Why Standard Work is not Standard: Training Within Industry Provides an Answer

Jim Huntzinger

If you are working on a lean conversion, but have not heard of Training Within Industry (TWI), you most likely will soon. Training Within Industry, "without question … the most successful corporate training programs in the history of the United States," had its first heyday during World War II.[1] After the war it became an unsung part of the Toyota Production System (TPS). Now it is being reborn in North America to help boost and hold gains from process kaizen.

Unfortunately, Americans saw TWI as a war program, not as a permanent workplace practice. TWI began fading from the American scene before the end of World War II, as soon as victory seemed assured. All along, management foot-dragging had been the major obstacle to TWI implementation, perhaps because grass-roots attention to how work was done tended to stir questioning of management in general.

After the war, TWI was introduced into Japan along with quality methods. Japanese industry, eager to learn from the industrial base which had defeated them, quickly made it a staple of their industrial training. By stabilizing and standardizing work, TWI helped improve quality in practice by removing much of the human variation from work processes. At Toyota, Taiichi Ohno and others recognized that the TWI "J-Programs," described in the box copy, greatly aided process improvement. They became embedded in the Toyota Production System. Sixty years later, TWI cards translated from Japanese back into English still read almost as they did during World War II. Although TWI was only one of many influences shaping TPS, it has been one underestimated in the West, so it is beginning to draw renewed interest.

Today many companies implementing lean methods are also working to create a

In Brief

Training Within Industries, rooted in training programs going back at least 100 years, is a well-proven methodology that has long been a "hidden part" of the Toyota Production System. Using TWI J-Programs, people skilled in describing work, instructing work, and sustaining worker relations can develop and hold standard work. Inability to hold standard work is one of the major reasons why lean initiatives stagnate instead of progressing on toward autonomous, daily improvement. TWI is being re-born in the United States, and a few companies are beginning to show remarkable results from it.

Training Within Industries: The TWI J-Programs

At the beginning of World War II, quickly training "green" workers in skilled industrial jobs was high priority. To become Rosie the Riveter, Rosie needed to learn skills fast. TWI administrators created robust methods of training — three programs, each complete with a training manual that was exactly scripted — and that had been thoroughly tested in actual manufacturing plants. Each of the J-Programs (J meant "Job") was delivered in its *standard* and *repeatable form* to others who, in turn, repeated the process — delivered it in its standard and repeatable form. This train-the-trainer approach quickly deployed instruction with a "reasonable" level of quality. Scripting was exact because TWI leaders realized that those giving instruction would have varying levels of experience.

1. Job Instruction (JI) was the TWI J-Program rolled out first. Training was the most immediate need. The Job Instruction card, shown below, was directly based on Charles Allen's 4-Step training method, which dated from early in the 20th century. The objective of Job Instruction was to teach supervisors how to develop a well-trained work-force. If they are skilled in instruction, supervisors can reduce defects, rejects, rework, accidents, and damage to tools and equipment. But if supervisors are not skilled in instruction, no matter how knowledgeable or skilled they are in the work itself, they cannot not effectively pass it on to others. Human errors go unchecked and uncorrected.

HOW TO GET READY TO INSTRUCT

Have a Time Table—
how much skill you expect him to have, by what date.

Break Down the Job—
list important steps.
pick out the key points. (Safety is always a key point.)

Have Everything Ready—
the right equipment, materials, and supplies.

Have the Workplace Properly Arranged—
just as the worker will be expected to keep it.

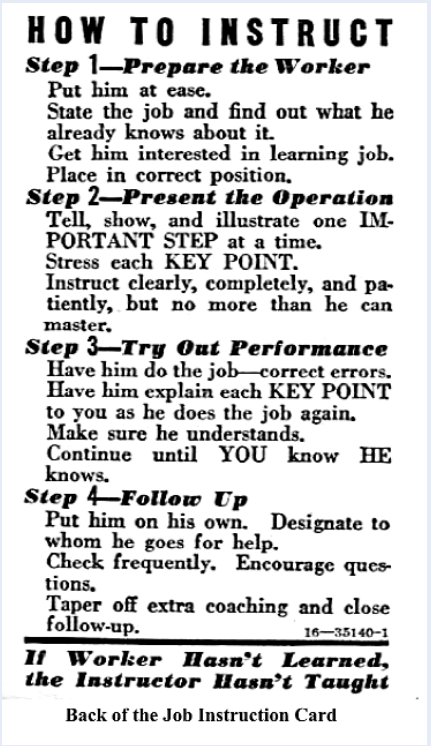
Job Instruction Training

TRAINING WITHIN INDUSTRY
Bureau of Training
War Manpower Commission

KEEP THIS CARD HANDY

GPO 16—35140-1

Front of the Job Instruction Card



HOW TO INSTRUCT

Step 1—Prepare the Worker
Put him at ease.
State the job and find out what he already knows about it.
Get him interested in learning job.
Place in correct position.

Step 2—Present the Operation
Tell, show, and illustrate one IMPORTANT STEP at a time.
Stress each KEY POINT.
Instruct clearly, completely, and patiently, but no more than he can master.

Step 3—Try Out Performance
Have him do the job—correct errors.
Have him explain each KEY POINT to you as he does the job again.
Make sure he understands.
Continue until YOU know HE knows.

Step 4—Follow Up
Put him on his own. Designate to whom he goes for help.
Check frequently. Encourage questions.
Taper off extra coaching and close follow-up.

16—35140-1

If Worker Hasn't Learned, the Instructor Hasn't Taught

Back of the Job Instruction Card

SOURCE: War Production Board, Bureau of Training, Training Within Industry Service, 1944, *Job Instruction: Sessions Outline and Reference Material* (Washington D.C.: U.S. Government Printing Office), inside back cover.

Job Instruction teaches supervisors how to break down jobs for instruction. JI thus develops skill making work easy to understand. Step 1 emphasizes first preparing an operator to learn, followed by properly demonstrating work using a job breakdown which identifies its Important Steps and Key Points. As trainees progress to performing trial runs, the instructor observes them; then tapers off coaching while continuing to follow-up.

2. Job Methods (JM) rolled out next. JM helped supervisors produce greater quantities of quality products in less time, by making the best use of available manpower, machines, and material. This skill was necessary to improve the job without help from engineers or managers, and using only resources at hand, because wartime shortages could be severe.

Job Methods taught supervisors how to break down jobs into their constituent operations, questioning details and developing new methods by eliminating, combining, rearranging, and simplifying these details. Does this sound like kaizen? It is, although it was done mostly by supervisors and confined mostly to work station kaizen, not work flow kaizen.

3. Job Relations (JR) was the final J-Program. Job Relations helped supervisors improve their ability to work with people and promoted teamwork. Supervisors that do not bring out the best in other people are ineffective. They need the cooperation of workers and others. Once they have Job Relations skills, improved cooperation prevents some problems from occurring. And problems that do occur are resolved more effectively.

Job Relations taught supervisors how to get the facts, weigh them carefully, make a decision, take action, and check results. Its basic principles include: providing constructive feedback, giving credit when due, telling people in advance about changes that will affect them, making the best use of each person's ability, and earning the employee's loyalty and cooperation. Sounds like ideals in a lean work culture too.

During World War II, TWI made a big difference. About 16,500 plants took part in TWI training. About 1.75 million people were trained and certified. Most of them were the crucial few — technicians in critical skill jobs and supervisors charged with making sure that others performed a huge amount of work properly.

"no blame" culture of continuous improvement. However, lean working cultures everywhere stagnate because we don't like doing standard work, so we fail to hold the gains from process kaizen. TWI helps people bypass their emotional reluctance to conform to a standard way of doing things — Standard Work. The TWI J-programs (see box copy) let people willingly enter a behavioral environment that they would not venture into before. Japanese do not take to Standard Work easily either, so Taiichi Ohno had this very same experience. He found that TWI helped overcome resistance by his shop people. Managerial resistance is another story. The TWI "J-Programs" also confer benefits even if not coupled with lean, just as was true during World War II.

How TWI Fits into the Toyota Production System

The tools of TPS, from 5S to kanban, developed in the 1950s and 1960s. The three TWI J-Programs slipped in too, hardly noticed among the rest. TPS work culture emerged primarily as the result of learning to use this mix of tools, including the J-Programs. For example, it is difficult to remain a "me-oriented" supervisor while becoming a top-notch instructor. When used alone, the J-Programs began to foster a work culture similar to Toyota work culture, but without a lean initiative they lacked a great deal of "go with" support. The original J-Programs had no overt intent to create a "no blame" culture. Actually using the techniques just seems to take people behaviorally in that direction.

Within Toyota, the origin of their supervisors' cards, which migrated from TWI 50+ years ago, isn't known by everyone. However, TWI-like practices remain elements of the interlocking human support that constitutes a TPS work organization. Toyota never got rid of foremen; that's a lean manufacturing idea. Instead, Toyota supervisors are mentors and instructors, first responders when workers have problems, and their team's primary support staff helping them execute ideas for continuous process improvement. A supervisor may be a disciplinarian if necessary, but the primary role is instructional — always leading a small "learning group" of workers.

No matter how often work is studied and revised, conditions are always changing, so Toyota workers stay in practice working on new problems uncovered by process visibility. Many of these are quality problems. TPS nips many of them in the bud — but only if solutions are quickly found and incorporated into Standard Work.

That's where the practices derived from TWI come in. All three TWI J-

Programs are in fact, proven, robust methods to promote problem solving with people, with follow up instruction learning repeatable and reliable work methods, thereby reducing the likelihood of the same problems repeating. Only if work methods and processes do not relapse do we achieve continuous improvement at the gemba level.

Steady progress with continuous improvement depends on effectively incorporating improvements into Standard Work. Although "ask why five times," the informal version, subdues many problems, Plan-Do-Check-Act (PDCA, the Deming Circle) remains Toyota's fundamental problem solving framework. As shown in Figures 1 and 2, PDCA, all three TWI J-Programs, and Charles Allen's 4-step training method parallel the scientific method. In various ways, all promote process learning.

Although PDCA most closely resembles it, the scientific method itself has no universally-accepted overall definition.[2] However, the cardinal rule of the scientific method, accepted by all scientists, is that conclusions must be based on evidence, not opinion. That leaves room for ego and argument, but it grounds science in processes, logic, and data, rather than personalities and persuasion. With minimal intervention trying to change behavior, the core of a "blame-free" learning culture is solving problems by going wherever reality, data, and logic take you.

Comparing Figures 1 and 2, the biggest difference between PDCA and the scientific method is that science seldom has to standardize a discovery in practice. Industry does — or should. Reducing a solution to Standard Work is where the TWI J-Programs offer a great deal of help. The other lean tools mostly create visibility that makes problems stick out. Consistently overcoming them is the latent power of lean and the real strength of TPS.

Toyota and other Japanese companies are well-known for embedding PDCA thinking in many sub-parts of the overall PDCA methodology for tackling a large-scope problem. Some PDCA cycles may be major projects; others are small elements

Comparison of Charles Allen, TWI, and the Scientific Method

Steps	Charles Allen	TWI			Scientific Method
		Job Instruction	Job Methods	Job Relations	
1	Preparation	Prepare	Breakdown	Get the Facts	Observation and Description
2	Presentation	Present	Question	Weigh and Decide	Formulation of an Hypothesis
3	Application	Try Out	Develop	Take Action	Use the Hypothesis to make Predictions
4	Testing	Follow Up	Apply	Check Results	Test the Predictions by Experiments

Figure 1.

Comparison of TWI and PDCA

Steps	TWI			PDCA
	Job Instruction	Job Methods	Job Relations	
1	Prepare	Breakdown	Get the Facts	Plan – observe data and reality; decide on a problem; define it
2	Present	Question	Weigh and Decide	Do – Analyze the problem; propose a countermeasure.
3	Try Out	Develop	Take Action	Check – Try the countermeasure; check the results.
4	Follow Up	Apply	Check Results	Act – if successful, standardize change; if not, start the cycle over

Figure 2.

that help resolve the larger problem. Figure 3 is a generalized version of this.

Thus TWI becomes part of PDCA in action on the frontline of an operation. And Toyota culture cultivates workers to solve as many problems as they can as often as they can. To do that, Toyota wants their people to kaizen a standard process, not one that has to be studied anew because standard work methods were not held. Standardization is nearly impossible unless workers learn to describe jobs well enough to instruct others to do them. That's JI and JM. Collaborating while doing it is JR.

When a work organization can convert problem solutions to Standard Work and hold it, they can begin the next round of improvement from the existing Standard Work. When they can't, each kaizen has to begin by observing what is really being done — whether a prior fix relapsed, or whether something new has entered the process. The difference can be astounding, as illustrated in Figure 4.

In a nutshell, Figure 4 illustrates why companies do not continue to see gains from lean conversion, and one important reason why these conversions stagnate. It looks simple, but developing team leaders and workers to actually standardize improvements and hold them takes time, probably two-three years to become accustomed to it. That's why Toyota claims that coaching standardized work is the lengthiest step in a conversion to TPS. The time-proven tools of the TWI J-Programs are a way to get into this without undue pain.

In fact, the original J-Program literature says nothing about developing a no-blame culture. That just happens as a *result* of practicing the 4-Step J-Programs, particularly Job Relations. A cooperative, "input from all members" environment is a *result* of using Job Methods. And standardized, repeatable work (Standard Work) practiced by everyone is the *result* of Job Instruction. The J-Programs spent little to no time discussing team building, consensus building, or a euphoric work environment that today's distorted vision of lean culture sometimes extols. It just focuses on solving problems and getting production out in an efficient, safe manner which is to everyone's benefit; the employees, the company, and society.

The 4-step TWI methods are very pragmatic and mechanical in their delivery, but the results can be huge — both from a profit, that is business standpoint, as well as a humanistic standpoint. A team-like

Rigorous Version of 5 Whys: Deming Circle

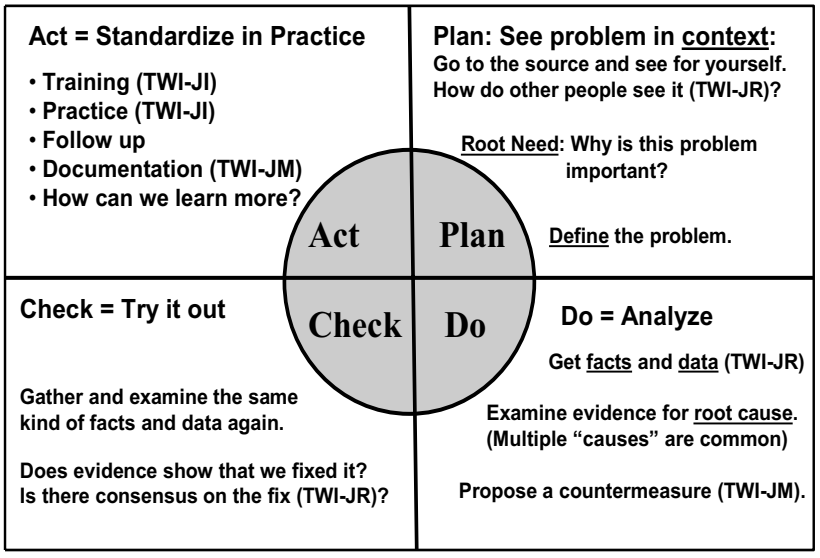


Figure 3.

The Benefits of Having and Holding Standard Work

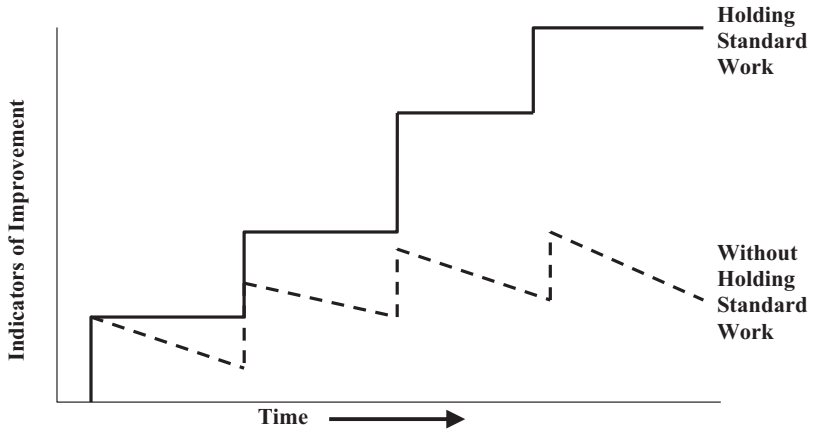


Figure 4.

atmosphere does result if the use of TWI is carried forward, and a team-like culture can arise if a system infrastructure is developed which cradles the matter-of-fact methods that the J-Programs provide.

The J-Programs are meant to be applied day-in and day-out under every condition and situation. The 4-Step procedures are drilled into trainees during all five training sessions of each program with the intent that the procedure will be memorized and then internalized by supervisors as they apply the methods in their everyday work. TWI called this activity, *Learn by Doing* — actively applying what you have learned each day so that you continually build on the procedure and your experience in using it.

TWI and Leadership

So how does an organization develop the leadership and skills to sustain TPS that resonate within Toyota? TWI is a foundational building block of this management function. Since TWI has been in service at Toyota 50-plus years — Toyota managers all the way up to the executive level (including Fujio Cho) have been trained in TWI and are experienced in these methods and practices.

Within Toyota the majority of managers — middle and executive — have been developed and mentored over many years in this very environment, and by others who before them were forged in the same environment. It is no wonder that it is institutionalized at all levels within the Toyota culture. As Fujio Cho, the incoming Chairman of Toyota — who was mentored by Taiichi Ohno, states, "we did a lot of things without thinking, because we had been taught in a certain way by our predecessors, and it seemed to work, so we just did it".[3]

The Toyota Way consists of concrete practice, so engrained it just becomes how people function. "Toyota has long maintained that the Toyota Way can only be grasped through constant practice on the factory floor under the tutelage of an experienced production master. Executives insist it requires the proper mindset as well as discipline and hard work."[4]

The Rebirth of TWI Today

In North America a handful of companies are re-pioneering TWI. One of the first to re-adopt TWI was ESCO Turbine Technologies in Chittenango, NY. ESCO Turbine is a world-class producer of precision casting parts for highly engineered products used in aircraft engines, power generation equipment, and missiles.

Over 60 ESCO Turbine employees have been trained in JI to date. Hundreds of Job Instructions have been written and added to a company database. This resulted in a reduction in Wax Department assembly defects by 96 percent from 2002 to 2004, an increase of on-time release of wax molds from 73.2 percent to 98.6 percent, and a reduction in training time from two months to two weeks. Paul Smith, ESCO's HR director, reported that "the TWI program cut the time to achieve strategic readiness in half. Rework dropped by 76 percent during this period, creating dramatic economic benefits."

As ESCO and other organizations move forward with TWI, they continue to reap a multitude of financial and performance benefits, and develop a more highly skilled workforce quicker than ever before. TWI has been at the center of this advancement and has greatly enhanced these company's lean efforts. The outcomes are reminiscent of the role TWI played in TPS's early development at Toyota.

So if you are working on a lean conversion, but have not heard of Training Within Industry yet, you most likely will soon. Like ESCO, companies are learning that TWI contributes to the sustainability of their lean efforts by helping them bypass the emotional dilemma of getting people to conform to a standard way of doing work. TWI is beginning to fade back into American Industry, and companies like ESCO are learning that it assures a competitive edge.

As Clay Chandler noted in discussing the TPS phenomenon in *Fortune*, "Its essence

is the notion that engineers, managers, and line workers collaborate continually to systematize production tasks and identify incremental changes to make work go more smoothly. It is a ballet of astonishing precision, enhanced by a myriad of tiny improvements on the factory floor."[5]

The leadership at Toyota has learned its lessons well and continually applies shop floor learning to the overall management of its business. Companies today, like ESCO, are starting to learn these lessons and reap benefits from them. TWI, even though it originally developed to focus on the supervisor-worker interface on the shop floor, has evolved into both a practice and a philosophy that moves people and organizations forward by a "learn by doing" approach and attitude. Giving people and their organization the ability to establish standards, sustain improvements made, and then springboard to an ever-higher level of practice and learning (as shown in Figure 4). TWI is an elemental foundation of this ability. Perhaps Fujio Cho's mentor, Taiichi Ohno, best expressed TWI's principles and attitude. Ohno believed "that Toyota managers should be sufficiently engaged on the factory floor that they have to wash their hands at least three times a day."[6] That is the essence of TWI.

Author's Note: I am indebted to Bob Wrona and Patrick Graupp for their contribution to this work, and to Karen Wilhelm of SME, as this article expands on one recently published in Lean Directions*, e-newsletter of the Society of Manufacturing Engineers.*

Jim Huntzinger is president of the Lean Accounting Summit. He began his career at Aisin Seiki, a Toyota group company, and has experience in lean operations at several other companies. He has researched the history of Toyota, lean, and TWI extensively, and was among the first groups in the modern era to be certified as a TWI instructor.

To Learn More:

Since Alan Robinson's research and articles prompted the re-emergence of TWI into industry in the United States, several other sources of information plus TWI training have become available:

- "Roots of Lean — Training Within Industry: The Origin of Kaizen" by Jim Huntzinger (Second Quarter 2002. *Target* Vol. 18, No. 2, pp. 9-22).
- *Training Within Industry: The Foundation of Lean* by Don Dinero (2005. New York, NY: Productivity Press).
- *The TWI Workbook*: *Essential Skills for Supervisors* by Patrick Graupp and Bob Wrona (2006. New York, NY: Productivity Press). Graupp and Wrona have the only known modern certification program in TWI at the Central New York Technology Development Organization, which is part of the NIST-MEP network. Contact Bob Wrona: rwrona@tdo.org or telephone: 315/425-5144.

The role of TWI in lean is also noted in *The Toyota Way: 14 Management Principles from the World's Greatest Manufacturer* (2004, McGraw-Hill) by Jeff Liker; and in *The Toyota Way Fieldbook: A Practical Guide for Implementing Toyota's 4Ps* (2006, McGraw-Hill) by Jeff Liker and David Meier.

Footnotes:

1. Alan Robinson and Sam Stern, 1997, *Corporate Creativity: How Innovation and Improvement Actually Happen* (San Francisco, CA: Berrett-Koehler Publishers), p. 77.
2. The PDCA cycle is often referred to as the Deming Circle (for W. Edwards Deming). This method is in fact originally known as the Shewhart Cycle, which was developed by Walter Shewhart in the 1930s. Deming was one of his pupils.
3. Clay Chandler, February 7, 2005, "Full Speed Ahead," *Fortune*, p. 84.
4. Clay Chandler, February 7, 2005, "Full Speed Ahead," *Fortune*, p. 82.
5. Clay Chandler, February 7, 2005, "Full Speed Ahead," *Fortune*, p. 82.
6. Clay Chandler, February 7, 2005, "Full Speed Ahead," *Fortune*, p. 84.