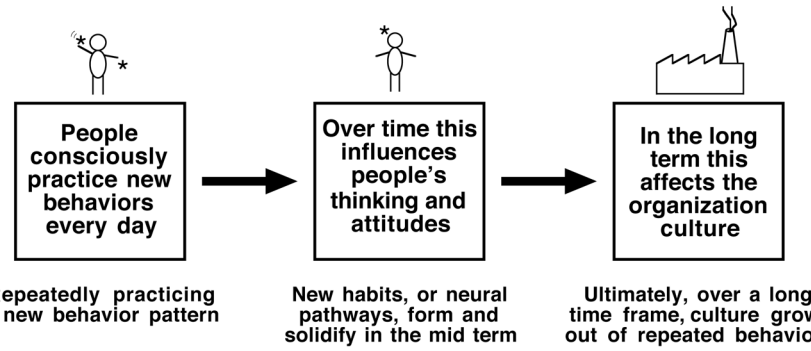


Figure 9-3. A model for changing organization culture

so different, and even counterintuitive, from the perspective of our current management approach. The only way to truly understand its underlying meaning and learn to apply it in different situations is by personally and repeatedly practicing it in actual application.

Ideally, following the improvement kata pattern would become automatic and reflexive, and our mindfulness thereby freed to be applied to the details of the situation at hand. This is the ideal that Toyota's coaching kata, described in Chapter 8, strives to achieve, and a reason why Toyota people have had difficulty explaining to us the underlying pattern of what they do.

> *We are what we repeatedly do. Excellence, then, is not an act, but a habit.*
>
> —Aristotle

> *To know and not to do is not yet to know.*
>
> —Zen saying

Fortunately, kata are designed specifically for passing on. In martial arts, kata were apparently created so the masters could pass on their most effective fighting techniques to further generations. In other words, kata are a way of doing exactly what we are discussing here: practicing behaviors and learning new habitual routines.

How to Experiment

Use Actual Work Processes

This is something we adopted one-to-one from Toyota's approach: training and doing are not separated (Figure 9-4). To practice the improvement and coaching katas, students apply them in actual situations at actual work processes. In this manner your experimentation will be real, not theoretical. You can perceive where the student truly is with his thinking and skills, and take appropriate next steps. And the degree or lack of improvement in the processes serves as a metric for the effectiveness of your effort to coach and develop the desired behavior routines.

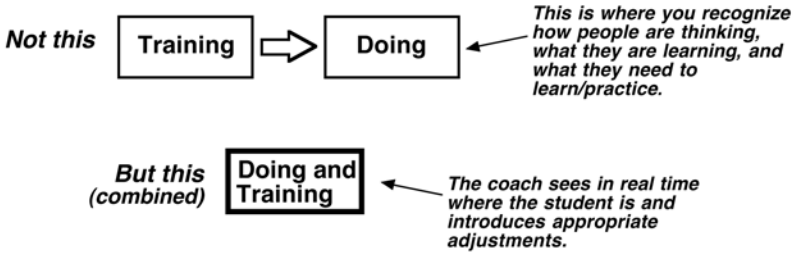


Figure 9-4. Experimenting with real processes

Focus On Three Main Factors

If we want to get people, including ourselves, to think and proceed along the lines of the improvement kata, I propose three main factors that we can influence in order to achieve this (Figure 9-5).[1]

Focusing on any one of these three areas alone is not effective for changing to a desired organization culture, and conversely, if any one of them is left out, the effort is also not effective. For instance, just

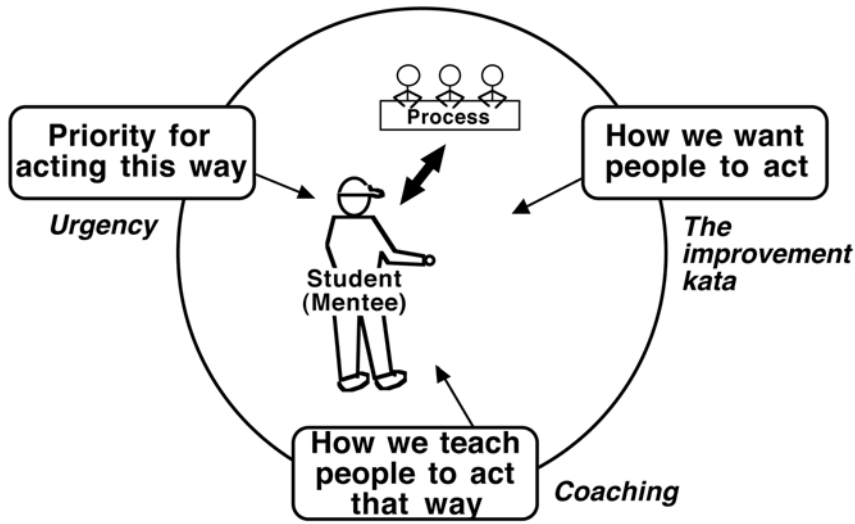


Figure 9-5. Three factors that we can influence

establishing urgency for change typically generates a wide range of behavior reactions. The result is often no real change at all or something quite different from the improvement kata. We should not expect that simply pushing people will generate improvement-kata behavior.

Likewise, coaching alone achieves very little. Coaching in what?

Finally, just defining and explaining the improvement kata, even if we were to combine that with a sense of urgency, will also not change people's behavior. It would be like saying to an athletic team, "You should play this way in order to win," and then leaving the team alone.

Use the Improvement Kata to Develop Improvement Kata Behavior

This is the most important advice in this chapter: to develop improvement kata behavior in your organization, you should utilize and follow the improvement kata *in this development process itself*. Simply put, the improvement kata is your means for experimenting.

This is not about "implementing" a new management system and culture. The way to any target condition, including culture change, is unclear, and practicing good PDCA will be a key factor in successfully achieving that condition. In other words, while working toward a target condition that includes a changed culture, it is just as important to frequently check the current condition and adjust accordingly. Developing new behavior patterns is a change process that occurs over time via PDCA.

Using the improvement kata in order to introduce improvement kata behavior is an example of applying it at a higher fractal level than at a production process. The improvement kata can be used at all levels, and anyone in the organization can be asked the five questions (Figure 9-6).

Let us take a closer look at how this can be done. As described in Part III, the improvement kata is applied to a *work process* by:

- Grasping the current condition
- Defining a measurable target condition

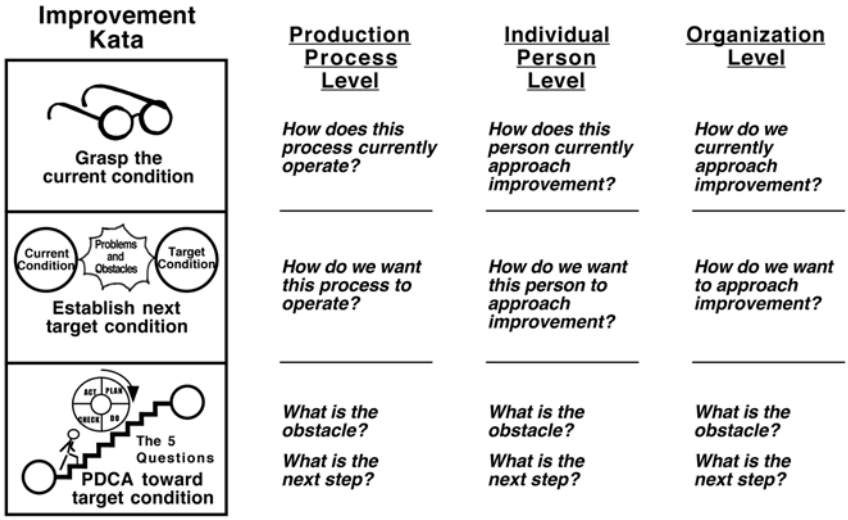


Figure 9-6. The improvement kata finds application at all levels

- Utilizing short PDCA cycles to move toward that target condition

The point to realize is that precisely the same kata can be applied to a *coaching process*. A target condition can be established for coaching, and you can PDCA toward that target condition.

A baseline assumption we should make here is that the improvement kata works. In other words, our experimenting is not done in order to test if the improvement kata is effective, but to learn what we need to do in order to develop effective improvement kata behavior. Ergo, if the improvement kata is not yet operating as desired, then it is the teaching/coaching of it that needs to be adjusted via PDCA. As shown in Figure 9-7, our coaching approach is perhaps the main knob we can adjust in order to develop desired behavior patterns. If you do not like the results at the work process, then scrutinize the coaching. In this regard, I encourage you to keep in mind: "If the learner hasn't learned, the teacher hasn't taught."

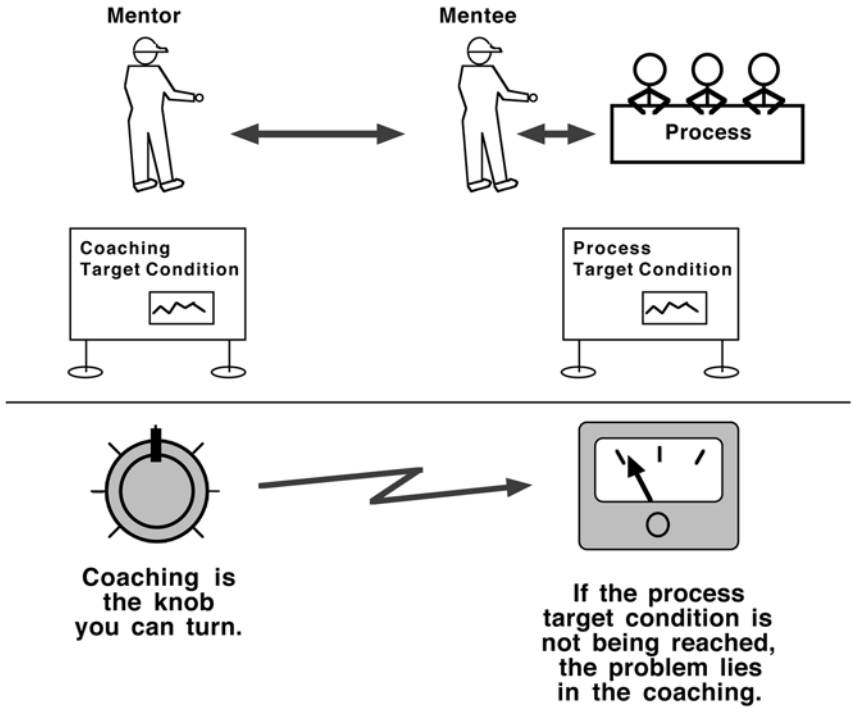


Figure 9-7. If the improvement kata is not working properly, the coaching needs adjusting

Tactics

The remainder of this chapter describes specific tactics I have been using, which may be generic enough to be applicable at other organizations. Since a discussion of tactics is essentially a discussion of solutions (countermeasures), I urge you to view them as thought starters, ideas and inputs to your own efforts to develop improvement kata behavior in your organization. It would not be appropriate or effective for me to propose countermeasures without understanding your specific current and target conditions, nor for you to jump directly into applying someone else's countermeasures. Again, the best advice here is to utilize and follow the improvement kata routine as you try to develop the improvement kata routine in your organization. Then you can adapt to what you are learning in your situation and find your own appropriate path to the desired condition.

Learning to Do Before Learning to Coach

Coaches should be in a position to evaluate what their students are doing and give good advice; to bring their students into the corridor of thinking and acting prescribed by the improvement kata. In other words, coaches should be experienced. It is only after they have practiced improvement kata themselves that coaches will be able to see deeply enough to provide that useful advice.

If a coach or leader does not know from personal experience how to grasp the current condition at a production process, establish an appropriately challenging target condition, and then work step by step toward that target condition, then she is simply not in a position to lead and teach others. All she will be able to say in response to a student's proposal is, "Okay" or "Good job!" which is not coaching or teaching.

The catch-22 is that at the outset there are not enough people in the organization who have enough experience with the improvement kata to function as coaches. This is not unlike Toyota's problem as it grows rapidly. It will be imperative to develop at least a few coaches as early as possible. (See "Establishing an Advance Group" later in the chapter.)

Who Practices First?

At Toyota, the improvement kata is for everyone in the organization and everyone practices it. No one group is singled out. However, Toyota is not trying to change its kata; it is continuing with the same basic approach it has been following since the 1950s.

On the other hand, if an organization wishes to effect a change in culture rather than continuing on the same path, it requires leadership from one group in particular: the senior level. In such a change situation, the senior managers should practice the improvement kata ahead of others in the organization.

Managers and leaders at the middle and lower levels of the organization are the people who will ultimately coach the change to the improvement kata, yet they will generally and understandably not set out in such a new direction on their own. They will wait to see, based on the actions (not the words) of senior management, what truly is the priority and what really is going to happen.

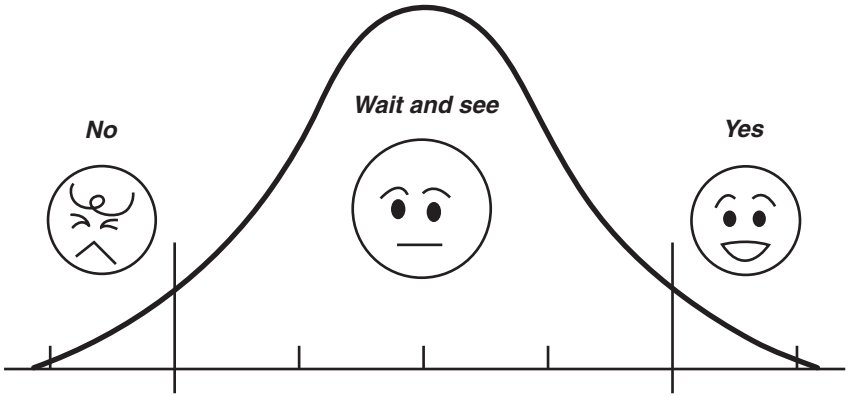


Figure 9-8. Distribution of reaction to change

George Koenigsaecker, an early lean thinker in the United States, has depicted this effect using the normal distribution curve in Figure 9-8.

What Mr. Koenigsaecker's diagram suggests is that only a small percentage of people in the organization (the right tail of the curve) will welcome a change effort and actively participate. Another small group (the left tail) will fight it actively. And the great majority—although they may nod and indicate their support—will be on the fence and waiting to see what is going to happen. Although many have criticized mid-level management for avoiding change, if you think about it, the wait-and-see attitude is an understandable reaction to uncertainty by managers who are on a career ladder in an organization. Also, do you want your managers to easily jump from one way of managing to another?

The point is:

(a) The way the majority of managers and leaders behave—the people in the middle of the normal curve—will determine how people in the organization act, and thus determine the organization's culture.

(b) If the senior managers do not go first in personally practicing and learning the improvement kata, then it is unlikely that they will be able to effectively enlist, mobilize, and guide those managers and leaders toward the desired behavior pattern. The kind of cultural shift we are talking about cannot be delegated by the senior leaders.

Establishing an Advance Group

Before starting to teach senior managers the improvement kata, we have tended to first establish a small advance group. The initial purpose if this group is to develop familiarity with the subject and how it works. It is this advance group that actually goes first with practicing the improvement kata.

I include a senior executive—*the* senior executive in the case of small and mid-sized companies—as a member of this group. The advance group is not a staff group or lean manufacturing department that will be responsible for all mentoring and training, or for making improvement happen at the process level. That will be the responsibility of the local managers and leaders at each level and in each area in the organization. Do not create a lean department or group and relegate the responsibility for developing improvement-kata behavior to it. Such a parallel staff group will be powerless to effect change, and this approach has been proven ineffective in abundance. Use of this tactic often indicates delegation of responsibility and lack of commitment at the senior level.

The advance group is responsible for monitoring, fine-tuning, and further developing (via PDCA) the organization's teaching approach. The advance group is the organization's "keepers of the kata," so to speak. However, this group will to some degree also assist with coaching at all levels of the organization so that it can maintain a grasp of the true current situation in the organization.

To be a workable size, the initial advance group should consist of no more than about five people. This group needs a mentor—for example, an external consultant. If you utilize an outside coach, it is important that you hire this coach specifically to help you get started and develop your internal coaching capability. Do not hire an external person to do the coaching work for you, because then you will not build this important capability in your organization. An external coach's job is to accelerate and help guide the development of your capability.

A good first step for the advance group is to simply try applying the improvement kata to a few assembly processes, all the while reflecting: "What are we learning about the improvement kata, our processes, our people, and our organization?" This allows the group to develop a better understanding of what the improvement kata

entails and to simultaneously gain a firsthand grasp of the current condition at the process level in the organization. A good place to begin practicing the improvement kata is at a "pacemaker process." Appendices 1 and 2 explain what that is and provide detail for assessing the current condition of a production process, which is the beginning of the improvement kata and prerequisite for establishing a target condition.

Something this group can do immediately, for instance, is to assess the stability of a production process, as described in Chapter 5. This involves timing and graphing 20 to 40 successive cycles at several points in the process and then asking, "What is preventing this process and the operators from being able to work with a stable cycle?"

These initial efforts to try out the improvement kata can easily occupy the advance group for two to six months. That may sound like a long time, but consider that we are talking about how we want the organization to operate; its culture. The advance group should not go into this task with only a shallow understanding of what is involved and where the organization is.

These initial shop-floor activities of the advance group are also a good opportunity to get started in training your first few internal coaches. We have tended to attach two or three potential coaches to the advance group, in addition to the four to five advance group members. These coaches in training do not participate in all advance group activities, such as planning activities. They participate in the shop-floor efforts to apply and learn about the improvement kata.

Training Through Frequent Coaching Cycles and the Five Questions

To develop new habits, the field of psychology tells us it is preferable to practice behaviors for a short time frequently—such as every day—rather than in longer sessions but less frequently. Ideally, of course,

every encounter and interaction in the organization would radiate the kata, as in the mentor/mentee case example in Chapter 8.

To get people to frequently practice and think about the routine of the improvement kata, I currently use a concept I call a "coaching cycle." These cycles come into play after a process target condition has been established, and utilize the five questions. The five questions are a regimen to train improvement-kata behavior. They simplify a part of the improvement-kata routine and thus make it easier to apply, understand, and transfer. One coaching cycle essentially entails the mentor going through the five questions once while standing at the process with the mentee (Figure 9-9). In most cases, we have been striving to

The Five Questions Make Up One Coaching Cycle

1. **What is the target condition?** ***(The challenge)***
   - What do we expect to be happening?
2. **What is the actual condition now?**
   - Is the description of the current condition measurable?
   - What did we learn from the last step?
   - Go and see for yourself. Do not rely on reports.
3. **What problems or obstacles are now preventing you from reaching the target condition? Which one are you addressing now?**
   - Observe the process or situation carefully.
   - Focus on one problem or obstacle at a time.
   - Avoid Pareto paralysis: Do not worry too much about finding the biggest problem right away. If you are moving ahead in fast cycles, you will find it soon.
4. **What is your next step?** ***(Start of next PDCA cycle)***
   - Take only one step at a time, but do so in rapid cycles.
   - The next step does not have to be the most beneficial, biggest, or most important. Most important is that you take a step.
   - Many next steps are further analysis, not countermeasures.
   - If next step is more analysis, what do we expect to learn?
   - If next step is a countermeasure, what do we expect to happen?
5. **When can we go and see what we have learned from taking that step?**
   - As soon as possible. Today is not too soon. How about we go and take that step now? (Strive for rapid cycles!)

Figure 9-9. Contents of a coaching cycle

do this at each focus process at least once per shift. The purpose of a coaching cycle is:

- To allow the coach to quickly grasp the current condition in both the process being improved and the mentee so that the coach can judge what is an appropriate next step
- To provide a routine for conditioning training
- To recognize the mentee's efforts

With practice and experience, one coaching cycle should not take very long. Novice coaches sometimes mistakenly let the cycle get into lengthy discussions that cover many different factors and can run into hours. I have been shooting for 15 minutes per coaching cycle in many cases. As soon as a *single* next step—not a list of steps—is clear to both mentor and mentee, then the coaching cycle is over. As in the mentor/mentee case example, the next step can and often should be very small. That is perfectly acceptable, as long as the cycles are rapid.

A coaching cycle is not all there is to coaching, of course. Get through the five questions one time relatively quickly and take stock: "What is the situation now? Where are we in the improvement kata, in the process being improved, and in the development of this person's capabilities? What is needed next?" After a coaching cycle, the mentor can then, for example, decide whether he should stay on with the mentee during the next step—to observe and provide guidance as Tina did in the mentor/mentee case example in Chapter 8—or return later for a check by means of another coaching cycle. The next coaching cycle should follow as soon as possible, often within hours or even minutes on the same day. If the next step can be taken right away, then by all means do that.

A few lessons learned about coaching cycles:

- It is a good idea to limit a student's first few target conditions to a time horizon of only one week. This way, the student can get more experience with the entire improvement kata, experience some success, and begin to develop a rhythm. After some practice you can begin to lengthen the target condition horizon a bit to, say, one to four weeks out.

- Do not wait until the end of a shift to conduct coaching cycles. Think of a check as a beginning, not an end, and do it early in the workday if possible. You can specify the time of day as part of a coaching target condition. If we're always putting off coaching cycles until the end of the workday, it suggests the lack of a specific coaching target condition and a low level of priority.
- Whenever you approach any process, go through the five questions. In this manner you will not only be teaching others the way of thinking, but you'll be teaching yourself as well.
- The fifth question—"When can we go and see what we have learned from taking that step?"—has been a sticking point. New coaches often ask this question thinking that the next step must be a countermeasure or solution. Likewise, the mentee often thinks this is what the coach wants. In many (or even most) cases, however, the next step is just to get a deeper grasp of the situation, as was illustrated in the case example in Chapter 8.
- Another lesson is to coach only one target condition at a time, which generally means one mentee at a time. If you try to coach several mentees at once, the dialogue tends to become too general and mentees may become less open about discussing problems. Every mentee is potentially in a unique situation and usually has unique development needs.

Sense of Achievement

Developing a new mindset also involves periodically deriving a feeling of success from practicing the behavior patterns. While we may think that success only comes at the end of something, there are important opportunities for positive reinforcement at all stages of the improvement kata, as shown in Figure 9-10. These opportunities should be utilized, since the objective is not just solutions, but building the capability to follow the improvement kata routine, to understand situations and develop appropriate solutions.

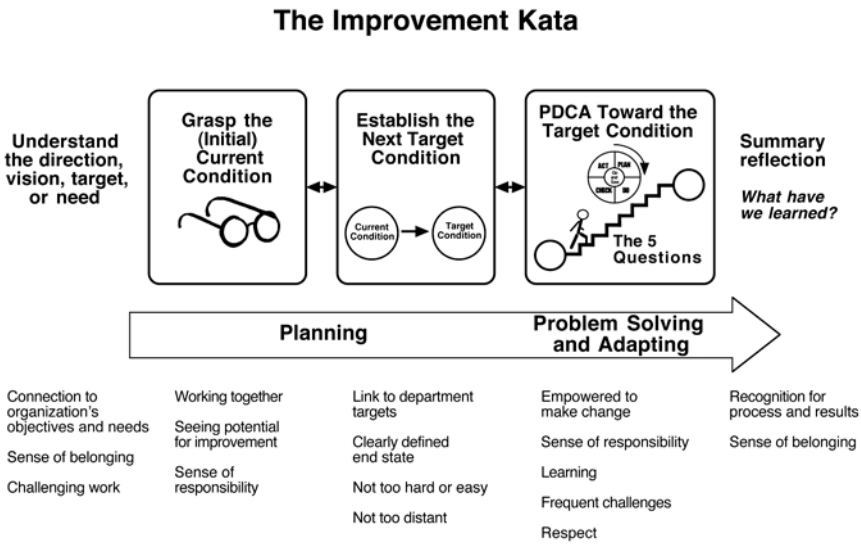


Figure 9-10. Example opportunities for successes throughout the improvement kata routine

Making a Plan

Once the advance group has spent a few months learning by applying the improvement kata at some processes, there will be a need for a plan to begin wider development of improvement kata behavior. The time horizon for such a first plan should not exceed 12 months, since at this stage you are on a steep learning curve and your grasp of conditions is likely to change appreciably. Because of our limited experience, our flashlight does not shine very far ahead.

Creating such a plan is the same as any A3 planning process as discussed at the end of Chapter 8:

- The advance group needs a mentor to whom it will present its planning efforts iteratively in coaching cycles. In developing this plan, the group focuses on one section heading at a time, since one section sets the framework for the next. Until the plan is signed, however, it is acceptable to go back and make adjustments to prior sections.

- Much of the benefit of the plan lies in the iterative planning process, because it forces you to get facts and data and repeatedly think through—deeper and deeper each cycle—what you are doing. The objective is not just to have a plan, but to go through the step-by-step effort to create the plan.
- It takes time to develop this kind of plan, easily two months. Continue practicing the improvement kata and testing ideas while the plan is being developed, since this helps you stay close to the real situation.

The following key points for this planning process are presented under their respective A3 headings.

1. Theme

The theme is to develop the behavior of managers and leaders toward a pattern that follows the improvement kata. However, be sure to keep the theme and activities linked to continuous improvement of production processes, since cost reduction via process improvement is the overall objective. We are not introducing the improvement kata for the sake of introducing the improvement kata. We should be improving processes and practicing (learning) the routine of the improvement kata simultaneously.

As described in Chapter 3, Toyota's improvement kata functions within an overall sense of direction, which is provided by a long-term vision. Without this you will find people going off in several directions when they hit obstacles. Thus, one of the first questions to ask yourself is, "Do we have consensus on a vision, that is, a long-term direction?"

I have witnessed several groups that went into long intellectual discussions about establishing a vision, and they typically ended up producing useless statements that protect several people's sacred cows. Developing a succinct, useful, but not overly confining long-term vision is difficult. It takes a considerable amount of time and reflection, and is not necessarily a democratic process. Also, if we are just beginners with understanding the potential of the improvement kata, then perhaps this is not yet the right time to be arguing about what might be an appropriate vision.

But you do need a vision, and if you are a manufacturer I see no reason why you should not simply adopt the same long-term vision for your production operations that Toyota strives for: "One piece flow at lowest possible cost." As we have seen in Chapter 3, this vision does not come from Toyota or Japan, and has been pursued for a few hundred years. Why not adopt this widely recognized production vision and get going?

2. Current Condition

The advance group has been gaining firsthand understanding of the current situation by trying to apply the improvement kata at the process level in the organization. Summarize what is being learned in bullet points. This summary should at least describe a) the current behavior of managers and leaders, and b) how process improvement is currently handled. You can also include any additional factors you would like. Some aspect(s) of this description of the current condition should be measurable so that you can gauge if you are making progress. (More on metrics later in this plan.)

Based on what the advance group has learned by immersing itself in the current condition, it can then establish a target condition.

3. Target Condition

What you are defining here is a condition you want to have in place at a future point in time (such as 6 or 12 months from now). Defining this takes some time and iterations, because it should be based on facts and data, and be specific and measurable.

There are two aspects to the target condition in this section of the plan:

1. Relative to process improvement activity. For example:
   - Total number of processes being managed and improved via the improvement kata
   - Measurable process improvement, such as process stability
2. Relative to leader/coaching behavior. For example:
   - What persons will have reached what capability level (Figure 9-11)

- What persons will be carrying out the improvement kata and the coaching kata, at what frequency, and at how many processes

How you intend to get to this target condition will be the subject of the next section of the plan.

Keep in mind as you define the total number of processes that, because the improvement kata is an approach for daily management, once you begin with the improvement kata at a process there is no end there. This means that, unlike improvement projects or workshops that have an end date, the number of processes being improved through the improvement kata accumulates and grows as you spread the approach to other processes. Do not overextend yourself at the start. In the beginning it is better to have picked too few focus processes, rather than too many.

In establishing this target condition, something we do is describe levels of capability that we would like individuals to reach. We have often used the three levels depicted below.

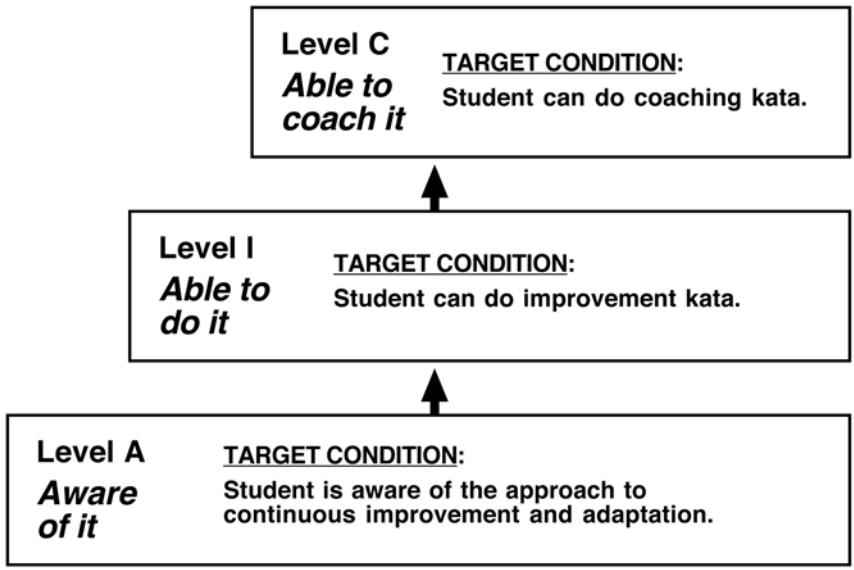


Figure 9-11. Example capability levels

Starting from the bottom of the diagram, Level A (awareness) means that the individual has a basic understanding of what the improvement kata is and how it works. Level I (improvement kata) means that the individual can effectively carry out the improvement kata. Level C (coaching kata) means that the individual can effectively carry out both the improvement kata and a coaching kata.

4. Moving from Current Condition to Target Condition

Once the advance group has defined the target condition, it should involve persons from the next level in the organization, its mentees, in planning how to move from the current condition to the target condition. The advance group should not finalize this part of the plan on its own. It is acceptable for mentors to set a target and sometimes even a target condition, but the mentees should become involved in planning how to achieve that condition. Otherwise it is akin to telling people what to do in traditional fashion.

The overall idea in this part of the plan is for people to learn the improvement kata by repeatedly practicing its routine on real processes under the guidance of a coach. In terms of tactics, this part of the plan should specify the coaching cycles in detail: who will practice when, where, and how? You might lay this out, for example, in monthly increments.

In planning how to move from the current condition to the target condition, we often linked the three levels of capability in Figure 9-11 with levels of training activity as depicted in Figure 9-12.

Starting again at the bottom of the diagram, the training activity at Level A is a classroom course with shop-floor exercises. The purpose of this course is only to create a sense of awareness about what the improvement kata is. The next training level is to practice the improvement kata, which in the diagram is called training Level I. After a person has demonstrated sufficient capability to effectively carry out the improvement kata—this is a gate—they can move to the next level of training, C, where they practice the coaching kata. Moving from Level I to Level C is not a function of time or number of practices completed, but of demonstrated capability.

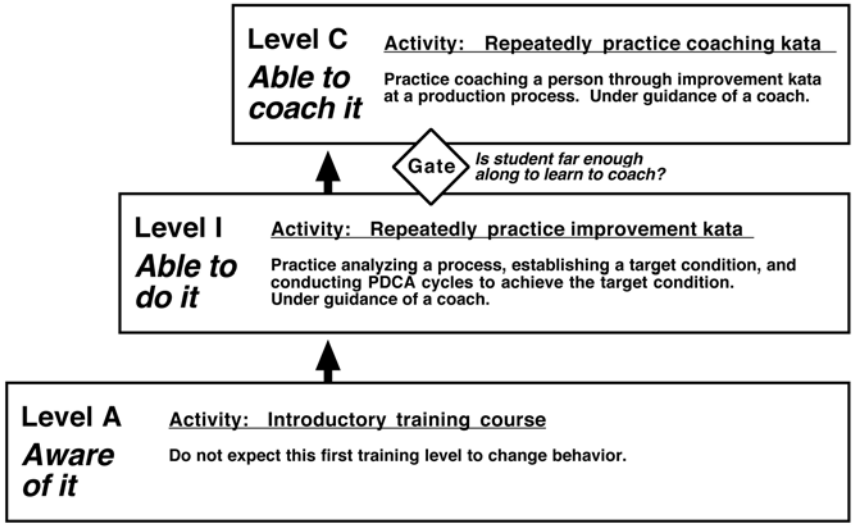


Figure 9-12. Example training levels

Within the "I" and "C" capability levels individuals will at any point in time, of course, have different skill levels. An interesting view of skill levels is provided by the "Dreyfus model of skill acquisition."[2]

The three levels of training activity, or whatever levels you may define, can then provide a framework for specifying who will practice what, when, and how. The table in Figure 9-13 is an example.

As you can see by the horizontal arrows in the table, as people move up in their level of experience, capability, and perspective, some of them teach and coach people in the next level. By coaching the next group, the higher level group can maintain a better sense of the actual situation, that is, people's true current capabilities. (See benefits of the mentor/mentee approach in Chapter 8.)

This generic table is intended to help you envision how you might move practice-based training through your organization. Real life will not be this neat and orderly, of course. What is depicted in this table will, in most organizations, also involve much more than one year. But with this sort of overall tactic in mind, you can develop your own first plan to match your situation.

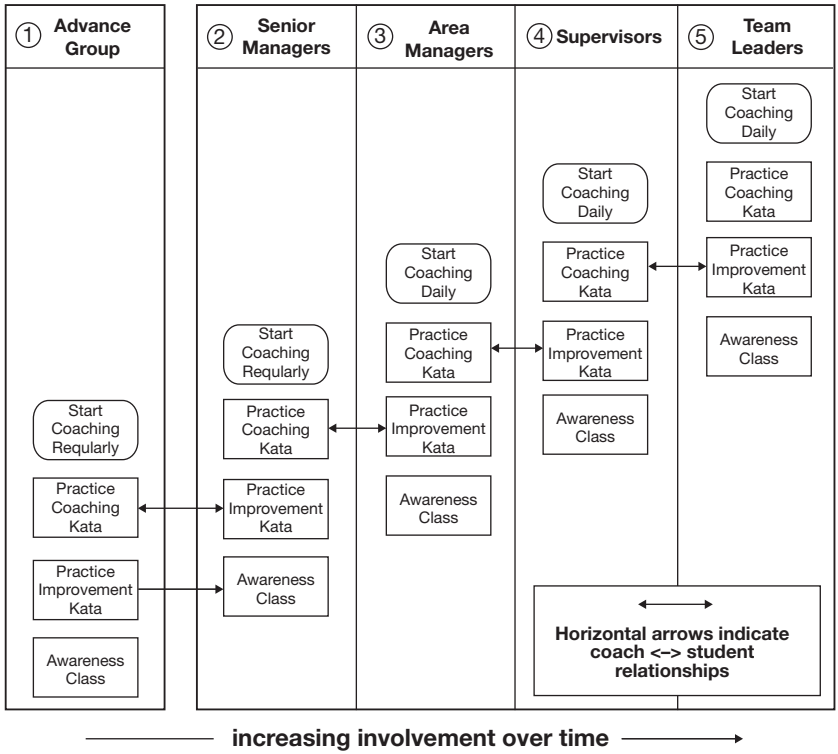


Figure 9-13. How training might be moved through an organization

5. Metrics

It is important that we can measure our progress and, in particular, lack of progress. We learn the most from our mistakes! Currently we use two categories of metrics.

1. One set of metrics has to do with coaching. These might be the start and stop times of coaching cycles, how many processes are coached, who does the coaching, how often the coaching cycles take place, and whether the next step (question five) was taken.

   However, it is entirely possible to fulfill a specified number of coaching cycles and have little to no improvement effect on the production process. Always bear in mind that the overarching objective is continual improvement of cost and quality performance at the process level.

2. Therefore you should monitor the relationship between coaching cycles (above) and a second set of metrics: to what degree the focus processes are being improved. Such improvement metrics are taken directly from the target conditions at the respective focus production processes.

   As mentioned earlier, if the coaching cycles (metric set 1) are being fulfilled as planned but the improvement in the focus processes (metric set 2) are not being reached, then you need to take a closer look at how the coaching is being done.

Also think about and define how these numbers will be obtained. Ideally this is done as simply as possible: with pencil and paper at the process. A good rule of thumb is that, if possible, you should go to the process to get the information you need. Ideally the mentee does not bring metrics to the mentor's office. It is more like a pull system, if you will, whereby mentor and mentee go to the process to obtain the necessary facts and data there.

Related to metrics, as part of their lean implementation efforts, many organizations have tried utilizing systems of point awards, or similar, to drive and assess progress. Be careful with such systems, since people often end up chasing points rather than a desired target condition. I tend to avoid such schemes.

Problems arise when awards are linked to completion or implementation of activities, which is easy to measure, rather than to attainment of a level of personal competency or of target conditions, which, admittedly, is more difficult to measure. Levels should be awarded based on the student's demonstrated capability or achievement of target conditions, not on how many courses or practices have been completed or tools implemented.

Include Reflection Times in the Plan

Keep in mind that when you execute a plan and work toward a target condition, you will need to make adjustments based on what you are learning from the unforeseen obstacles and problems you discover along the way. This is one of the reasons we prepare a plan: so we can see what is not going as expected. The advance group should reflect

regularly and make adjustments as necessary. Build this into your plan by scheduling advance-group reflection times, for example, every two weeks.

By conducting reflections—that is, PDCA checks as you work to develop improvement-kata behavior across the organization—you will learn what you need to work on to achieve that behavior. You can conduct reflections in an uncomplicated fashion. Go through the five questions and record on a flip chart what is going as planned (+) and what is not working or not going as expected (−). The inputs for the reflection can come out of the more frequent coaching cycles, which are a kind of process metric.

However, one lesson I have learned is to begin any reflection session with (1) a restatement of the overall theme (for example, "To develop improvement kata behavior in the organization"), and (2) a reiteration of "why we experiment," in order to calibrate everyone's thinking before conducting the reflection. In a reflection, people may feel pressure and start defending why they were not able to complete a step as planned. This, of course, inhibits PDCA. It is useful to remind everyone that you are experimenting in order to see obstacles and to learn from them what you need to work on in order to achieve the target condition. You are not looking at individuals and evaluating them, and our success depends upon the reflection being a depersonalized, open, and data-based dialogue.

One more point to reiterate for conducting reflections. We know that the improvement kata is scientific and that it works. If process improvement results are not as expected, then it is not the improvement kata that is faulty but something in our coaching that is still incorrect. Practicing the improvement kata over and over should produce results. If they do not come, then something is wrong in our teaching.

Common Obstacles

In our experimentation there have been many obstacles, many ah-has, and many course corrections. Here are some common obstacles, just as an example. You will find more.

- It is hard for people to resist making a list of action items.
- The five key questions are often difficult for senior leaders to internalize.
- We like doing but not checking and adjusting.
- We jump into solutions and skip over careful observation and analysis.
- People do not understand Toyota-style coaching. Both mentor and mentee mistakenly believe that the mentee needs to figure out what solution the mentor has in mind.
- The unclear path to a target condition is uncomfortable for many people. People like a clear plan in advance even though that is actually only a prediction.
- Iteration (redoing steps) is uncomfortable. People feel like they did something wrong when they are asked to look again or repeat a step, yet this is very important for learning and seeing deeply.
- Many people will view this effort as just another project, rather than as developing a new way of managing. At the start, it naturally seems like this effort means adding more work on top of daily management duties, as opposed to it being a different way of conducting daily management.
- At the start, coaching cycles often take too much time and thus become burdensome. Once a target condition has been established, a coaching cycle can often be completed in 15 minutes. Less is more. As discussed earlier, rather than making a list of steps, just take one next step and then see where that takes you. Conduct your coaching cycles standing up at the process (target condition information and process data will need to be at the process), and do not let them turn into endless talk sessions. Go through the five questions, find the next step, and that is then the end of the coaching cycle. Take the next step as soon as possible.

Lifelong Practicing

In this chapter we have been talking about developing capabilities and behavior patterns, which, in Toyota's view, represent the strength of an organization.

The ongoing challenge of kata training is to strive for mastery and perfection, and even the most accomplished Toyota engineers, leaders, managers, and executives will say they are still working toward that goal. The sports metaphor is again appropriate here. Just like athletes, even advanced students and senior leaders will need to keep practicing the katas they learned as beginners, under guidance of a coach. The never-ending need for improvement and evolution of our processes and products gives us the opportunity to keep honing our skills while working on actual issues and toward real target conditions. While doing so, we should listen to our coaches and others who may detect a bad habit.

The elegant trick in this is that while you are practicing, you are also doing something real, always to the best of the current level of your abilities. This is an interesting way to manage continuous improvement and adaptation, and a fascinating way to manage an organization.

Notes

1. I am indebted to Mr. Ralph Richter for his input on this diagram.
2. This model, by Stuart Dreyfus and Hubert Dreyfus, proposes five stages of skill acquisition: Novice, Competence, Proficiency, Expertise, and Mastery.

Conclusion

We admire Toyota's ability to thrive in different environments and in changing, challenging conditions. Yet it is not necessarily a problem that organizations sometimes come and sometimes go. The economist Joseph Schumpeter saw this as a process of *creative destruction*, and suggested that it accounts for a lot of the vitality in the most vibrant and dynamic economies on Earth.

In the late 1980s when I was starting to research how manufacturing companies can retain or regain competitiveness, a Buddhist colleague surprised me with an observation. He pointed out that by conducting that research and trying to assist manufacturers, it is possible that I was interfering with natural selection, artificially prolonging untenable situations and, thus, in the long run, perhaps even causing more rather than less suffering.

Yet despite Mr. Schumpeter and my Buddhist colleague, I do find myself caring if an organization survives or not, and if your organization survives. This is not because I fear change or have a special affinity for the organization. It is because the unplanned decline or collapse of an organization suggests to me that we as humans were somehow unable to sense in a timely fashion what was happening, react appropriately, and adapt elegantly. I do not lament the loss of the organization so much as I regret the failure to use our human capability—our capability to keep adapting—to its fullest extent. In fact, if we more fully use our capabilities to adapt, then there will be plenty of change as

organizations keep intentionally modifying and evolving themselves, their products, and their services, to suit dynamic conditions.

With success, business organizations may shift too much of their focus away from serving customers and society, to simply making money, trying to preserve a status quo or maximizing short-term shareholder value. Consequently, it can become more likely that progress—through improvement and evolution of processes, product, or service—will occur outside these organizations. In contrast, Toyota's improvement kata helps keep an organization's attention on what it needs to do to continue improving and evolving how it provides value for customers and society.

Financial targets and results are vital, of course, but for long-term organization survival the question "How do we achieve those financial results?" should often be preceded by the question "What do we need to do with our processes, product, or service in order to meet customer needs?"

In the space between these two questions lies much resourcefulness and creativity, which are available to any organization that has a kata that taps and channels those abilities.

If we know and can master how to proceed through unclear territory, then we need not fear many of the challenges, changes, and unknowns we encounter in any of our endeavors. Rather than trying to hold on to what may be a false sense of certainty, which can lead to trouble because we then act with a mistaken sense of reality, we can learn a means for dealing with uncertainty. This is why I continued to study Toyota and why, as the research progressed and the findings became clearer, I decided to write this book. I hope that Toyota will stay with us long enough so that many of us—in business, education, politics, and daily living—can learn from this unique company about how we might better utilize our human capabilities. Thriving in the long term, the fundamental purpose of the Toyota organization, is to me a sign of good concerted use—good management—of our human ability and potential.

Six years ago I began the research that led to this book thinking, like just about everyone else, that the story was about techniques and other *listable* aspects of Toyota. Today I see Toyota in a notably different

light: as an organization defined primarily by the unique behavior routines it continually teaches to all its members. Due to the linear nature of the book format, some of my descriptions of the improvement kata are necessarily too mechanical, as compared with how this kata is utilized in every day's work at Toyota. Fortunately, the improvement kata, even as presented here, will readily accommodate reality.

Toyota's improvement kata and coaching kata are largely invisible when we benchmark Toyota. Yet these two kata play perhaps the major role in Toyota's ability to achieve ambitious targets, keep improving, and adapt. I have worked with these kata extensively now and I am intrigued by their capacity to help us move through the unpredictable paths ahead and achieve beyond what we can see (Figure C-1). When you look behind the curtain at how Toyota manages itself, you realize that Toyota has achieved not only a commercial but also an intellectual accomplishment.

The response by business leaders when they learn about Toyota's improvement and coaching kata has been overwhelmingly, and even surprisingly, positive. As if it were something we have been waiting for. When skepticism is expressed, it tends to revolve around two thoughts: that the step-by-step improvement kata and coaching kata seem to proceed slowly, or that it will take a long time to develop such behavior patterns.

In regard to the first comment, Toyota's approach may indeed appear slow, but in fact the continuous improvement and adaptation it generates is in sum both faster and more effective than our current approach of periodic attempts at improvement and adaptation. It is perhaps a classic example of the race between the tortoise and the hare.

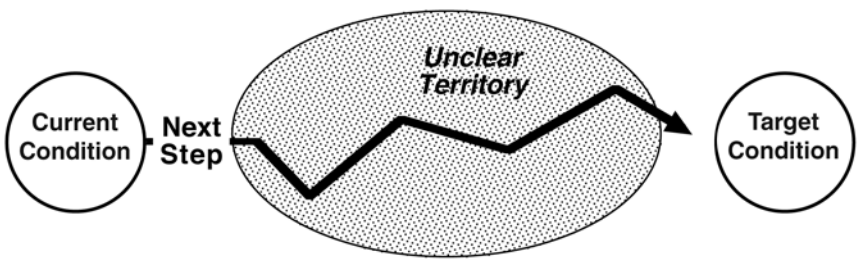


Figure C-1. Beyond what we can see

In regard to the second comment, I would agree that developing new behavior patterns across an organization involves a more far reaching effort, and probably more time, than a supposedly quick-fix solution. But a quick fix does not alter the underlying management system, and—the conclusion is becoming unavoidable—some aspects of our prevailing management system need to be changed.

Permanent pressure to adapt can keep an organization fit and healthy, if it has a systematic way—a kata—of responding to that pressure. This book does not describe everything about Toyota, but it provides more than enough information and detail for you to begin developing—through experimentation and practice—your own continuous improvement system like Toyota's. You can even see your organization as part of human history through your efforts to bring continuous improvement and adaptation into it. This is because each step in that direction not only benefits your company, it also helps move our society forward because it mobilizes our capability.

Does the way ahead for developing improvement kata behavior in your organization seem unclear? Are you unsure about what you will need to do to achieve successful culture change? Well, that is exactly how it should be, and if so, I can assure you that you are already on the right track. We cannot know what the path ahead will be, but the improvement kata shows us a way to deal with and perhaps even enjoy that unpredictable aspect of life. That latter sentiment is my wish for all of us, and, with that in mind, I will end with a question:

What is your improvement kata?

Appendix 1

Where Do You Start with the Improvement Kata?

Ideally, every production process would have a target condition. Leaders would be able to check and mentor improvement activity by going from process to process daily, observing, and asking the five questions at each stop. Certainly no process in a production facility should operate without a defined standard that it is striving to achieve. However, it would be overwhelming and infeasible to begin by applying the improvement kata at many processes simultaneously.

One common answer to the question of where to start is at the loop in the value stream with the greatest potential for improvement. In the simplified value stream map in Figure A1-1, clearly the stamping loop, with its eight days of lead time, has greater improvement

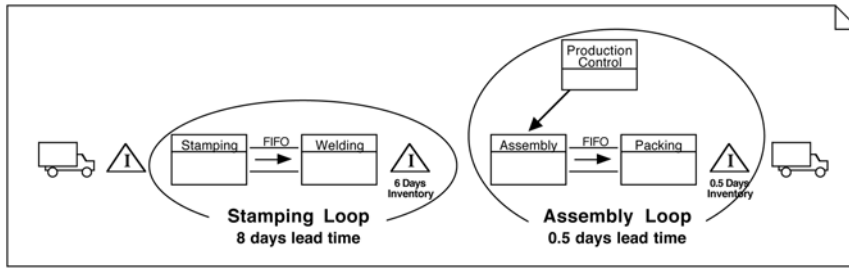


Figure A1-1. A value stream with two loops

potential than the assembly loop, which generates only a half day of lead time. Many of us would logically begin in the stamping loop.

As part of the research leading to this book, I studied how Toyota works with its suppliers. One thing I observed is that after Toyota supplier support personnel walk a value stream for some time—in order to gain a broad understanding of the overall situation—they usually began by focusing on the assembly loop of a value stream, even if it had far less inventory and lead time than the upstream loops. In the value stream depicted in Figure A1-1, Toyota would most likely begin in the assembly loop. Why?

In Toyota's way of thinking, the first place in the value stream to establish and drive toward a target condition is at the "pacemaker process," rather than at upstream "fabrication" processes. The pacemaker process, or loop, in a value stream is the set of downstream steps that are dedicated to a family of products, and where that family of products is finished for the external customer. The external-customer takt time applies to this process. Often this is an assembly process and its associated scheduling process (Figure A1-2).

Note that a pacemaker process means something different than a bottleneck process, although they could by coincidence be the same process.

Toyota tends to begin at the pacemaker loop because it occupies a critical position in a value stream and is worthy of special attention. Fluctuation and instability in the pacemaker loop can quickly affect the just-downstream external customer, and simultaneously cause hard-to-follow, amplifying demand fluctuations for the upstream processes.

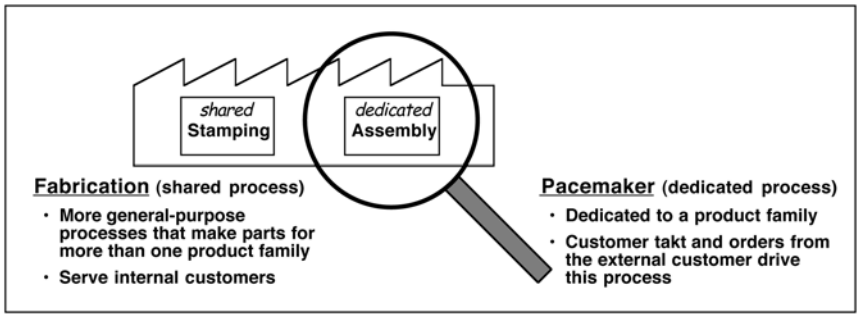


Figure A1-2. Pacemaker and fabrication processes

I first came across this effect when I visited a plant and was told that the biggest problem was the upstream machining area. The assembly process could often not fulfill its production schedules because it was frequently running out of machined parts. Yet when we got to the machining area, a few calculations revealed excess capacity there. The machining supervisor cleared things up when he said, "Yes, we have enough capacity here, but no one can expect us to keep up with assembly the way they constantly change their production schedule." At that point we went back to assembly—in the pacemaker loop—and started taking a closer look there.

Many problems in the upstream processes of a value stream actually have their origin in a poorly operated pacemaker loop. If the pacemaker is operating in a unstable or unleveled manner, it becomes difficult to discern where problems in the value stream are actually coming from. Problem solving and improvement are difficult. Toyota's improvement strategy here is to strive to develop a stable, leveled pacemaker process *first,* and then see what problems remain in the upstream processes and migrate there *as needed*.

Sometimes, of course, you cannot start at the pacemaker loop because there is a show stopper problem at an upstream process. What Toyota often does in this situation is to fix this upstream problem quickly, within a few weeks at most—even by temporarily increasing inventory there—and then get back to concentrating on the pacemaker.

A special focus on pacemaker processes, particularly at the start, may take some practice and extra effort to bring it into an organization. At one company I know, the vice president of manufacturing regularly visits the manufacturing facilities; a common practice for manufacturing VPs. Despite having been instructed on the pacemaker focus, plant managers would invariably want to walk the visiting VP through the factory to show "all the improvements we have made"; that is, to show scattered point improvements made at many places in the factory. To change this and get people more focused, it took the VP saying, "For the near future when I visit your plant, I will go to your pacemaker processes first, where I will be asking the five questions."

As you continue to focus on the pacemaker process and strive to achieve successively tighter target conditions there, the causes of obstacles

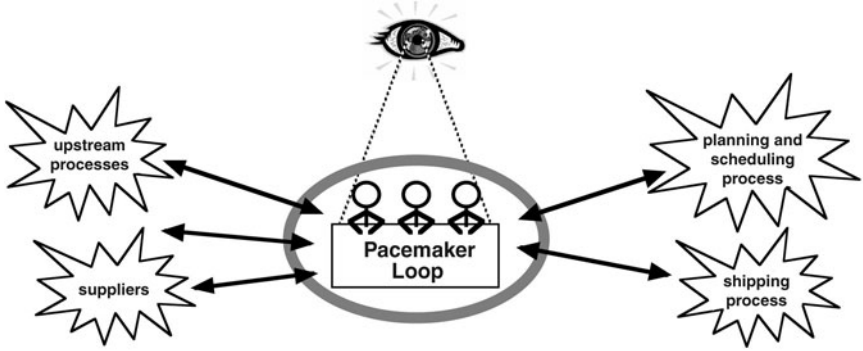


Figure A1-3. Migrating into the value stream and other areas as needed

will increasingly lie up- or downstream of the pacemaker or even elsewhere in the organization. When conditions in other processes and areas become the obstacles preventing you from achieving the next target condition at the pacemaker, you can migrate to them (Figure A1-3). This is an elegant way to expand into the value stream—following where the problems lead you—because then you are always working on what you need to work on, and individual improvement efforts tie together. Eventually you will be striving for target conditions at all processes, but in a connected and concerted way. And as you move into other processes, the value stream mapping tool will prove helpful for understanding and planning how you would like the flow to tie together next.

Appendix 2

Process Analysis

The purpose of this appendix is to show you a procedure for analyzing the current condition of a production process. This is done to help obtain the facts and data you need in order to define an appropriate process target condition.

I have used this process analysis on a wide variety of production processes; some more automated and some less automated. In some cases adjustments will be necessary in order to fit the analysis to the characteristics of a particular type of process, but the basic concept as presented here is usually about the same.

The purpose of the process analysis is *not* to uncover problems or potential improvements, but to grasp the current process condition (Figure A2-1) and obtain the facts and data you need for establishing an appropriate next process target condition. This is an important point. This is not a hunt for waste in the process. Going through the steps of this process analysis is intended to force you to look into and confront the details of a process, so you can define how the process should be operating. Once you have a target condition, then you can strive to move toward it, ask the five questions, and identify what you need to work on.

The process analysis and establishing a target condition take some time, but once a target condition has been established, the coaching cycles can be frequent and short. Try practicing the steps of this

process analysis, establishing a target condition and applying the rest of the improvement kata. Once you understand the thinking and pattern behind this process analysis, you may well decide to modify it to better suit your environment.

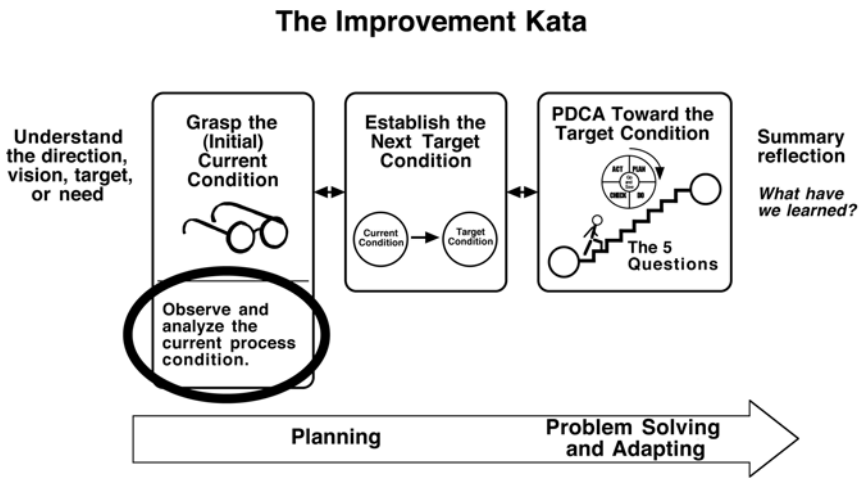


Figure A2-1. Process analysis helps you grasp the current condition

Start with the Value Stream

Improvement happens at the process level, but conducting at least a "value stream scan" is a prerequisite before conducting a process analysis and establishing a first target condition. Such a scan helps you understand the overall flow from dock to dock and to identify the segments or "loops" of a value stream.[1]

A value stream scan often does not take too much time, typically one day or less. Do not try to get all the details, just a basic overview of the value stream by asking the questions below. You can add detail to this value stream map later, as you begin to gain a deeper understanding of the pacemaker process.

Questions for a Value Stream Scan

1. Which value stream (product family) have you selected?

2. What are the processing steps? (Figure A2-2)

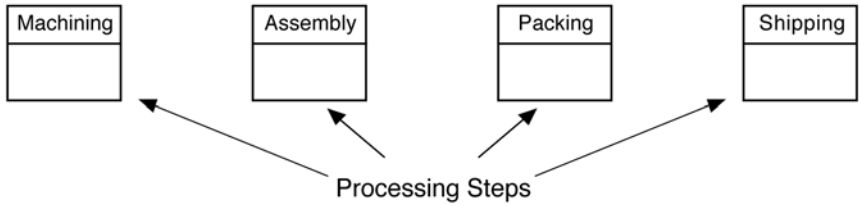


Figure A2-2.

3. Is the process dedicated (D) or shared (S)? (Figure A2-3)

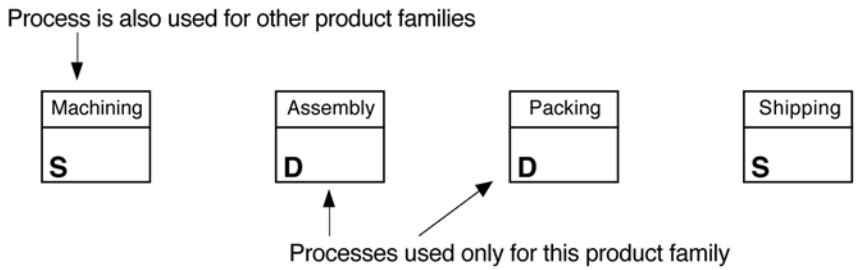


Figure A2-3.

4. At what points along the value stream is inventory kept? (Figure A2-4)

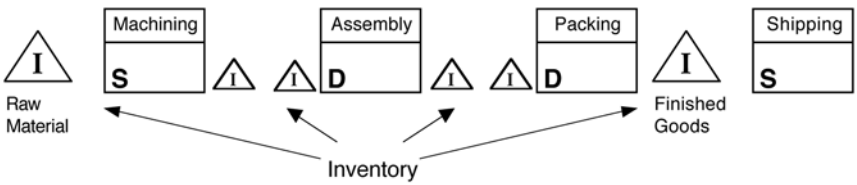


Figure A2-4.

5. How does each process know what to produce (information flow)? (Figure A2-5)

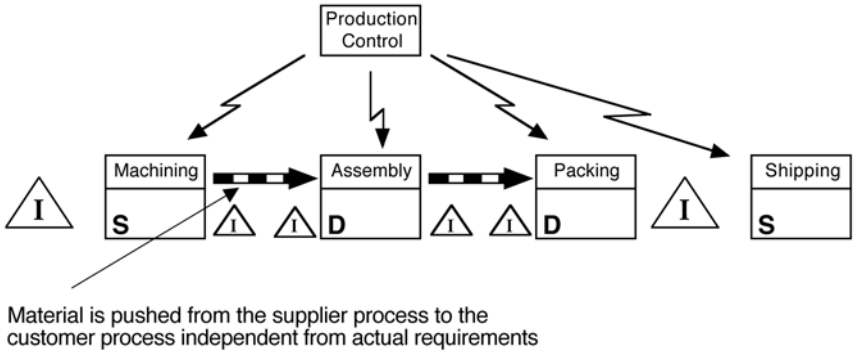


Figure A2-5.

6. At what processes are changeovers needed? (Figure A2-6)

What is the changeover time, current lot size, current number of changeovers per day, and the estimated EPEI at those processes? (Every-Product-Every-Interval: this is the interval of time over which a process produces every high-volume product it makes.)

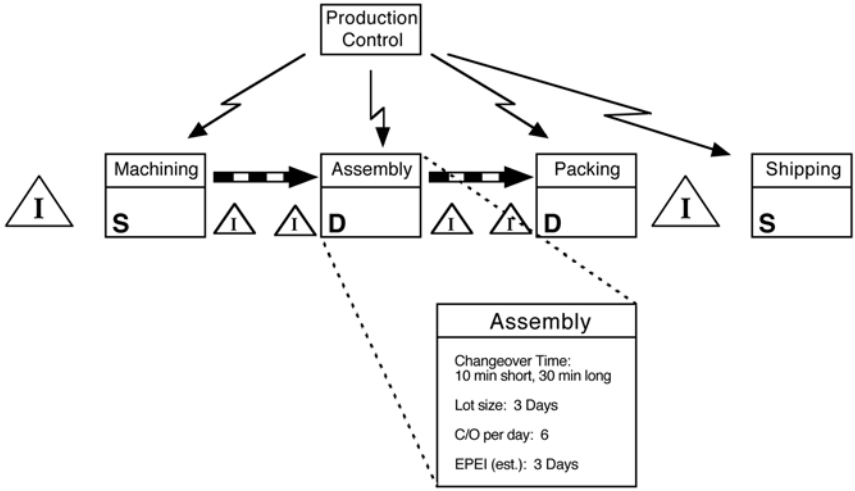


Figure A2-6.

7. What are the "loops" in this value stream? (Figure A2-7)

Which loop is the pacemaker loop? (See Appendix 1 for an explanation of the pacemaker process or loop.)

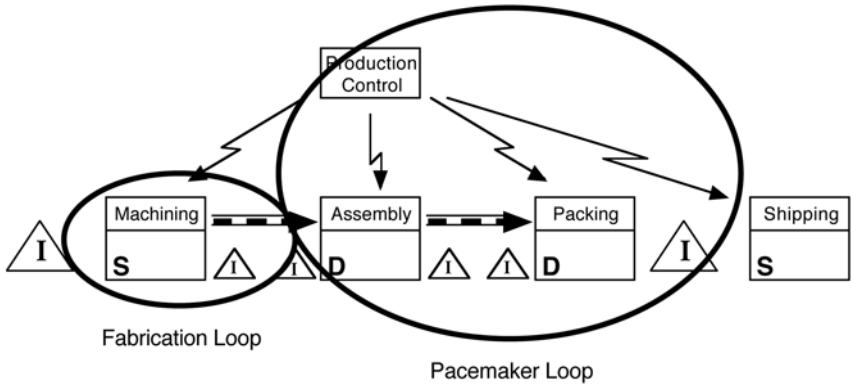


Figure A2-7.

8. With a one- to two-year time horizon in mind, where:

Do you think 1x1 flow should be possible?

Do you think inventory should be replaced with a Pull or FIFO system?

Now Focus On One Process in the Value Stream

You are now dropping down from the value stream level to the process level, to conduct the process analysis. Start at the pacemaker loop and stay focused on it. Often this means you will be analyzing an assembly or similar process (Figure A2-8).

There is a logic behind the order of these steps. However, the effort quickly becomes iterative. As you move through the analysis, you will often have to go back and review or recalculate an earlier step based on what you are learning as you move forward. This is normal. You are trying to get a deep understanding of the current condition.

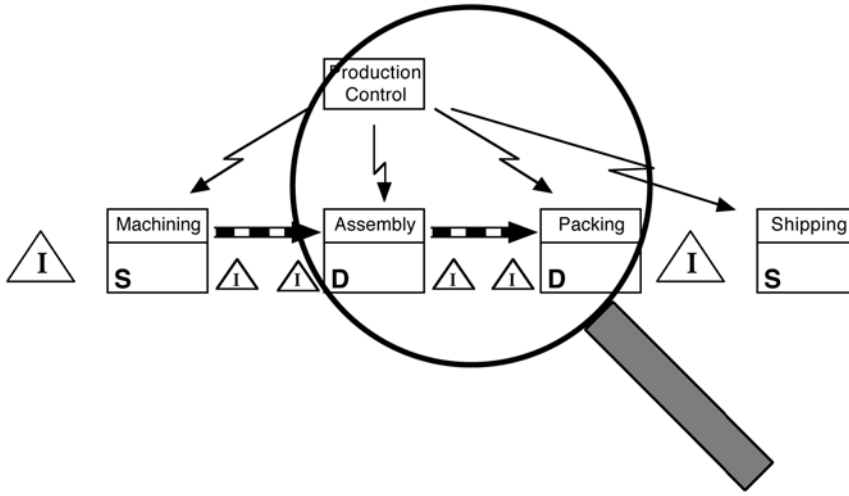


Figure A2-8. Start at the pacemaker loop

STEPS OF PROCESS ANALYSIS

Assess customer demand and determine line pace

- Customer takt
- Planned cycle time

First impressions of the process

- Get to know the process by sketching a block diagram of it.
- Is there a 1x1 flow?
- Are each operator's work steps the same from cycle to cycle?
- Is line output consistent?

Is machine capacity sufficient?

- Can the equipment support the planned cycle time?
- What is current capacity?
- How many shifts?

☹ No ☺ Yes

Is the process stable?

- Time 20 to 40 full cycles of each operator's work

☹ No ☺ Yes

What is the necessary number of operators if the process were stable?

- Calculate number of operators

Figure A2-9. Steps of process analysis

The only equipment you need to conduct a process analysis is:

- A stopwatch that measures seconds
- Graph paper
- Pencil
- Eraser
- Calculator

Do not forget shop-floor courtesy:

- Approach the process via the team leader or supervisor

  Introduce yourself
  Explain what you are doing
  Do not interrupt the operators while they are working

- Explain that you are watching the work, not the operator. (People will not believe you when you say this, but if it is what is in your heart, eventually they will.)
- Show any notes you've taken.
- Say "Thank you" before you leave.
- Perhaps keep your hands out of your pockets on the shop floor. People are working hard here, and hands-in-pockets sends a too casual message. A better message is: "We are all working hard for the customer."

Assess Customer Demand and Determine Line Pace

Here are two numbers you should know (Figure A2-10).

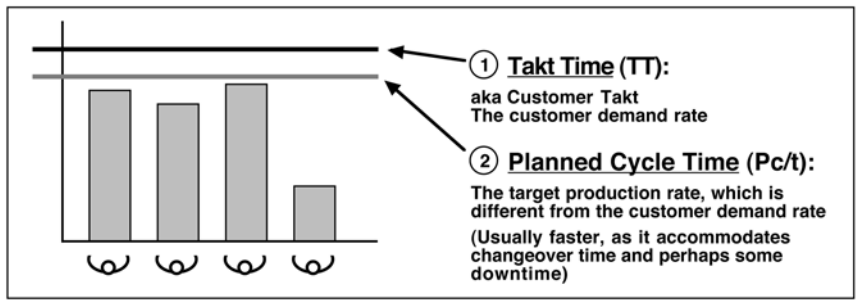


Figure A2-10. Takt time and planned cycle time

Takt time (TT). This is the rate of customer demand for the group of products produced by a process. Takt time is calculated by dividing the effective operating time of a process by the quantity of items customers require from the process in that operating time. You can see the formula in Figure A2-11, and an example in Figure A2-12.) "Effective operating time" is the available time minus planned downtimes such as lunches, breaks, team meetings, cleanup, and planned maintenance. *Unplanned* downtime and changeover times are not subtracted, because they are variables we want to reduce.

$$\text{takt time} = \frac{\text{your effective operating time / shift or day}}{\text{average customer requirement per shift or day}}$$

Figure A2-11. The takt time calculation

Example:

$$\frac{\text{26,100 seconds available time}}{\text{450 pieces required}} = \text{58 seconds takt time}$$

Figure A2-12. Example takt time calculation

Interpretation of the example: The customer is, on average, currently buying one unit every 58 seconds. (Of course, customer demand rates change over time. For example, Toyota recalculates takt time every 30 days and reviews it every 10 days.)

Planned cycle time (Pc/t). Once you have calculated takt, then also subtract changeover time and, perhaps, other losses, such as unplanned downtime and scrap and rework rates, from the operating time to arrive at the planned cycle time (Pc/t). This is the actual speed at which the line should be running.

a. *Changeover time.* In your first Pc/t calculation you can simply use the number of changeovers currently done per day, and the total time that currently takes. You can also calculate with other patterns of changeovers and changeover times, in order to explore different scenarios.
b. *Downtime.* There are two kinds of downtime: short stoppages throughout the day that add up, and rarer but longer-lasting catastrophic failures. In calculating Pc/t, we are concerned with only the small stoppages. You cannot cover for occasional catastrophe with a faster Pc/t.

   Toyota subtracts changeover time in calculating Pc/t, but not unplanned downtime. This is because Toyota factories maintain a time gap after each shift, which is used to make up for small stoppages that occurred during the shift. If you do not currently have that option, then you will probably have to accommodate for some unplanned downtime in calculating the Pc/t.

   One tactic is to strive for a Pc/t that is only 15 or 20 percent faster than takt, and prescribe that changeover time and other losses should be controlled to fit within that 15 or 20 percent gap.

The following simple capacity analysis using the L-shaped stack chart is an exceptionally useful tool for calculating planned cycle time, which you should master.

- In the stack, show each category of losses individually, rather than, for example, combining them in an OEE figure (Overall Equipment Effectiveness). This way you can better understand the issues.
- Start with a one-day interval to make the Pc/t calculation.
- If you are seeking Pc/t, calculate *down*. If the Pc/t is fixed, say because of an unchangeable machine cycle, then calculate *up*.
- Use the optimal changeover sequence to minimize total changeover loss.
- Always put changeover time at the top of the stack.

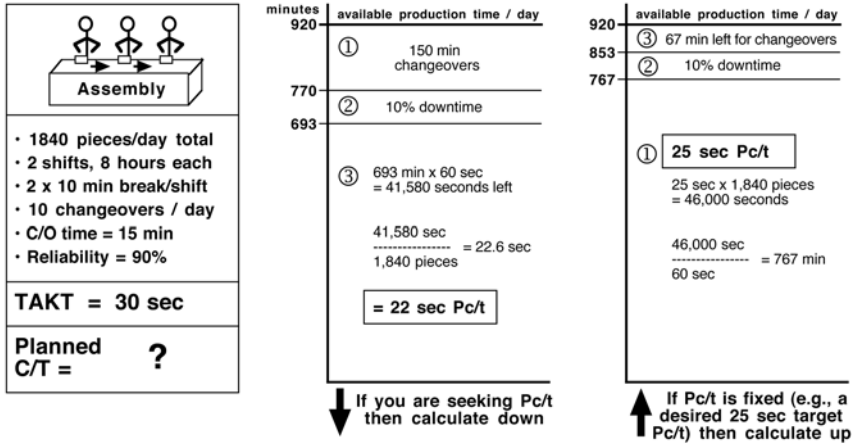


Figure A2-13. Capacity analysis

Figure A2-13 includes an example of using capacity analysis to determine Pc/t.

First Impressions of the Process

What do you see?

- Get to know the process by trying to sketch a block diagram of it. Draw a straight-line sketch of the workstations in the process. Do not draw to scale or worry about the shape—the layout—of the line. Simply make each box about the same size as shown in Figure A2-14. Each box equals one workstation or machine. This sketch can get messy as you see deeper and deeper into the process. That's ok.

Now observe the process and try to answer the following three questions. Write down your observations. You can ask questions, but do not interview people. Learn to see and understand for yourself.

pump assy	harness & filter	flange assy	harness	test	assy	tank assy	tank weld	assy	sender assy	auto tester	label & pack

Figure A2-14. A block diagram sketch of a process

- Is there a 1x1 flow?
  - Do parts move directly from one value-adding step to the next?
- Are each operator's work steps the same from cycle to cycle?
- Is output consistent at the end of the process?
  - Use a stopwatch to time 20 successive cycles at the output end of the process. Select a point and time how often a part comes by this point. Chart the individual times as shown in Figure A2-24. Do not calculate or use averages.

Check Machine Capacity

What is meant here by "machines" is automatic equipment that runs even if an operator walks away. A drill press that is operated by a person, for example, is not automatic. A drilling machine that drills by itself after a person unloads and loads it is automatic.

The questions we are trying to answer with this step of the process analysis are:

1. Can the automatic equipment in this process meet the planned cycle time?
2. What is the fastest planned cycle time that the automatic equipment can currently support? (This is current process capacity.)

Theoretically, an automatic machine's cycle time has to be right at or faster than the planned cycle time. For example, if the planned cycle time for a process is 20 seconds, then the automated machines in the process would need to go through their full cycle in 20 seconds or less. In practice, however, this is not quite correct.

Every machine has a certain small fluctuation from cycle to cycle. Sometimes the time to unload and load the machine varies slightly, or the machine cycle itself varies a small amount. Due to this "personality" of machines, a close-coupled 1x1 flow will not be sustainable if any of the automated machines in it require the full Pc/t interval to complete their cycle. In a 1x1 flow, if one machine goes over the planned cycle time, then this variation can telegraph up- and downstream and disrupt the 1x1 flow.

For this reason, automatic machines should finish their cycle a little before the planned cycle time is up, at the latest. A guideline—only a guideline—is that the total machine cycle time for any automated equipment in a 1x1 flow should be no longer than about 90 percent of the planned cycle time. This guideline applies only to machines, not operators. Operator work should ideally be filled up to the planned cycle time. Looked at another way, the fastest planned cycle time with which a line is able to consistently run a 1x1 flow is depicted in Figure A2-15. This quotient represents the current capacity limit of a 1x1 flow process.

$$\frac{\text{Longest total machine cycle time}}{0.90}$$

Figure A2-15. Current capacity limit of a 1x1 flow process

Insufficient machine capacity is a show-stopper issue, which is why there is a smile/frown check in this step in Figure A2-9. If machine capacity is insufficient, then you must address this first, before going on and making other improvements, because in that situation other improvement efforts will not stick. We must provide the factory floor with a process that is capable of supporting the planned cycle time.

To check machine capacity, draw a machine capacity chart as in Figures A2-16 through A2-19.

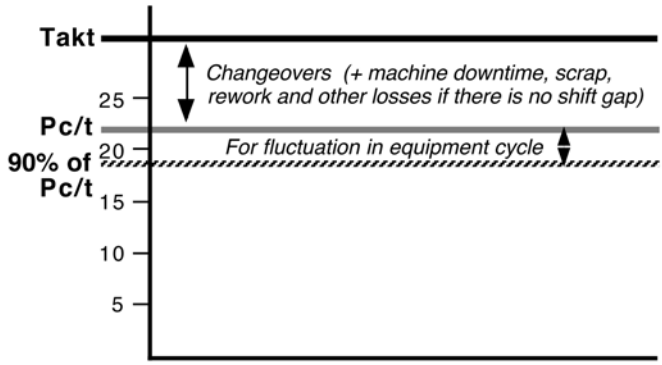


Figure A2-16. Step 1

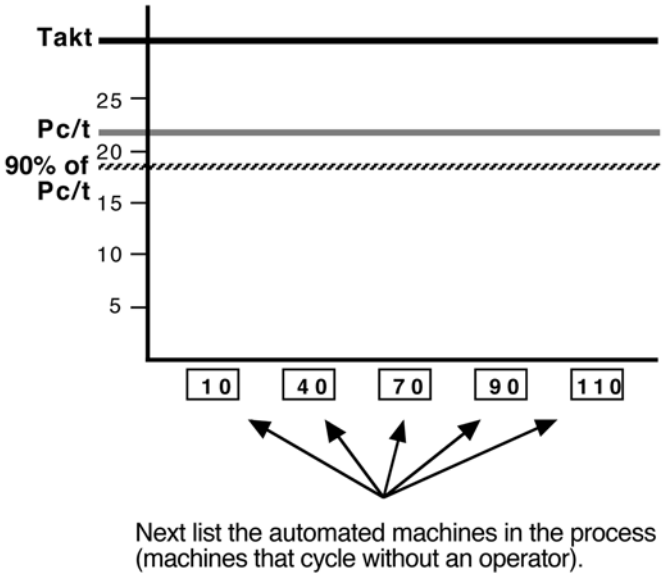


Figure A2-17. Step 2

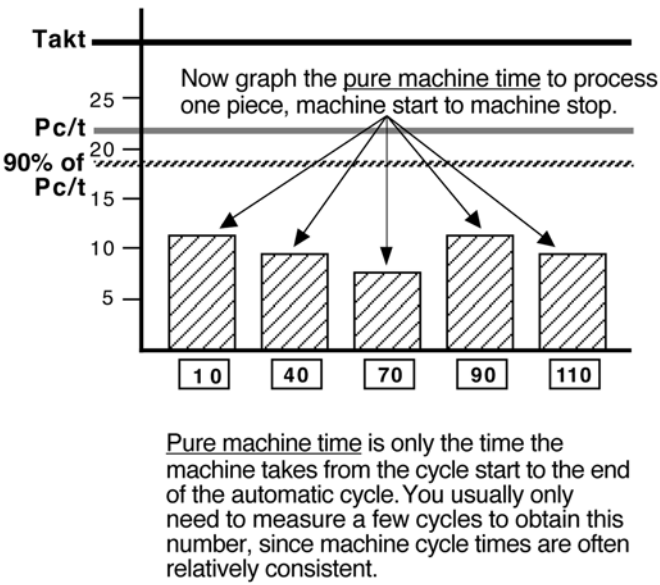
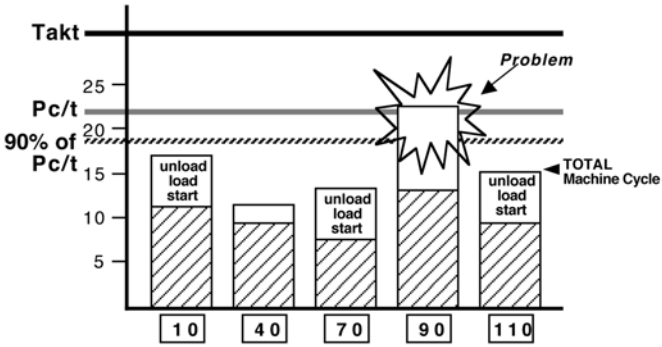


Figure A2-18. Step 3



Finally, add unload and load times to the machine times. This is the time it takes to unload and load the machine if the machine has to wait during unloading and loading.

The sum of pure machine cycle + unload/load time equals the **total machine cycle time (TMc/t).**

Figure A2-19. Step 4

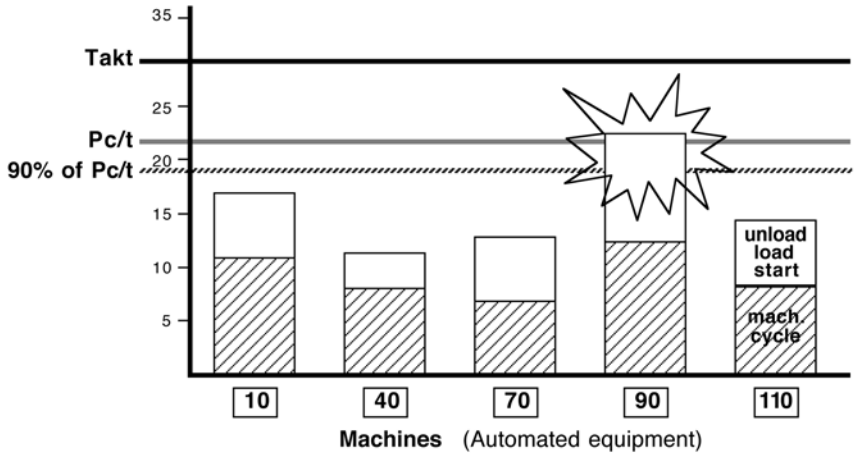


Figure A2-20. Example of a machine capacity chart

Interpretation of the machine capacity chart. The first thing a machine capacity chart shows you is if you have any equipment that currently cannot support the planned cycle time. As you can see in the example in Figure A2-20, machine 90 has a total cycle time that is too

long for the planned cycle time. This must be addressed before going on. Tactics for dealing with this obstacle fall in three successive categories, the first category being preferable to the next, and so on.

1. *Category 1: True improvement.* Work hard to achieve this before going on to the next category.

   - Shorten unload and load time.
   - Reduce the gap between takt time and planned cycle time, which makes the Pc/t slower.
   - Find capacity in the machine cycle. For example, reduce empty machine cycle time, such as "cutting air." How much of the machine's cycle time is actually spent processing?
   - Split up multifunction machines, if this can be done inexpensively. Single function machines have more capacity.
   - Make machine and unload/load times occur in parallel. For example, put the part fixtures on a turntable so the operator can unload and load while the machine is running and processing another part.
   - Speed up the machine (quality cannot be compromised).

2. *Category 2: Compensating. Not true improvement.*

   - Add a small standard work-in-process buffer up- and downstream of the machine, to isolate its "personality" from the rest of the 1x1 flow. This only works if the total machine cycle time is at or below the planned cycle time.
   - Move work to other processes, which slows down the takt time and planned cycle time for this process.

3. *Category 3: Buy more capacity. The last resort option.*

   - A Toyota person once told me, "If we are resourceful and creative we can almost always find ways to get more capacity out of a machine."

A machine capacity chart can also help you see the current natural capacity level of a process. In Line A, Figure A2-21, there is a capacity problem, but it only involves two machines. If we can reduce the total

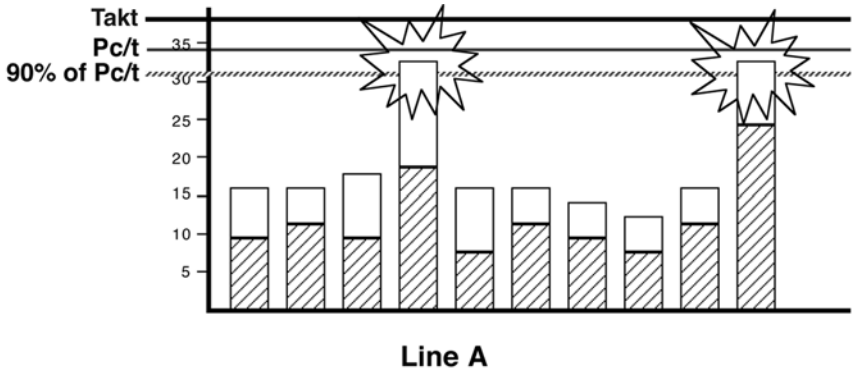


Figure A2-21. Line A is not yet at its natural capacity limit

machine cycle time for these two machines, the planned cycle time can be met. There is capacity available in this line, and perhaps, with some creativity, additional products can be added to it.

In Line B, Figure A2-22, two machines also cannot currently meet the planned cycle time. However, most of the other machines here are near their current capacity limit. There are of course things we can do to free up more capacity in this line, but increasing capacity in this process would involve nearly all the machines. Line B is close to its current natural capacity limit.

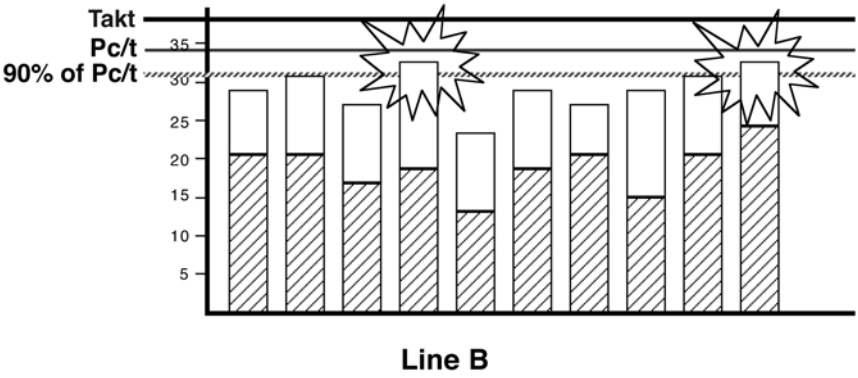


Figure A2-22. Line B is close to its current natural capacity limit

How many shifts? In conjunction with checking machine capacity, you should also consider the number of shifts. The clearest way to see what the options are is to prepare a table, as shown in Figure A2-23.

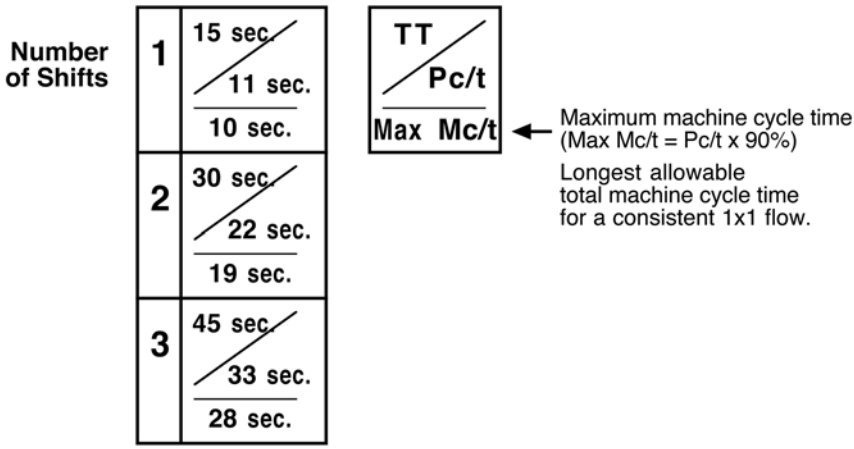


Figure A2-23. Consider the options for number of shifts

Is the Process Stable?

When you start applying the improvement kata to a production process, as well as again and again after process changes are made, the target condition often includes establishing cycle stability. Process stability, or lack of it, is another show-stopper issue.

- If a process is not stable, you will need to address this before trying to make other improvements, because without a stable process, further improvements will often not stick.
- Whenever production processes are unstable, especially pacemaker processes, the entire organization (shop floor, administration, planning, logistics, sales and after-sales service, customers, etc.) will experience waves of fluctuation, variation, and extra activities. The total extra effort and cost generated by this variation in production is called the "hidden factory." The extra

expense is not measurable because there are too many intangibles, but such variation has been estimated to add 20 to 30 percent to cost. The more stable and level you can get your processes, the leaner the entire organization can be.

Note that a stable process does not mean there are no problems, but that the process operates in a consistent manner from cycle to cycle.

Time 20 to 40 cycles of each operator's work. You can check process stability by measuring individual cycles, hourly output, and daily output. The most revealing of these measures is individual cycles, from one piece to the next, because it is a process metric that makes process details visible (Figure A2-24). Fluctuation in hourly output is also interesting, but is determined after the fact, and fluctuation in total output from day to day is only an outcome metric, that is, simply too coarse and too late for process improvement.

To check process stability, time 20 to 40 successive cycles of line output and do the same for each operator's work. Graph the results as shown in Figure A2-24, including lines for the takt time and planned cycle time. Time full cycles: select a single reference point in the cycle for starting and stopping your stopwatch and let the stopwatch run until the operator returns to this point in the cycle. Distinguish between work cycle time and waiting time as much as possible, and graph the work cycle time. Finally, do not use averages, because they conceal instability.

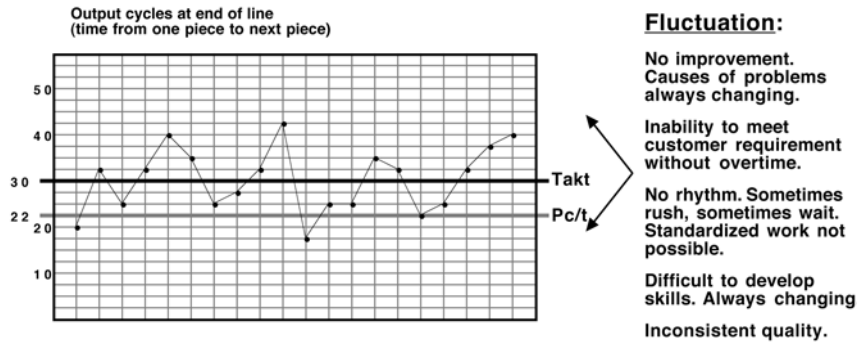


Figure A2-24. Measuring process stability

On this graph you should also note the lowest repeatable work cycle time for each operator, which is a figure you will use in the next step. In the graph above, for example, the lowest repeatable operator work cycle time seems to be 24 seconds.

What Is the Necessary Number of Operators If the Process Were Stable?

The more unstable a process, the more extra operators it will need in order to make target output. Unfortunately, overstaffing a process leads to even greater inconsistency, as lightly loaded operators naturally (and with the best intentions) assist one another with problems, work ahead to build batches, and work differently from cycle to cycle. Such increased variability actually generates more problems and makes understanding the causes of problems even more difficult. A vicious cycle.

Keep in mind, however, that if you operate even a stable process with the correct number of operators, you will need to have a way of responding quickly from outside the line when problems occur (see Chapter 7). Problems will happen.

Calculate the number of operators. Determining the necessary number of operators for a process involves measuring the total operator work time required to process one piece from start to finish. This can be done by watching and timing each operator's work, and adding the times together. (Avoid standard timetables here, as they take you away from observing the real situation.)

There is also a quicker and simpler way, which is sufficient for this process analysis: Simply use the lowest repeatable operator work cycle times from the 20 to 40 cycle graphs of the previous step. In this process analysis the initial operator times you use do not need to be exact, because you will quickly notice imbalances, overlooked wait times, and problems, and adjust as you work toward the target condition and carry out PDCA cycles. Do not waste time trying to obtain and agree upon perfectly accurate operator times now, up front, because the situation will change anyway as soon as you start taking steps toward the target condition.

The theoretically necessary number of operators for a process is determined with the formula in Figure A2-25.

$$\text{correct number of operators} = \frac{\text{Total operator cycle time to process 1 piece}}{\text{Planned cycle time}}$$

Figure A2-25. Number of operators required

Figure A2-26 is an example of this calculation.

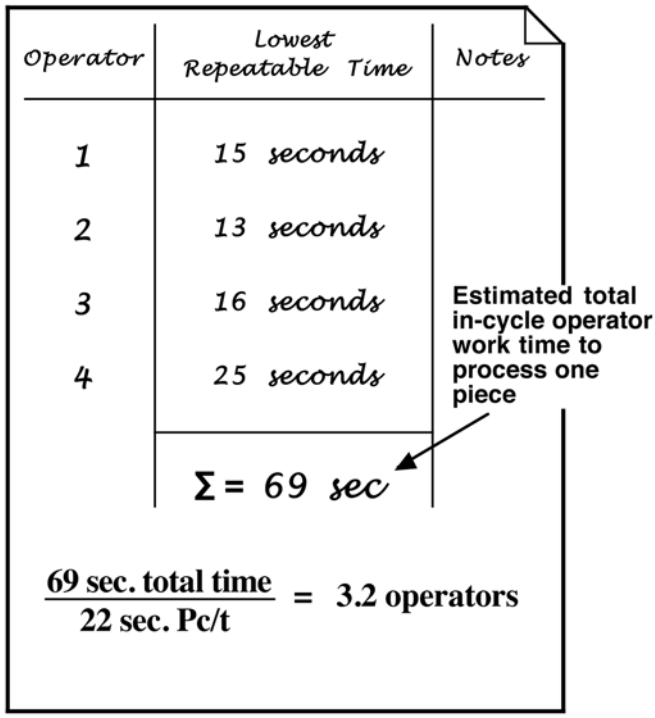


Figure A2-26. Example calculation to determine necessary number of operators

Currently, the process has four operators, and the calculation shows 3.2 operators. So four operators are necessary today. Since four

operators are underutilized, however, one stretch aspect of a target condition for this process, if it is stable, could be to run with three operators.

Summarizing the Current Condition

One purpose of the process analysis is to make you spend time observing the real situation at the process, and the information and data you have obtained at this point may be sufficient for outlining a first target condition for this process. You may see what would be an appropriate next target condition and be anxious to start working toward it. However, be sure to make a simple written summary of the current condition before you start to define the next target condition.

Figure A2-27 is one example of a current-condition summary in a one-page format from a German company. I encourage you to develop your own format.

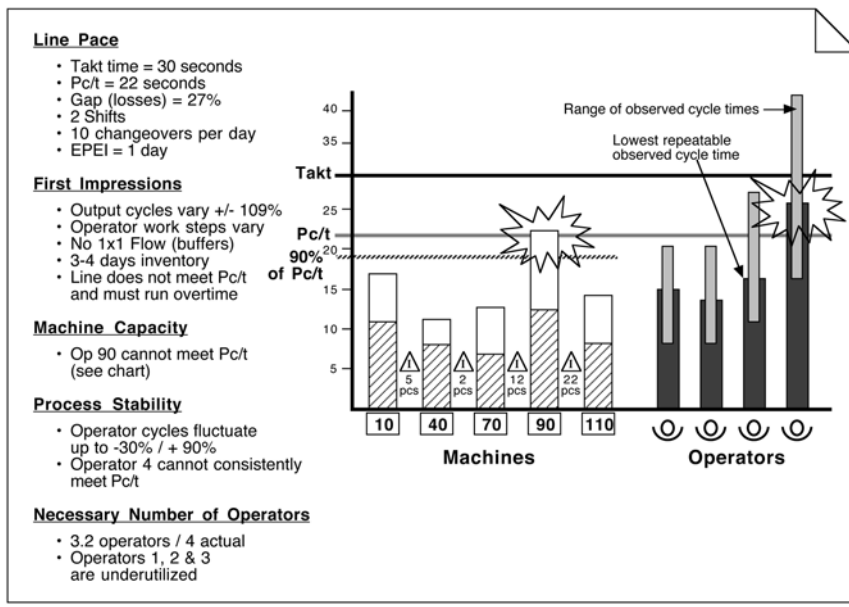


Figure A2-27. Current condition summary in one-page format

Notes

1. For more on value stream mapping see: Mike Rother and John Shook, *Learning to See* (Cambridge, Massachusetts: Lean Enterprise Institute, 1998), and www.lean.org.

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26 15 8 26 21 15 12 1 8 15 10 20 14 5 20 21 15 24 21 20 12
15 1 8 15 2 4 15 16 10 20 14 26 21 15 20 15 17 20 14 7 23 4
26 15 16 12 1 8 15 10 20 14 24 21 20 12 3 20 17 16 14 17 4
15 1 8 15 25 14 16 15 8 26 21 15 16 20

22 8 17 24 15 12 8 26 21

The key to this TK puzzle is hidden in one of the illustrations in this book.

Locators with "n" refer to note.

J

K

L

M

P

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Mike Rother is an engineer, a teacher, and a guest researcher at the Technical University Dortmund. He was formerly an associate in the Department of Industrial and Operations Engineering at the University of Michigan and a researcher at the Fraunhofer Institute in Stuttgart and at the Industrial Technology Institute in Ann Arbor. He began his career in the manufacturing division of Thyssen AG. Mike's work has brought him to numerous companies and hundreds of factories, where he collaborates with people to test ideas and share lessons learned. He splits his time between Ann Arbor, Michigan, and Cologne, Germany.