The Roots of Lean

Training Within Industry: The Origin of Kaizen

Jim Huntzinger

The Training Within Industry Service, or TWI, was a forerunner of modern manufacturing techniques. It remains a model for training people in industry and may well be the ground zero of lean manufacturing and kaizen.

The TWI Service was developed to support U.S. industry during World War II. The TWI Service began in August 1940 and ceased operation in September 1945. Prior to its entry into the war, the U.S. government recognized that the Allied forces needed significant war supplies and took steps to ramp up industry to fill their needs.

To teach valuable techniques to war manufacturers, TWI established a nationwide network of industrial professionals, all volunteers, some full-time and some part-time, from private industry on loan from their companies. "The real job had to be done *by* industry, *within* industry."[1]

This working credo was critical to legitimize an organization acceptable to manufacturers. For the same reason, TWI was never forced onto any plant, but came in only by invitation of the plant's own management.

The Results of TWI

The effectiveness of the TWI Service was dramatic, as detailed by *The Training Within Industry Report: 1940-1945*. TWI developed a standard program of five two-hour sessions. In all, 1,750,650 industry people from 16,511 plants and unions were certified through some or all of these sessions.[2] Figure 1 summarizes improvement results at seven different intervals during TWI's existence.

How TWI Developed

As stated in its overview bulletin, the purpose of the TWI program was:

> To assist war production industries to meet their manpower needs by training within industry each worker to make the fullest use of his best skill up to the maximum of his individual ability, thereby enabling production to keep pace with war demands.[3]

This objective guided the leaders of TWI in developing, by trial and error, the best means to train workers. Through persistence TWI emerged with excellent field-tested methods.

At first TWI network professionals consulted with plants to solve production issues. Demand quickly overloaded the limited resources of the network. From this chaos, the TWI leaders saw that to help industry fast, they had to focus on training workers and changed course.

The Second Effort

Walter Dietz, the associate director of TWI, explained what they did.

	Percentage of Plants Reporting Results of 25 Percent and Over						
	May 1943	Sept. 1943	Feb. 1944	Nov. 1944	April 1945	July 1945	Sept. 1945
Production increased	37	30	62	76	64	63	86
Training time reduced	48	69	79	92	96	95	100
Manpower saved	11	39	47	73	84	74	88
Scrap loss reduced	11	11	53	20	61	66	55
Grievances reduced	(Not reported)		55	65	96	100	100

Source: War Production Board, Bureau of Training, Training Within Industry Service, September 1945, *The Training Within Industry Report: 1940-1945,* (Washington D.C.: U.S. Government Printing Office), p. 92.

Figure 1. TWI plant results.

> "The district heads met in Washington where experiences were exchanged and ideas discussed. It was decided to make a major shift in the whole approach to the task, and some of the original plans, such as giving contractors a consulting service on a broad range of in-plant training problems, were abandoned. Instead, the needs of the supervisors were to be the area of concentration because the serious shortage of experienced men had forced numerous plants to appoint many who were not qualified to do the job." [4]

This became TWI's objective throughout the rest of its tenure. Improving supervisors and their interface with employees became the critical factor that boosted war production. Soon after the war it became one of the foundations from which Japanese management methods evolved.

TWI leadership realized that the training methods had to apply to a wide variety of industries. Trainers with differing amounts of experience and skill had to instruct plant supervisors with various levels of knowledge and experience, who would in turn train workers who generally began with no skills. Training methods had to be absolutely bulletproof. They turned to Charles Allen's 4-Step method.

The Origin of the TWI Methodology

During World War I, the Emergency Fleet Corporation of the United States Shipping Board urgently needed a big training program to multiply shipyard workers tenfold. Only non-experienced ones were available.

The board asked Charles Allen to head this training. Allen turned to his 4-step method, which he had developed as a vocational instructor prior to WWI. Later he described the method in his book, *The Instructor The Man and The Job*, published in 1919:

> ...each complete teaching lesson calls for four steps, or teaching operations known as step 1, Preparation, step 2, Presentation, step 3, Application and step 4, Testing (or Inspection). These steps, are always carried out in the order given — The purpose of step 1 is to get the learner ready to be instructed, of step 2 to instruct him, of step 3 to check up errors, and of step 4 to give a final inspection of the instruction job.[5]

Allen's 4-Step method, which had been around and validated for 30 years or so, was interwoven into TWI methods and

practices. His methods remain as valid today as they were then.

The Importance of Training by Principles

Allen stressed the importance of proper training. Improperly trained employees create excess cost, and low-cost operations use only well-trained people. For the best training, apply four principles, integrating them into all the company's business processes:

1. Standards must be set
2. Good instruction must be established
3. Continued training must be maintained
4. Training must not end too soon.

The 4-Step Process

Allen's first step, preparation, creates in learners' minds a connection between their past experience and the lesson to be taught. A good instructor finds an analogy or a familiar story that the learner can connect in his mind with the teaching objective. Preparation increases the effectiveness of instruction when teaching the simplest of skills, so the 4-step method assumes a great deal of one-on-one interaction.

The second step, presentation, is in Allen's words: "to lead him to 'get' the new idea which the instructor desires to 'tack on' to what he (learner) already knows." Presentation imparts a piece of knowledge to the person being trained, each piece being only a small part of a larger lesson. An instructor must not give too much information at one time, but here and now, focus on the individual point to be taught.

Application, the third step, establishes whether the learner can "do it." Allen stressed that the learner may be in the right frame of mind (step 1), and the lesson pres entation (step 2) excellent, but unless the person can actually do it and do it correctly, the learning has no value. No matter how well the lesson has been taught, mistakes will be made and must be corrected in this step.

The final step, testing, is simply allowing the learner to do the job unaided, but viewed by the instructor. If the learner can't do the work independently, the instructor didn't use the proper teaching method, and so must improve and repeat the instruction. Allen emphasized that if each lesson step is carefully developed and properly taught, the learner will not fail the test step. The fault is completely the instructor's, a point which TWI coined into a familiar slogan, "If the learner hasn't learned, the teacher hasn't taught".[6] Becoming a good instructor requires much practice and experience.

Allen's 4-Step Method is a stack of building blocks, each step completely dependent on the previous one. To be successful, the 4-Step method depends on correctly stringing together a series of *One-Point* lessons. Each individual lesson must have a stand-alone point that must be understood by the learner while connected to the entire lesson.

TWI Courses

Charles Allen's methods were incorporated into TWI's Service training program by its four leaders: Channing Rice Dooley, director of the TWI Service; Walter Dietz, associate director; Mike Kane, assistant director; and William Conover, assistant director. All had become familiar with Allen's methods during WWI. In fact, *The*

Steps	Function	Description
1	Preparation	To make the learner think about certain things to aid him in comprehending the new thing to be taught.
2	Presentation	To add the new idea to those already in the learner's mind.
3	Application	To train the learner in actually applying what was presented to them in the preceding step and to check the degree which it was learned.
4	Testing	To inspect the result of the teaching by testing the ability of the learner to do the new idea alone.

Figure 2. Allen's 4-Step process.

Training Within Industry Report 1940-1945 discusses Charles Allen's work at length. Teaching and instructing instead of telling and showing became the main foundation of the TWI programs. Allen stressed *learning by doing*, which evolved into solving problems on the job with the guidance of a properly trained instructor.[7]

The Five Needs of a Supervisor

TWI had to "sell" its programs to plant managers. To explain the benefits, TWI developed a philosophy of supervision that became a staple of TWI Service:

Every supervisor has five needs:
1. Knowledge of the work
2. Knowledge of responsibility
3. Skill in instructing
4. Skill in improving methods
5. Skill in leading.[8]

The plant or company was responsible for the first two needs, namely equipment, products, manufacturing skills required, policies, agreements, and schedules. TWI training helped supervisors attain their last three needs.

These five needs are as critical today as they were then. Supervisors are responsible for understanding and leading those who create value — the shop employees. Today, industry must understand its deficiency of infrastructure in this area, which unfortunately is common.

"Key Points" and the J-Programs

The "J" programs, as they became known, concentrated Allen's 4-Step method where it was most needed. TWI found that in most manufacturing environments, only a few of a large number of operations were difficult to master. Within these vital few operations, only a few steps were usually critical to successfully mastering the whole. These become the "Key Points" on which training focused, greatly leveraging the effectiveness of limited time and resources.

"Key Points" suggests that much supposedly difficult work in any industrial operation is relatively simple.[9] Allen's 4-Steps had an enormous effect by focusing on "Key Points."

Job Instruction

Charles Allen's 4-Step method guided development of the five-session (two hours each) training program called Job Instruction, given first to trainers, then by them to supervisors. The first two sessions presented and discussed the 4-step method; the last three sessions consisted of actually practicing the method. Between sessions, all participants converted an instructional method used in their department to the TWI method and reported back to the group.

Job Instruction and all other training programs weren't officially released until they had been used, evaluated, and revised multiple times based on feedback from many plants and TWI's own assessment of effectiveness. This approach developed a sure-fire method usable in all industries, plus variants developed for specific industries. The Job Instruction training manual focused on "instructing employees" rather than "letting them learn," and concentrated on the critical issue of training new, green employees.[10]

All persons attending Job Instruction were issued a pocket-sized Job Instruction card. The front of the card outlined the instructor or supervisor's procedure for "getting ready" to instruct, and is very similar to a technique in Allen's book. The back outlined *How to Instruct* according to the 4-step method. (See Figure 3.) It was to be carried by the supervisors at all times to remind them of the methods they should use when training workers on the job.

Job Methods for Process Improvement

Job Methods trained supervisors to achieve obvious work area improvements using a practical approach instead of technical fixes, proving successful in all types of war production plants. The objective of Job

Methods:

> ... helping the supervisors to produce greater quantities of quality products in less time, by making the best use of the manpower, machines, and material now available.[11]

Job Methods was a thought process to break down jobs and to develop new, improved ways to do them, using steps very similar to kaizen or PDCA today, as can be seen in Figure 4. One purpose of the Job Methods program was to prevent supervisors from trying flawed or incomplete improvement ideas.

Job Relations

The Job Relations program was sorely needed because:

> ...supervisors needed a great deal of help in human relations - the art of handling men.[12]

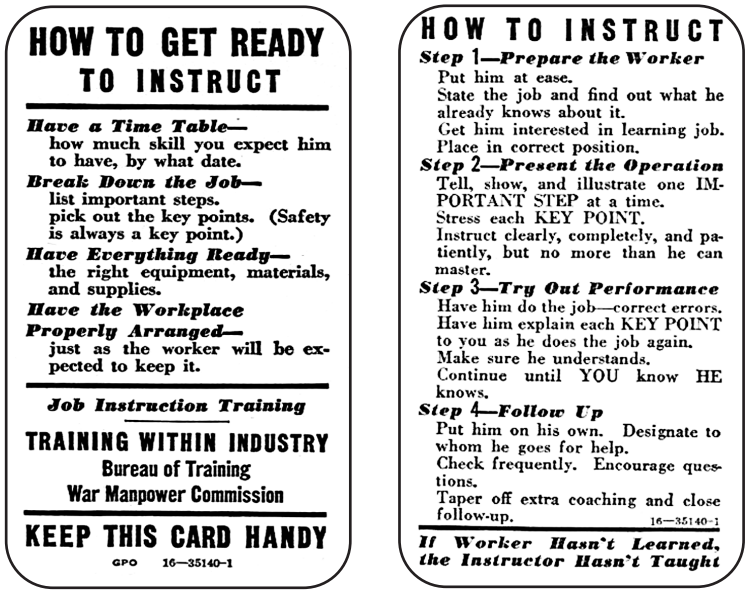
Although working with women wasn't implied by the language of the time, women played a key role and were featured in some of the case studies of TWI training. All "J" program names included the term "job" to emphasize a theme consistent with work, and the Job Relations program adopted the additional themes, "poor relationships cause poor results" and "good relations lead to good results."[13] It emphasized understanding and resolving small issues before they became large. The most vital skill for any supervisor to achieve was presented in the aptly named "*People Must Be Treated As Individuals.*"[14] Job Relations also had a card, shown in Figure 5.

Job Relations training sessions illustrated the principles with everyday case studies using a fictitious supervisor and his employee. Following each of the four steps, a case study illustrated how the supervisor handled the situation. Each attendee was required to use the process in his/her area and report back to the class.

Program Development

Program Development, the last service

TWI Job Instruction Card



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

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

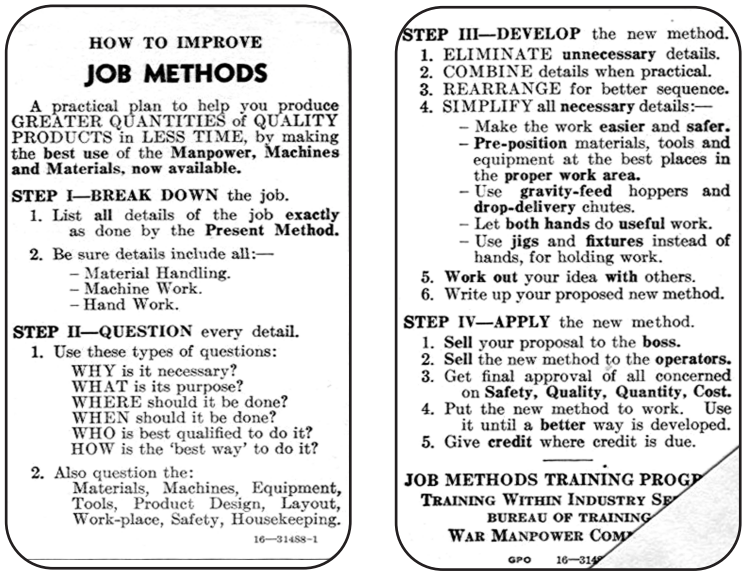
If Worker Hasn't Learned, the Instructor Hasn't Taught

Front Job Instruction Card **Back 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.

Figure 3.

TWI Job Methods Card



HOW TO IMPROVE
JOB METHODS

A practical plan to help you produce GREATER QUANTITIES of QUALITY PRODUCTS in LESS TIME, by making the **best use** of the **Manpower, Machines and Materials, now available.**

STEP I—BREAK DOWN the job.
1. List **all** details of the job **exactly** as done by the **Present Method.**
2. Be sure details include all:—
   - Material Handling.
   - Machine Work.
   - Hand Work.

STEP II—QUESTION every detail.
1. Use these types of questions:
   WHY is it necessary?
   WHAT is its purpose?
   WHERE should it be done?
   WHEN should it be done?
   WHO is best qualified to do it?
   HOW is the 'best way' to do it?
2. Also question the:
   Materials, Machines, Equipment, Tools, Product Design, Layout, Work-place, Safety, Housekeeping.

16—31488-1

STEP III—DEVELOP the new method.
1. ELIMINATE **unnecessary** details.
2. COMBINE details when practical.
3. REARRANGE for better sequence.
4. SIMPLIFY all **necessary** details:—
   - Make the work **easier** and **safer.**
   - **Pre-position** materials, tools and equipment at the best places in the **proper work area.**
   - Use **gravity-feed** hoppers and **drop-delivery** chutes.
   - Let **both hands** do **useful** work.
   - Use **jigs** and **fixtures** instead of hands, for holding work.
5. **Work out** your idea **with** others.
6. Write up your proposed new method.

STEP IV—APPLY the new method.
1. **Sell** your proposal to the **boss.**
2. **Sell** the new method to the **operators.**
3. Get final approval of all concerned on **Safety, Quality, Quantity, Cost.**
4. Put the new method to work. Use it until a **better** way is developed.
5. Give **credit** where credit is due.

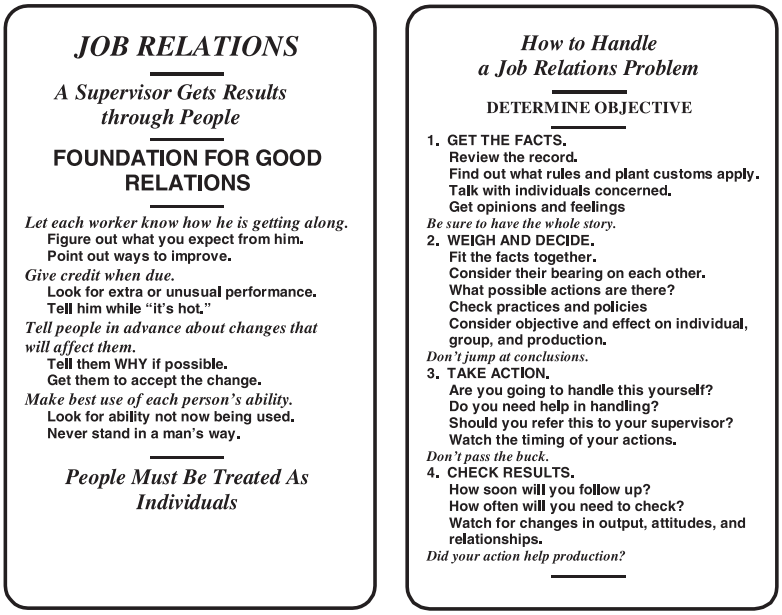
JOB METHODS TRAINING PROGR
TRAINING WITHIN INDUSTRY SE
BUREAU OF TRAINING
WAR MANPOWER COM
GPO 16—314

Front Job Methods Card **Back Job Methods Card**

Source: War Production Board, Bureau of Training, Training Within Industry Service, 1943, *Job Methods: Sessions Outline and Reference Material* (Washington D.C.: U.S. Government Printing Office), inside back cover. Replicated from best available source.

Figure 4.

TWI Job Relations Card



JOB RELATIONS

A Supervisor Gets Results through People

FOUNDATION FOR GOOD RELATIONS

Let each worker know how he is getting along.
Figure out what you expect from him.
Point out ways to improve.
Give credit when due.
Look for extra or unusual performance.
Tell him while "it's hot."
Tell people in advance about changes that will affect them.
Tell them WHY if possible.
Get them to accept the change.
Make best use of each person's ability.
Look for ability not now being used.
Never stand in a man's way.

People Must Be Treated As Individuals

How to Handle a Job Relations Problem

DETERMINE OBJECTIVE

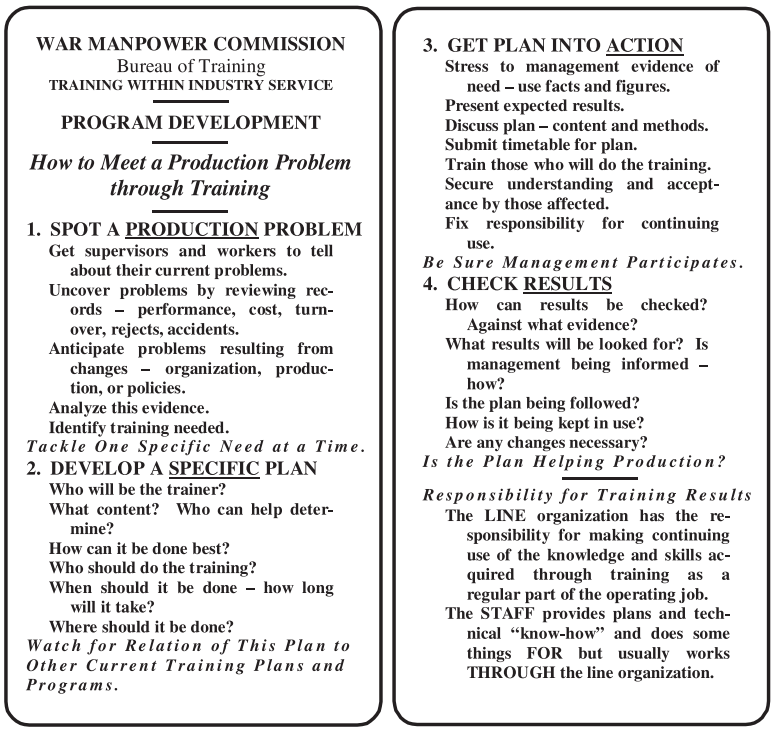
1. GET THE FACTS.
Review the record.
Find out what rules and plant customs apply.
Talk with individuals concerned.
Get opinions and feelings
Be sure to have the whole story.
2. WEIGH AND DECIDE.
Fit the facts together.
Consider their bearing on each other.
What possible actions are there?
Check practices and policies
Consider objective and effect on individual, group, and production.
Don't jump at conclusions.
3. TAKE ACTION.
Are you going to handle this yourself?
Do you need help in handling?
Should you refer this to your supervisor?
Watch the timing of your actions.
Don't pass the buck.
4. CHECK RESULTS.
How soon will you follow up?
How often will you need to check?
Watch for changes in output, attitudes, and relationships.
Did your action help production?

Front and Back of the Job Relations Card

Source: Adapted from Bird McCord, "Job Instruction," Robert L. Craig (ed.), 1976, *The Training and Development Handbook — A Guide to Human Resource Development,* 2nd ed. (New York: McGraw-Hill), p. 32-22.

Figure 5.

TWI Program Development Card



WAR MANPOWER COMMISSION
Bureau of Training
TRAINING WITHIN INDUSTRY SERVICE

PROGRAM DEVELOPMENT

How to Meet a Production Problem through Training

1. SPOT A PRODUCTION PROBLEM
Get supervisors and workers to tell about their current problems.
Uncover problems by reviewing records – performance, cost, turnover, rejects, accidents.
Anticipate problems resulting from changes – organization, production, or policies.
Analyze this evidence.
Identify training needed.
Tackle One Specific Need at a Time.
2. DEVELOP A SPECIFIC PLAN
Who will be the trainer?
What content? Who can help determine?
How can it be done best?
Who should do the training?
When should it be done – how long will it take?
Where should it be done?
Watch for Relation of This Plan to Other Current Training Plans and Programs.

3. GET PLAN INTO ACTION
Stress to management evidence of need – use facts and figures.
Present expected results.
Discuss plan – content and methods.
Submit timetable for plan.
Train those who will do the training.
Secure understanding and acceptance by those affected.
Fix responsibility for continuing use.
Be Sure Management Participates.
4. CHECK RESULTS
How can results be checked? Against what evidence?
What results will be looked for? Is management being informed – how?
Is the plan being followed?
How is it being kept in use?
Are any changes necessary?
Is the Plan Helping Production?

Responsibility for Training Results
The LINE organization has the responsibility for making continuing use of the knowledge and skills acquired through training as a regular part of the operating job.
The STAFF provides plans and technical "know-how" and does some things FOR but usually works THROUGH the line organization.

Front and Back of the Program Development Card

Source: Adapted from Walter Dietz with Betty W. Bevens, 1970, *Learn by Doing: The Story of Training Within Industry* (Summit, NJ: Walter Dietz), p. 26.

Figure 6.

TWI deployed, showed plants how to set up and administer training within their own facility using their own people. As was now standard, the 4-Step method and Key Points guided Program Development instruction, which culminated in issuing another pocket card shown in Figure 6. By the time of its last revision, the end of the war was in sight and with it, the end of TWI.

The Multiplier Principle

A simple but powerful technique known as the *Multiplier Principle* was critical to quickly dispersing TWI throughout all of the country's war production facilities. It's how a thinly staffed network trained over 1.7 million supervisors and trainers in five years. Simply put, the Multiplier Principle was:

> Develop a standard method, then train the people who will train other people who will train repeated groups of people to use the method.[15]

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The multiplier principle worked because TWI exercised quality control by requiring strict adherence to the training. War Production Trainers followed the manuals exactly or lost their licenses. Manuals could be read from up to five feet away so trainers could easily reference them during training sessions. Reference sections explained details, and each manual used font changes and symbols to denote exactly what trainers should do, emphasize, and even write on blackboards.

On every page the Job Instruction manual inserted the phrase, WORK FROM THIS OUTLINE - DON'T TRUST TO MEMORY. All other "J" program manuals included a letter with a similar statement:

> To assure a uniformly high standard, you should ALWAYS work from this outline. Never deviate from it. Don't trust to your memory, regardless of how many times you may present the plan. It is not difficult and if you follow instructions you can't fail.[16]

TWI and Kaizen

TWI, and particularly Job Methods, may be the father of kaizen, and Charles Allen's 4-step method its grandfather. Kaizen is one of the foundations the Toyota Production System, or TPS, and lean manufacturing. While Americans were consigning TWI to the dustbin, what happened to TWI in Japan?

John Shook, who went to work for Toyota in 1983, suggests an answer.

> I discovered them (TWI materials) in a roundabout way in the process of "adapting" some Toyota training materials to make them appropriate for NUMMI. When I found myself struggling with some of the concepts of a certain training program, my Japanese colleague fetched from a back-room file a yellowed, dog-eared, coffee-stained copy of the English-language original training manual, just as they had received it (minus the coffee stains I trust) some 30 years before. To my amazement, the program Toyota was going to great expense to "transfer" to NUMMI was exactly that which the Americans had taught the Japanese decades before.[17]

How TWI Went to Japanese Industry

During the post-war occupation, authorities quickly realized that nearly complete destruction of the Japanese industrial base might foment civil unrest. Instead of severe punishment, as many people in the West desired, they saw rebuilding Japanese industry as critical. A major objective of the rebuilding was to eliminate intense militarism and instill a democratic attitude within industry. Some among MacArthur's Occupation leadership thought that TWI would both aid the rebuilding and infuse democratic principles throughout Japan. Alan Robinson's book *Corporate Creativity* discloses a memo from 1949 describing the situation in Japan:[18]

> Supervision is ordinarily a "haphazard" rule-of-thumb process, and ... in-plant training is characteristically done by putting a new man under an experienced worker to pick up his skills as well as he can. Such practices are incompatible with modern industrial methods and with the achievement of high output per worker.[19]

This statement not only describes Japan in 1949, but common practice for many supervisors today!

The Occupation authorities brought TWI lock stock, and barrel to Japan where it took root. By 1995, almost 100,000 TWI instructors had been certified. In addition, many certified instructors set up non-certified internal TWI programs in their companies. For example, Toyota implemented TTWI, Toyota Training Within Industry. Takahiro Fujimoto notes TWI's influence on Toyota:

> As for management techniques, the Japanese automakers continued to learn the U.S. techniques related to scientific management, including training within industry (TWI) ... education of first-line supervisors for quality control and continuous improvement (kaizen) started also in the 1950s, following TWI.[20]

Translated into Japanese in 1950, Job Method training remained unmodified for nearly 20 years.[21] Many Japanese executives now at retirement age were responsible for rebuilding Japanese industry when young. Their training by the TWI programs (and several others) influenced them throughout their careers.

Job Methods - The Original Kaizen

The objective of Job Methods was to give supervisors a practical method to improve production in their work area other than better technology, proving to be both simple and effective. Job Methods pocket cards were issued in the United States to stimulate ongoing improvement, an idea similar to *kaizen*, usually translated as *continuous improvement.* As TWI

originally expressed it:

> Management must be shown that Job Methods was not an attempt to make professional engineers out of their supervisors. Job Methods will help supervisors to make many small improvements on the job they are closest to. TWI needed to stress this point to management, and trainers needed to steer supervisors toward the improvements that were closest to them, those which could be made without wholesale re-design of machines or tools or department layouts.[22]

Research by Alan Robinson of the University of Massachusetts confirms that Job Methods was the precursor to kaizen in Japan.

Sounds much like the aim of kaizen today. Research by Alan Robinson of the University of Massachusetts confirms that Job Methods was the precursor to kaizen in Japan:

> The aim of this program was to teach supervisors the importance and techniques of continuous improvement.[23]

The outline for TWI's Job Methods 4-Steps also reads much like the kaizen training materials offered by the Shingijitsu Consulting Group (a Japanese consulting group, whose founders came from Toyota and its group companies). Shingijitsu has given kaizen workshops throughout North American and European industry.

Any one in a kaizen workshop may have heard the phrases below:

- "The answers to Why? And What? identify unnecessary details to be eliminated."
- "The answers to Where?, When?, and Who? give leads for combining and rearranging."
- "The answers to How? supply leads for developing 'the one best way' today by simplifying."
- "Work out your ideas with others."
- "Operators have good ideas too; often just as many as we have — sometimes more!"
- "Improvements are of no value unless put to work."
- "Put the new method to work — use it until a better way is developed."
- "Remember there will always be a better way. Keep searching for further improvements."
- "We can't afford to be 'too busy' to find time to continually search for improvements."
- "Improvements must be made now!"[24]

All these phrases are found in the 1943 TWI Job Methods training manual, additional evidence of kaizen's roots in TWI. Since 1943, kaizen is much refined, and the techniques that the Toyota Production System merged with it, such as 5S, jidoka, etc. had the objective of promoting kaizen. But *learning by doing* and other principles on which both are based are not new:

> The principles of the Job Methods plan are not new. They were developed 30 years ago.[25]

This statement from the Job Methods training manual (1943) refers to Charles Allen's development of his 4-step method. As with most solid methodology, Charles Allen's 4-step method had developed from ever-earlier roots, the Herbartian steps of training from the previous century.[26] In any case, an industrial philosophy Americans consider modern and foreign is actually an old, but neglected, hometown practice.

Learn By Doing

All training programs were based on the learner using the procedure on an actual shop issue and presenting it to the group — *learning by doing* — a phrase oft repeated in *The Training Within Industry Report: 1940-1945:*

> It must be built on the principle of demonstration and practice of "learning by doing," rather than on theory. [27]

This referred to Charles Allen, whose 4-Step method was built upon creating the best possible environment to enable perfect *learn by doing* situations. This simple idea got lost in the United States, but it is still alive in the Toyota Production System.

John Shook relates another example of *learn by doing* in *Becoming Lean*:

> Learn by doing translates as: build some cars. After a couple of weeks of orientation, I was put to building Corollas at the Takaoka plant, which was a great experience, though I didn't appreciate every aspect at the time.[28]

John experienced the method working in Toyota's plants including assembly, stamping, body weld, paint, and final assembly. All engineers and managers get a similar experience to gain an intimate understanding of the processes for which they will be responsible. There is no better understanding than by doing.

Supervisor Development

TWI changed the role of supervisors in Japanese industry. Although supervisors have always played a critical role in manufacturing, TWI emphasized the interface between the supervisor and operator. Within Toyota, the team leader becomes instructor, leader, advisor, fill-in, improvement solicitor, and implementer. These functions correlate to the three "J" programs and the lessons they taught the supervisors.

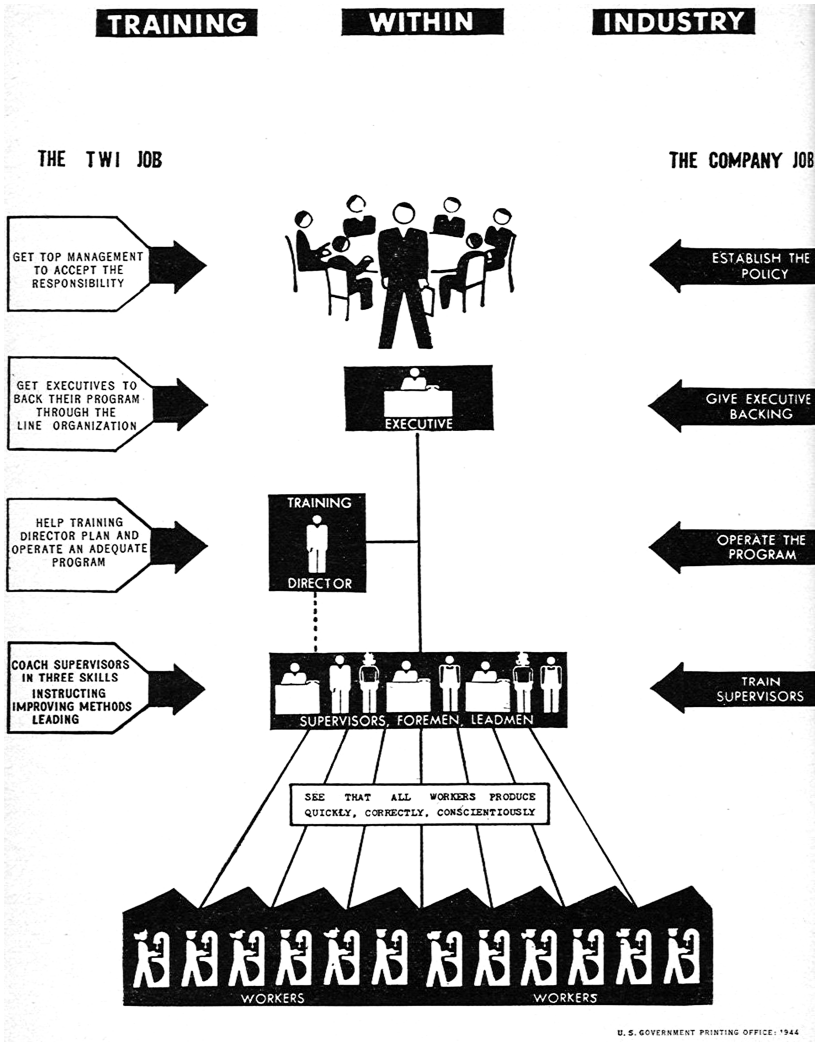
1. Job Instruction Training (JIT) taught supervisors the importance of proper training for their workforce and how to provide this training.
2. Job Method Training (JMT) taught how to generate and implement ideas for continuous improvement.
3. Job Relations Training (JRT) taught leadership and human relations.[29]

As both TWI and Charles Allen emphasized, the supervisors (instructors) must do much more than know the job. They must be able to develop procedures and instruct learners to receive, understand, and apply the methods of the job. Job Methods and Job Relations also required supervisors to lead people and use their ideas to improve production.

Top Management Support

Anyone who has worked to implement lean manufacturing understands that to be successful, the absolute support of management is necessary. It has always been necessary for any major change. During the days of TWI, before any training took place, upper management support for it had to be forthright. TWI directives delineated TWI's responsibilities and the host company's responsibilities. (See Figure 7.)

TWI and Host Company Responsibility Requirements



Source: War Production Board, Bureau of Training, Training Within Industry Service, June 1944, *Management and Skilled Supervision* (Washington D.C.: U.S. Government Printing Office), back cover.

Figure 7.

This requirement fit the "for industry by industry" attitude held by TWI leadership. Chapter 5 in *The Training Within Industry Report* is entitled, *Working With Management.*

> In 1943 TWI established the policy of starting a program in a plant only after the executive group and the supervisory organization had been thoroughly informed about the TWI programs. This executive group, also, had to be thoroughly aware of its responsibility for making these programs work. It can readily be appreciated that a busy president can approve a program enthusiastically, but the plant superintendent, if ignorant of it or unsold as to its possibilities, can be a barrier.[30]

TWI presented training as a management tool and promoted results, not techniques. The leadership knew that most American managers were ultimately interested in bottom line results, a predilection that continues, but by playing to it, TWI achieved initial buy-in and continued support by a large number of executives.[31]

Coaching

"Coaching" is often presented to all levels of management as a greatly improved, modern method of managing people. Yet "coaching" was repeated throughout the TWI Report, and devotes a section to it. TWI explained coaching to "J" program trainers using five points:

1. Give reasons and advantages.
2. Get understanding of the principles.
3. Select a problem and work on it together.
4. Ask him to work another problem alone.
5. Give credit for good results and good effort.[32]

The TWI report went on to explain what it means to coach someone in a plant environment and how it supports the Multiplier Principle:

> Coaching only means helping someone to do a better job of what he's trying to do.[33]
>
> The objective of a TWI program, and the objective of coaching, is not to solve a problem, but to develop ability to solve any problems when they come up. All of this means a personal working relationship — you can't coach on the phone, or in a letter, or by a lecture. You have to work with a man. His boss is the best one to work with him, out on the job. He can show him how to do a better job — not just criticize, explain why his good work succeeded so he'll do the same thing again ...[34]

And where did TWI derive their ideas on industrial coaching? Charles Allen again:

> The men will eventually think of the instructor as a "coach" rather than as a production foreman ... Under good management ... the men will not be afraid to ask questions and the questions will be to the point; there will be much discussion but there will be little argument; the men will be on the job whether they are under the eye of the instructor or whether they are not; all conditions will be business-like and "natural." [35]

Allen and TWI had both the concept and practice of coaching down pat, but didn't quite get around to calling it a "team" environment.

Job Elimination Due to Kaizen

Just as is true when implementing lean manufacturing today, one of the most common questions asked during Job Methods training was, "What should be done if employees are eliminated as a result of methods change?"[36] TWI emphasized that this issue was the responsibility of companies, but promoted a standard "suggestion" to them that parallels the standard response in kaizen projects today:

In dealing with a specific instance during this war period, it is recommended that no one ever be laid off as a result of a methods change but that an employee thus affected be transferred ...[37]

Waste Elimination

Job Methods is about job improvement or in today's terms, waste elimination. Its 4-Step method closely resembles kaizen methodology: List the details of an operation; question all steps presently involved in a job; develop new methods (combine, rearrange, simplify), and apply the new methods. It comes down to the same basics. Set an original standard, then start asking why, improve it, and set a new standard. In TWI language:

This improvement was not accomplished through speed-up, but through elimination of unnecessary details.[38]

Use it until a *better* way is developed.[39]

The TWI Service merely promoted good management practices as a means to improve production. Process improvement, or kaizen, is as fundamental now as it was then. TWI had a bigger impact on war production than was generally realized at the time. Transplanted to Japan, it had a bigger impact than is generally realized now. (See Figure 8.)

Why Was TWI "Lost?"

No explanation is simple and straightforward, but two factors played a significant role. At the end of World War II the United States had not only led the victory in both the Pacific and Europe, but also supplied products to its allies before and during the war. An incredible industrial build-up took place with many of the "boys" fighting overseas. It emerged as a Superpower with no damage to its infrastructure. Morale was high; the industrial base big and strong.

One factor in TWI's demise was that it developed under conditions considered

Timeline of TWI Evolution

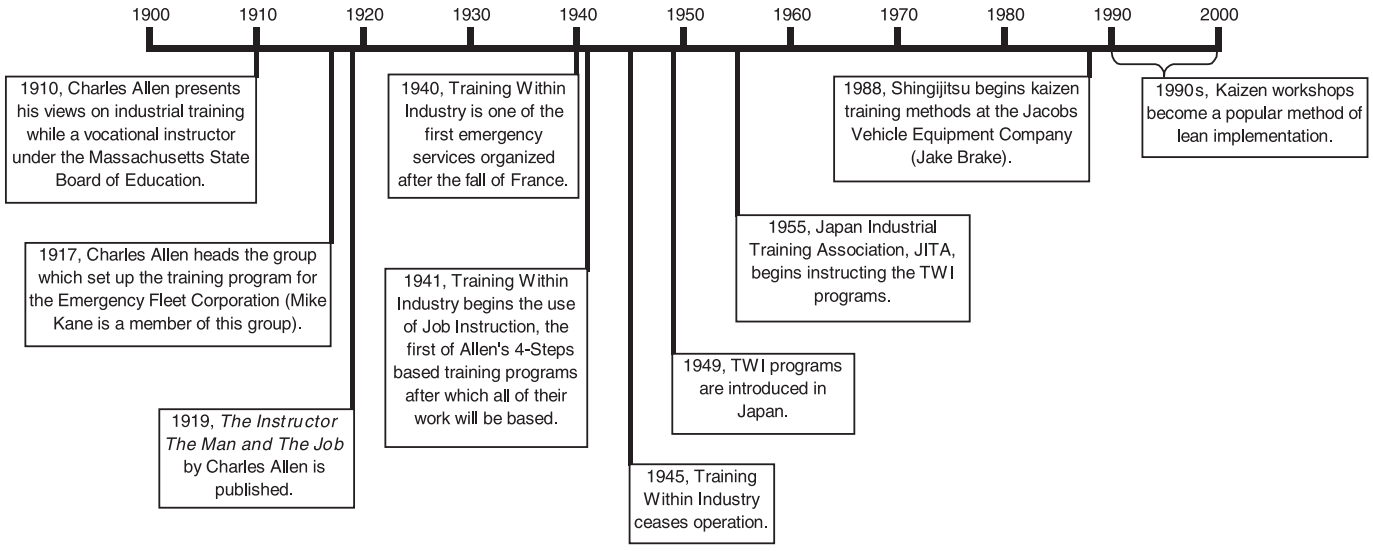


Figure 8.

In a sense, manufacturing success in the future may depend on learning to do again what we have already done.

temporary. High volume war production was considered a project to be discontinued at war's end when things would go back to normal. In their report, TWI leaders recalled how they always felt that the end of their service was just a few days away. This "feeling" lasted about five years, much longer than they had anticipated. No vision for TWI beyond the wartime years existed.

Back to normal meant that many men returned from the war to their old jobs, trying to take up where they had left off. Untrained in TWI methods, they saw no need for it, and their bottom-line managements saw no further need for it. The U.S. industrial base reigned supreme because it was the only one left standing. Complacency may be the biggest contributor to the loss of TWI's accomplishments. Dooley, Dietz, Kane, and Conover, the leadership of TWI, seemed to sense what would happen.

> In looking at the simplicity of TWI programs it would seem that, since they only represent common sense, their development should have been possible without too much trouble. But it must be remembered that a lot of non-essentials had to be eliminated.
>
> The TWI programs have been developed under opportunities never before available — the nation's war plants have been the laboratory, the experimental shop, and the proving ground. Development work would have continued as long as TWI existed — no program is ever perfect, and no program is any good unless it meets needs. Since needs change, any program must be kept growing.[40]

As may be recalled, when war production was obviously critical, perhaps as much time was spent selling TWI to company managements as was spent conducting the training. After the loss of the "need" and the untrained "boys" returned, the sales job seemed impossible. Resistance to change returned to "normal" too. Inevitably, TWI principles faded from the industrial landscape.

By contrast, the Japanese had no "normal" to which they could return. Their industrial war of survival began with the post-war occupation, and in this crucible, TWI, SPC, and other "advanced" industrial practices of the day began to be transformed into the systems that have migrated here since around 1980.

Japanese themselves contend that most of their post-war industrial development had no relationship with any uniqueness of Japanese culture. The methods most famously developed by Toyota are well-organized, well-trained common sense, some of which originated in the West, probably around a hundred years ago, their underlying themes unchanged. In a sense, manufacturing success in the future may depend on learning to do again *what we have already done*.

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Footnotes

[1]War Production Board, Bureau of Training, Training Within Industry Service, September 1945, *The Training Within Industry Report: 1940-1945,* (Washington D.C.: U.S. Government Printing Office), p. 6.
[2] Ibid., p. 126.
[3] Labor Division, War Production Board, Training Within Industry Service, January 1943, *The Training Within Industry Program, Bulletin No. 1* (Washington D.C.: U.S. Government Printing Office), p. 3.
[4] Walter Dietz with Betty W. Bevens, 1970, L*earn by Doing: The Story of Training Within Industry* (Summit, NJ: Walter Dietz), p. 13.
[5] Charles R. Allen, 1919, *The Instructor The Man and The Job,* (J.B. Lippincott Company; Philadelphia and London), p. 129.
[6] Training Within Industry Service, September 1945, T*he Training Within Industry Report: 1940-1945*, p. 193.
[7] Training Within Industry Service, September 1945, *The Training Within Industry Report: 1940-1945*, pp. 185-190.
[8] Ibid., pp. 48-49.
[9] Dietz, p. 4.
[10] Labor Division, Office of Production Management, Training Within Industry Service, August 1941, *How To Train Production Operators* (Washington D.C.: U.S. Government Printing Office), p. 1.
[11] Training Within Industry Service, September 1945, *The Training Within Industry Report: 1940-1945,* p. 230.
[12] Dietz, p. 19.
[13] Bird McCord, "Job Instruction," Robert L. Craig (ed.), 1976, *The Training and Development Handbook - A Guide to Human Resource Development,* 2nd ed. (New York: McGraw-Hill), pp. 32-17.
[14] Training Within Industry Service, September 1945, *The Training Within Industry Report: 1940-1945,* p. 40.
[15] Ibid., p. 6.
[16] War Production Board, Bureau of Training, Training Within Industry Service, 1943, *Job Methods: Sessions*

Outline and Reference Material (Washington D.C.: U.S. Government Printing Office), p. 1.

[17] John Shook, "Bringing the Toyota Production System to the United States: A Personal Perspective," Jeffrey Liker (ed.), 1997, *Becoming Lean* (Portland, OR: Productivity Press), p. 69.

[18] This section is based on the research and writing of Dr. Alan Robinson of the University of Massachusetts, Amherst. He has done excellent research in discovering the story behind the impact of TWI in Japanese management practices. For further details, reference his work given in the bibliography.

[19] Alan Robinson and Sam Stern, 1997, *Corporate Creativity: How Innovation and Improvement Actually Happen* (San Francisco, CA: Berrett-Koehler Publishers), p. 74.

[20] Takahiro Fujimoto, 1999, T*he Evolution of a Manufacturing System at Toyota* (Oxford University Press: New York, New York), p. 40.

[21] Robinson, 1997, Corporate Creativity: *How Innovation and Improvement Actually Happen*, pp. 77 - 79.

[22] Ibid., pp. 38-39.

[23] Alan Robinson, 1991, *Continuous Improvement in Operations: A Systematic Approach to Waste Reduction* (Cambridge, MA: Productivity Press), p. 18.

[24]Training Within Industry Service, 1943, *Job Methods: Sessions Outline and Reference Material,* pp. 29 - 34.

[25] Ibid., p. 37.

[26]The Herbartian steps of training was a methodology developed by John Frederick Herbart (b. at Oldenburg, 1776; d. at Göttingen, 1841, Germany), a German philosopher and educationist.

[27]Training Within Industry Service, September 1945, *The Training Within Industry Report: 1940-1945,* p. 32.

[28]John Shook, "Bringing the Toyota Production System to the United States: A Personal Perspective," Jeffrey Liker (ed.), 1997, *Becoming Lean,* p. 47.

[29]Robinson, 1997, *Corporate Creativity: How Innovation and Improvement Actually Happen,* p. 75.

[30]Training Within Industry Service, September 1945, *The Training Within Industry Report: 1940-1945,* p. 61.

[31]Training Within Industry Service, September 1945, *The Training Within Industry Report: 1940-1945.* The details of TWI process are discussed fully in Chapter 5, Working With Management, pp. 60 - 75.

[32]Training Within Industry Service, September 1945, T*he Training Within Industry Report: 1940-1945,* p.172.

[33]Ibid., p.173.

[34]Ibid., pp.172 - 173.

[35]Allen, 1919, p. 281.

[36]Training Within Industry Service, September 1945, *The Training Within Industry Report: 1940-1945,* p. 231.

[37]Ibid.

[38]Training Within Industry Service, September 1945, *The Training Within Industry Report: 1940-1945,* p. 224.

[39]Ibid., p. 227.

[40]Training Within Industry Service, September 1945, *The Training Within Industry Report: 1940-1945,* p. 261.

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