# Applying TRIZ in Process Improvement

Haiyan Ru, sindyru@hotmail.com
Haibo Ru, browruguard-register@yahoo.com.cn

TRIZ could be used not only in product innovation, but also in process improvement. It can increase the organization management efficiency and effectiveness, which is also valuable. Here we provide a case of applying TRIZ to improve the training process.

The training process is shown as Figure 1:

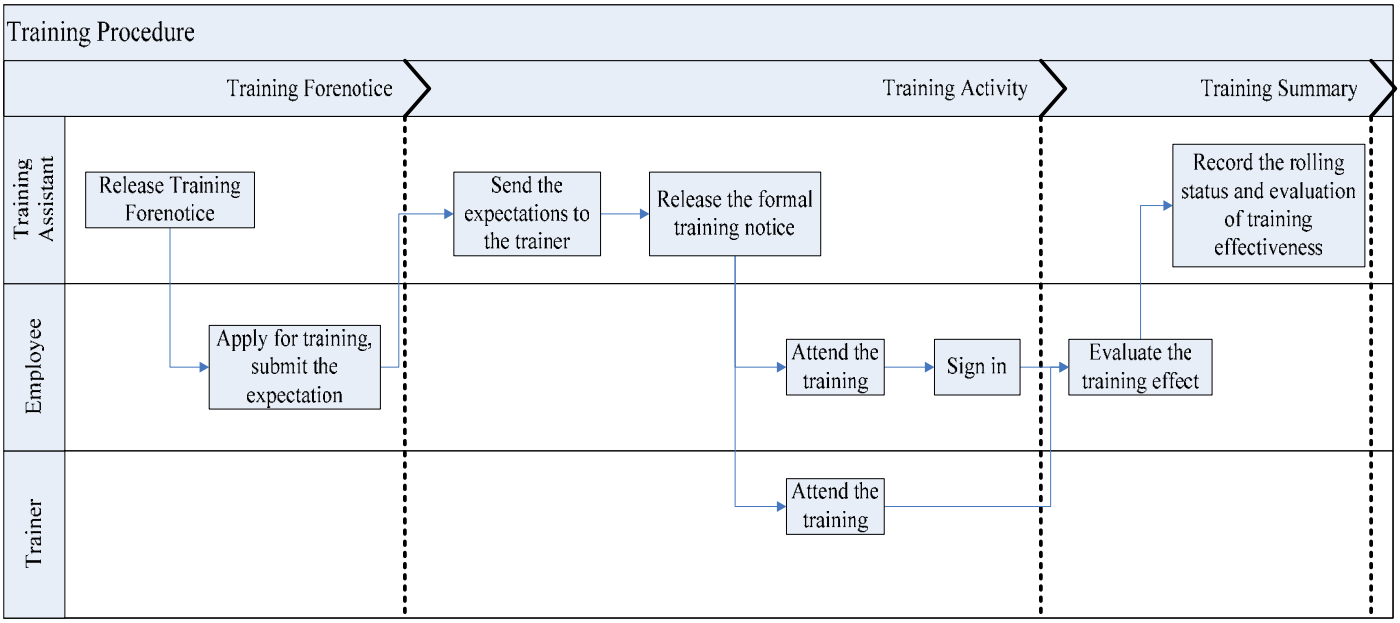


Figure1 Training process

Complaints about training seem to be a permanent problem in a modern company, mainly in two aspects. The first, training courses usually increase gradually as a result of the organization's developing, so does the training assistants' burden and complaining. Not surprisingly, the training quality decreases in consequence. On the other hand, process improvement requests more detailed process information, such as detailed evaluation of the training effect. As a contrast, only a general evaluation score is supplied now, which is not enough to analyze the internal defect and correct it later. So the new requirement is outputting more information, meanwhile the training assistants' burden should be reduced.

How to achieve this goal? TRIZ may works well here. Now we apply the method of Function Analysis to trace the primary problem in the training process and look for a solution by the guidance of TRIZ principles or laws. In order to compare the improvement effect, firstly we define a measure to evaluate the status in quo of the process. The entire process is M-A-I-V: Measuring-Analysis-Improvement-Validation.

**A. Measuring the existing status of the training process**

All of the systems could apply a generic measuring index: Ideality. The TRIZ Law of Idealization says that any engineering system develops in order to become more ideal, which is the

ultimate direction of the technology system evolves towards. The definition of Ideality is:

$$Ideality = \frac{\sum Useful\ Functions}{\sum Cost + \sum Harmful\ Functions}$$

How to distinguish the Useful Functions, Cost and Harmful Functions in a process? According to the Value Stream of Lean, we can put activities of the process into 3 categories:

1 ) Value-added activity: directly creating new value for the process outcome. In the process referred to here, the step of training is value-added; and since the expectation of the employees who take part in has a certain influence on the training content, emphases and methods, this step is value-added as well.

2 ) Supplementary activity: not creating new value for the process outcome directly but necessary to achieve the process goal, for example: the activities of preparations, verification and testing. In this case, the steps of “Signing up” and “Signing in” are necessary preparations for guaranteeing the training effect. The training record is a kind of auxiliary information about an employee’s competency. The evaluation of training effectiveness is not useful for the finished courses but useful for the future training. All of the above activities are supplementary ones.

3 ) Corrective activity: If the value-added or supplementary activities are carried out properly, the corrective activity is needless, however, work usually goes on not as ideally as people expect at first. So the corrective activities apply here. These activities are resulted from those activities which there are something wrong with, so that they don’t add new value to the process. In our case here, there is no such activity.

The value-added activities of a process are just like the useful functions in the technology system. The cost of the process includes the cost of the value-added and supplementary activities. We consider the corrective activity of the process as the harmful functions. Obviously, duration is the cost of the training process. Therefore we describe those activities with the period of each activity. Hence the process index can be defined as following:

**Training efficiency = (Sum of the periods of the value-added activities) / (Sum of the periods of the value-added activities, supplementary activities and corrective activities)**

According to this definition, we classify each step of the training process as the table 1.

Table 1 Training Steps

| Step | Who | How | Where | Period |
|---|---|---|---|---|
| Release the fore-notice | Training assistant | Manual | Email | 24 |
| Apply for the training course, and put forward expectation | Employees | Email | Email | 5 |
| Send the expectation to the trainer | Training assistant | Email | Email | 60 |
| Release the formal notification | Training assistant | Email | Email | 6 |
| Attend the training | Trainer & trainees | | | 120 |
| Sign in | Attendees | Manual | Paper | 1 |
| Evaluate the training effect | Attendees | Manual | Paper | 5 |
| Record the rolling status and evaluation of training effectiveness | Training assistant | Manual | Online system | 118 |

The steps with green background are value-added activities; those with yellow background are supplementary. The column of “Who” tells who is responsible for the activity of the corresponding row. The column of “How” means the method. “Where” indicates the place where the information is stored. “Period” means the duration of each step by sampling statistics in the unit of minute. Because the number of attendees may vary dramatically in different trainings, we suppose that the data related to the trainees is counted according to a single person to avoid the deviation by the attendees’ numbers. So the efficiency of Table 1 is:

Training efficiency = (5+60+120) / (24+5+60+1+120+1+5+118)*100% = 54.6%

**B. Analyzing the root cause**

Why is the training efficiency low? It looks so succinct theoretically because no corrective activity exists in the process chart. Hence the improvement opportunity is either increasing the period proportion of the value-added activities or reducing that of the supplementary ones. Usually the latter is easier to realize. In the supplementary activities of this process, “Record the rolling status and evaluation of training effectiveness” takes a considerable term, so naturally it is the first candidate to be improved.

In this step, the training assistant loads the attendees’ name list and effectiveness evaluation into the online system. Why does it take so long? The main cause is the manual operation of inputting data, it always takes time actually. However, there is something more annoying: some trainees sign their name with crabbed handwriting on the paper. So the assistant has to guess whose name it is, which is more time-consuming. So does the evaluation information. This fact leads to another result: though the trainee evaluates item by item, the assistant inputs only the summary score in order to reduce his burden, which makes some important information for improving the process lost.

The function analysis model is shown as the figure 2.

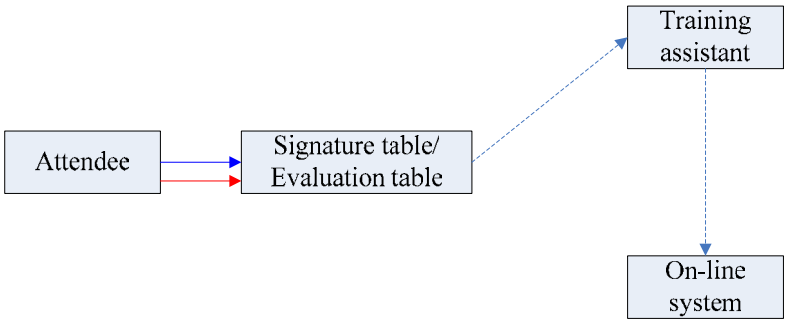


Figure 2 Function analysis model of signing in and evaluating

You can see that signing in and evaluating is useful, however, the crabbed handwriting is harmful for the assistant to recognize, hence the recognizing difficulty makes some information lost. In the next step, inputting information into the on-line system is useful but merely inputting summary score also leads to losing information, which is deficient as well.

In conclusion, the root cause of the time consuming is not “Record the rolling status and evaluation of training effectiveness” itself, but the former step of signing in and evaluating with crabbed handwriting.

**C. looking for a solution**

In “Idealization” of function analysis method, solution is always got by “Trimming”: Distinguish the useful function, and search an alternative way to provide it:

1 ) If the system’s main function isn’t affected without the original component, remove it.

2 ) If no, consider providing the function by the component itself which receives the useful funciton from the original component;

3 ) If no, consider other components in the system to provide it.

We analyze it step by step:

1 ) It is valuable that the attendee provides the information of signing in and evaluating, but the method is harmful. If we removed the two steps, the training process would be incomplete. So it doesn’t work here by trimming these steps.

2 ) Then we may consider an alternative way. It is the assistant who receives the useful information. Could the assistant provide the information instead of the trainees? It’s not acceptable for the evaluation step because the trainees need a free environment to execute evaluating without any interference or pressure in order to keep the evaluation as true as possible. Perhaps this method does work for signing in, but it will increase the burden of the assistant, for the assistant have to record the attendees’ names while training and input them later. This is not accordant with our improvement target, so it is not preferred.

3 ) Can we find other alternative component to help the attendees to provide the information? In this model, the only component other than the attendees and assistant is the online system. If the attendees could sign in and evaluate on line, all problems would not appear as before: the assistant doesn’t need to interfere anything and there’s no loss of information, consequently the efficiency increases.

This idea actually sounds hopeful. Going ahead to consider its feasibility, two new problems exists: first, the trainees sign in in the classroom, but we do not ensure all the rooms were connected with the intranet. Second, evaluation should be done by the attendees but not the applicants, so the online system shouldn’t deliver the evaluation tables until the attendee name list is confirmed. The latter could be easily resolved for evaluating with a short delay is acceptable.

So we focus on the trainee’s signing in while training. The crabbed handwriting is harmful; however, if he doesn’t sign in, the information is lost. This is a pair of contradictory factors: 31 Harmful Side Effects <--> 24 Loss of Information. We get 3 principles from the Altshuller’s Matrix: No. 10 Preliminary action, No. 21 Rushing through, No. 29 Pneumatics or hydraulics. Considering the context of this problem, the principle of No. 10 is more suitable.

Principle 10 describes:

1) Perform before it is needed, the required change of an object (either fully or partially).

2) Pre-arrange objects such that they can come into action from the most convenient place and without losing time for their delivery.

Maybe we could prepare the applicants' name list in advance so that the attendees could make marks instead of writing their names while training, no crabbed writing would reduce the harmful effect extraordinarily. The online system could generate the applicants' name list easily after the employees apply for the training. And this standard list could greatly reduce the assistant's burden of confirming the attendees' name.

All of the problems are resolved now. The point of new solution is to use the online system as much as possible: lots of automatic operations are performed before and after the action of training. The new process chart is shown as figure 3:

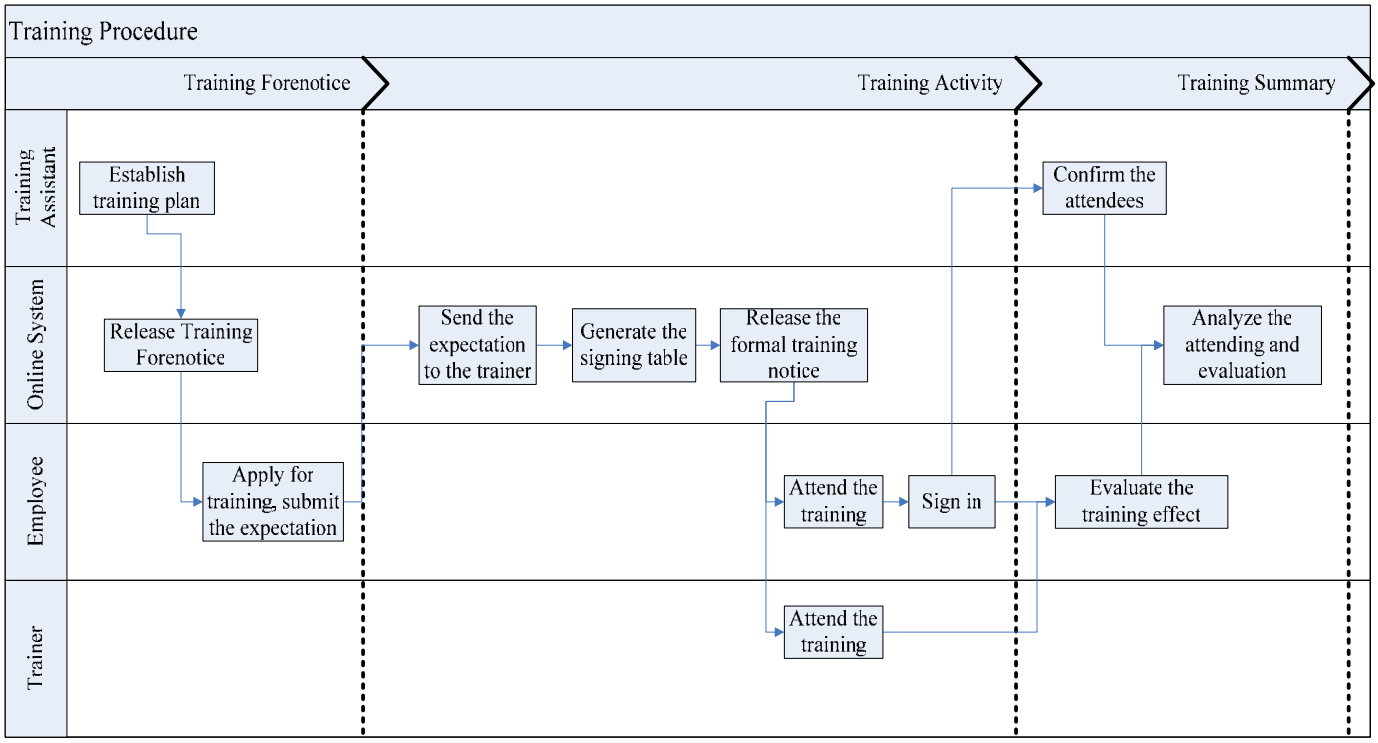


Figure3 New Training Process Map

The detailed design of the new process as following:

1 ) The training assistant establishes the plan for the training in the online system in advance, and affirm the time of fore-notice, the trainer and the deadline of gathering the expectations;

2 ) The online system automatically sends the training fore-notice, the employees apply for it and deliver their expectations;

3 ) At the deadline moment, the system automatically exports the list of expectations and sends it to the trainer; So does the signing table which includes the list of the attendees' name;

4 ) When training starts, the attendee finds his name in the table and makes a mark;

5 ) After the training, the assistant takes the signing table back and confirms online whether each specific applicant has attended the training;

6 ) After confirmation, the system automatically delivers the training evaluation table to the attendees and they fill it online.

7 ) Once the condition of ending evaluation is met, say, time is up or the samples are enough, the system automatically analyzes the attending and training effectiveness, provides the improvement information, and closes the training process.

So the information transfers in the process as figure 4 where the harmful and deficient functions are eliminated.

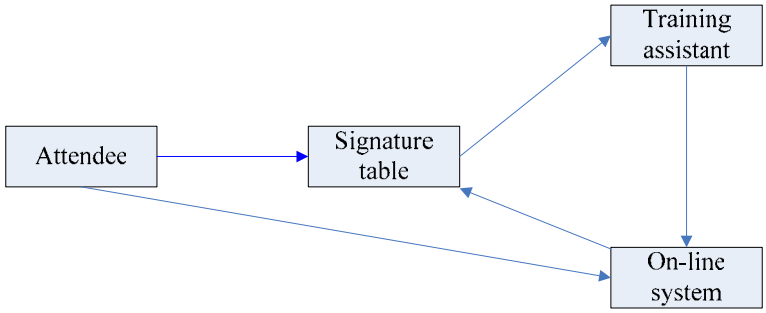


Figure 4 Improved function analysis model of training signing in and evaluating

Correspondingly, the new training activities are classified as table 2:

Table 2 New Process Steps

| Step | Who | How | Where | Period |
|---|---|---|---|---|
| Establish the training plan | Training assistant | Manual | Online system | 30 |
| Release the training fore-notice | Online system | Auto | Email | 0 |
| Apply for the training, and submit the expectation | Employees | manual | Online system | 5 |
| Send the expectation to the trainer | Online system | Email | Email | 0 |
| Generate the name list | Online system | Auto | Online system | 0 |
| Release the formal training notice | Online system | Auto | Email | 0 |
| Attend the training | Traniner,trainees | | | 120 |
| Sign in | Attendees | Manual | Name list | 1 |
| Confirm the attendees | Training assistant | Manual | Online system | 10 |
| Evaluate the training effect | Attendees | Manual | Online system | 5 |
| Analyze the attending and effectiveness | Online system | Auto | Online system | 0 |

**D. Verify the improvement effect**

In our case, the training assistants approve of this solution. Soon every one likes the new process after practicing that itself. We re-calculate the process efficiency with new data as shown in the column of “Period” in Table 2. For the activities performed by the online system don’t increase manual work of the assistant, and it almost takes no time, their periods can be neglected.

Training efficiency = (5+0+120) / (30+5+120+1+10+5)*100% = 73.1%

Compared with the one before, not only the efficiency increases a lot, but also the burdens of the assistant reduces 80.8%, and the total duration of the training process reduces 49.6%

Table 3 the data comparison

| Index | Old process | New Process | % Reduction |
|---|---|---|---|
| **Effort of Training assistant** | 208 | 40 | 80.8% |
| **Training Cycle** | 339 | 171 | 49.6% |
| **Training Process Efficiency** | 54.6% | 73.1% | |

Data in Table 3 shows we have achieved the improvement goal: add the information provided by the training process, increase the process efficiency and reduce the training assistant's burden at same time.

Looking back the above improving procedure, the value of this simple case is to explore a new thinking way of looking for a solution: the framework of M-A-I-V, which is rather like DMAIC of 6sigma. The point is to probe into the essential cause of the process deficiency with Function Analysis, and search the solution with Altshuller's Matrix. Otherwise, we define a generic process index of process efficiency, referenced as the Law of Idealization and Value Stream Analysis. All of these are valuable for future improvement.

**Haiyan Ru:** 6sigma Blackbelt, 9-year practical experience in product development and process improvement;

**Haibo Ru:** 6-year practical experience in mobile services operating and marketing. Master of Signal and Information Processing, Dept. Electronic Engineering, Tsinghua University, and Bachelor of Wireless Communications Engineering, Beijing Univ. of Posts & Telecommunications;