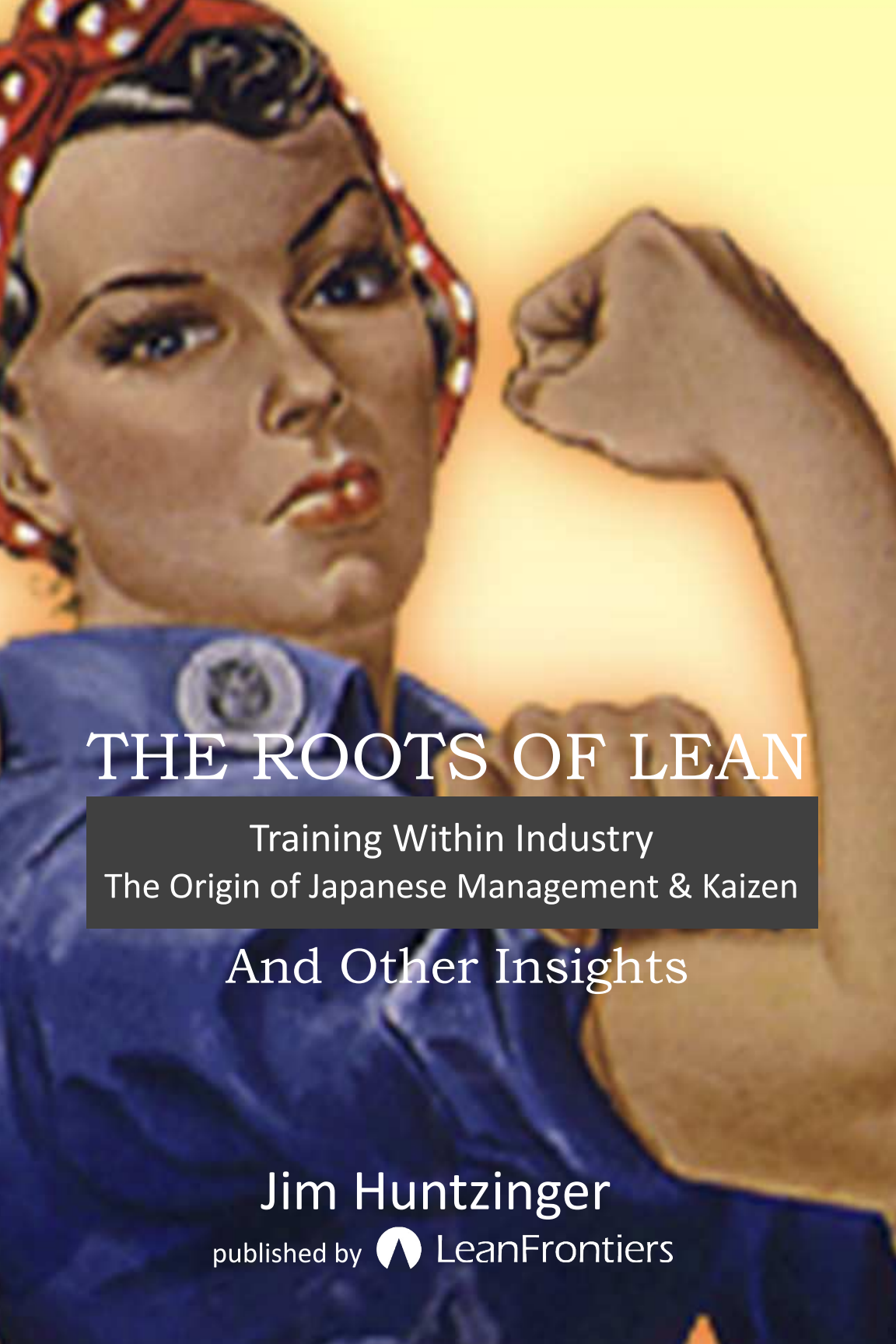

THE ROOTS OF LEAN

Training Within Industry
The Origin of Japanese Management & Kaizen

And Other Insights

Jim Huntzinger

published by LeanFrontiers

The Roots of Lean

Training Within Industry:
The Origin of Japanese Management and Kaizen
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by Jim Huntzinger

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

PREFACE

I originally wrote my "Roots of Lean: Training Within Industry, The Origin of Japanese Management and Kaizen" paper in 2001. I wrote it for an independent study course while working on my Master's degree to fulfill a part of my course work. My main purpose for writing the research paper was to capture the information I had discovered researching and learning about TWI. As I learned more about TWI, I realized it was an important part of developing and executing the lean business model. Being directly involved in "lean," (actually the Toyota Production System) from the first few years of my career working for Aisin Seiki, a Toyota Group Company, I came to realize that there had to be "something" missing from efforts to successfully implement Standard Work and kaizen. During my tenure at Aisin, and with my new company after I left Aisin, I had been directly involved in plant start-ups, process development and design, and the development and deployment of Standard Work and continuous improvement. It was a struggle in a variety of ways. While my colleagues and I made tremendous progress on implementing flow manufacturing (one-piece flow) and Standard Work, we were not achieving the consistency I had witnessed at Aisin and Toyota. There was something missing!

Upon discovering TWI from the books, Maasaki Imai's *Gemba Kaizen* and Jeff Liker's *Becoming Lean*, I knew this was the "something" I had known existed but had no idea what it was so I began digging. The "Roots of Lean" paper became the result of what I discovered.

In the years following my initial research, I continued to discover and learn more about TWI. I also eventually participated in train-the-trainer training for Job Instruction, Job Relations, and Job Methods. Furthermore, many of my colleagues also began and continue to research the robust sources and activities around the globe on TWI focusing on both its past and current implementations. My hope is that they not only continue their efforts, but also write about their learnings and discoveries as some of them already have. Their work and writings greatly add to the knowledge and history of this amazing set of skills and foundation of business and industry.

One of the miraculous discoveries (of many) in digging into the history of TWI was from 1944 in a December Newsletter written by C.R. Dooley. It discloses a foundational philosophy which drove the leadership of the TWI

program during the war. Their efforts were enlightened by the basic spiritual foundation of the United States which they manifested through their work with the TWI program. I have included this *News Letter* to illustrate the philosophical underpinning of the TWI program.

Jim Huntzinger
August 2014

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C.R. Dooley, December 16, 1944, *TWI News Letter*

As individuals we all believe this, but as groups we take the defensive. As individuals we give everything we have to those few nearest to us, but as the circle widens we become possessive and belligerent. As individuals we are courageous and stand for what we think is right, without hesitation. As members of a group we fight to preserve the group though it destroys the individuals who built it.

With Christ the dignity of the individual was born, but the struggle still goes on to recognize the individual within the group.

Once again, on Christmas Day we face this age-old problem with confidence that some day, notwithstanding centuries of struggle, groups of individuals will learn the importance of the dignity and true worth of every individual soul, for whom the very existence of any group is but to serve.

The TWI - Job Relations card says, *"People must be treated as individuals."* This is both good Job Relations and the Christian way of life.

May all our Christmas gifts, given and received, remind us of the parts we play as individuals within the group that *giving* will be the rule some day among organized groups, industry, labor and nations, as it is and always has been among individuals.

C.R. Dooley,
Director, TWI Foundation

INTRODUCTION

The Training Within Industry Service (TWI) was established in 1940 during World War II to increase production output to support the Allied Forces' war effort. The TWI Service was led by the Four Horsemen, as they became known during World War II; Channing Rice Dooley, Director of the TWI Service; Walter Dietz, Associate Director; Mike Kane, Assistant Director; and William Conover, Assistant Director. Three of the four men had met while serving in a training capacity during World War I using methods developed by Charles Allen. Charles Allen's training methodology, developed prior to World War I for shipbuilding, would become the key to the methods developed by the Four Horsemen during their TWI Service.

From Allen's 4-step training method the "J" programs would evolve and have a major impact on manufacturing in the United States during the war. The "J" programs were:

Job Instruction
Job Methods
Job Relations
Program Development

These programs were incorporated into industry by a large network of trainers setup throughout the country by the TWI Service. They focused on the interface between supervisors and employees and proved invaluable to the United States' industrial support of the war effort.

After the defeat of Japan, the occupational forces realized that in order for Japan to rise from the destruction they had received as a result of the war and to prevent chaos in the defeated country, Japan needed support in rebuilding its industrial infrastructure. The programs developed by the TWI Service were just what were needed to help the new Japanese management accomplish this goal.

A former TWI trainer and his group were contracted to come to Japan and begin the training process. They used the multiplier effect (training trainers who would be the core to train more trainers) to get the program started. Then, several Japanese agencies picked up the training program and promoted it at a national level. The massive training of the TWI's programs over the following decades in all facets of Japanese industry pushed the principles taught to become an integral part of the Japanese industry- or what is known today as *Japanese Management*. A major key of these methods is *kaizen*, which is derived from the TWI and Charles Allen's method.

A review of some basic philosophies of Japanese management and kaizen proves that they are actually an evolution of a training technique developed nearly ninety years earlier in the United States. The techniques have evolved through the TWI programs of World War II and their infiltration into Japanese industry by the Allied occupational forces. They continued to evolve in post-war Japan up through the present to become some of the most successful management techniques in use today in industry. The table below compares the basic four-steps of each type of training.

Steps	Charles Allen	TWI			Kaizen
		Job Instruction	Job Methods	Job Relations	
1	Preparation	Prepare	Breakdown	Get the Facts	Observe and Time Current Process
2	Presentation	Present	Question	Weigh and Decide	Analyze Current Process
3	Application	Try Out	Develop	Take Action	Implement and Test New Process
4	Testing	Follow Up	Apply	Check Results	Document New Standard

Table 1: Comparison of Steps

The ironic twist of these management principles is that even though they have their roots in the United States, today American companies struggle to use them in the same successful manner as some of their Japanese competitors do.

CHAPTER 1
Training Within Industry, TWI

What was the Training Within Industry Service, TWI? What does it have to do with modern manufacturing techniques? Everything. Lean manufacturing, Japanese management methods, and kaizen; TWI may well be the ground zero of these modern manufacturing philosophies that have developed into the most promising methods in industry today.

What is TWI and Why was It Formed?

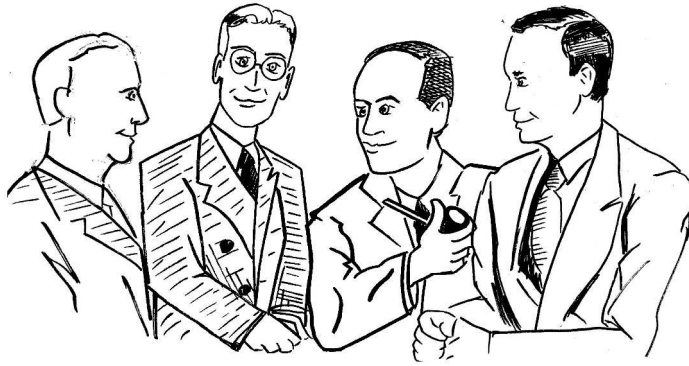
The TWI Service was started and developed to support industry for the United States' war effort during World War II. It was established in August of 1940 by the National Defense Advisory Commission and eventually was moved under the Federal Security Agency to function as a part of the new War Manpower Commission on April 18, 1942.[1] It would remain under the War Manpower Commission until it ceased operation in September of 1945.

TWI was one of the first emergency services to be organized after the Fall of France on June 20, 1940[2]. As the war escalated, the Allied Forces (even prior to the United States' entry into the war) needed significant war supplies. This need greatly increased the production levels in all types of industry. The United States government realized this situation and began steps to help cover the demand of war products. Many companies were receiving increasing orders for existing and new products, which exceeded their ability to respond. It also became apparent that if the United States entered the war, the situation would become even more critical. Thus, the TWI service was launched to increase production in order to meet the serious demand that had been

[1] 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.
[2] 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. 3.

placed upon industry. It focused on war contractors and other necessary war supply manufacturers, which continued to grow significantly in numbers as companies transitioned to war production.

TWI established a nationwide network of industrial professionals to teach valuable techniques to the manufacturers of war products. The network was to be made up of a volunteer staff of people, 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."[3] This emphasis was critical to create a legitimate organization that would be accepted by manufacturers. Also, for the same reason, TWI was never forced into any plant, but served only by invitation and acceptance from the plant's own management.



The Four Horsemen

The Four Horsemen[4], as they would become known for their leadership and service, were Channing Rice Dooley, Director of the TWI Service; Walter Dietz, Associate Director; Mike Kane, Assistant Director; and William Conover, Assistant Director. Dooley and Dietz were both graduates of Purdue University and had extensive industrial experience as well as previous government service in training issues during World War I. They both generously accepted the assignment to be on loan from their companies to coordinate and develop the TWI program. During their World War I assignment they had worked together and were both familiar with Charles Allen's 4-step method of training. (As will be explained later, this method of

[3] 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.

[4] The nickname came from the Four Horsemen from Notre Dame's 1922 to 1924 backfield of Harry Stuhldreher, Don Miller, Jimmy Crowley, and Elmer Laydon, made famous by Grantland Rice's article in the October 19, 1924, *New York Herald Tribune* covering the 13-7 victory against Army on October 18 in 1924. The legendary quote was, "Outlined against a blue-gray October sky the Four Horsemen rode again."

training became the backbone of the TWI's programs.) Kane had been involved with industrial training most of his career and had worked directly with Charles Allen during the training of shipyard employees during World War I. Kane had known Dooley and Dietz from the Great War. Conover had also been involved with industrial relations and training during his professional career.

The Four Horsemen were the leadership and drive of the TWI Service and it was their vision and experience that would help the TWI programs become a major success. Although it was the combined contribution of a huge number of people from industry to develop and deploy the objectives of the TWI Service, the Four Horsemen were the ones whom understood the magnitude of the task and what would be needed from industry and the government to evolve and guide the process.

The Results of TWI

The effectiveness of the TWI Service was very dramatic during the course of the war. *The Training Within Industry Report: 1940-1945* gives many details of the results of the programs and how TWI tracked the impact of their service throughout its existence. Given below is the tabulation of results collected by TWI at seven different intervals during its service.

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

Table 2: TWI Plant Results

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), page 92.

The number of industry people to go through the five, two-hour sessions for each training program was quite large. Even though the number of those who attended the sessions does not necessarily directly translate to results, it does give an idea of the magnitude of coverage the TWI Service achieved during its short five-year existence. Considering that all of the programs had to be developed and that the Service actually started down the consulting path during its first year, the number of people trained is impressive.

The War Production Board reported the following training totals:

> When TWI operating service ended September 30, 1945, the following certification totals appeared:
>
> | | |
> |---|---|
> | Job Instruction..... | 1,005,170 |
> | Job Methods..... | 244,773 |
> | Job Relations..... | 490,022 |
> | Union Job Relations..... | 8,856 |
> | Program Development..... | 1,829 |
> | Total..... | 1,750,650 |
>
> These people have been trained in 16,511 plants and unions, in. every kind and size of war industry and essential service…[5]

How TWI Evolved During WWII

The purpose of the TWI program was directly stated in its overview bulletin:

> 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.[6]

This objective would guide the leaders of TWI as they continued to develop the best means to apply the service during its five-year existence. Although the development process was very laborious, it resulted in excellent field-tested methods and procedures.

The First Effort

The initial effort was to use the TWI network of people for consulting with plants on how to solve many of their production issues. However, the leaders of the TWI quickly learned that this method would not be adequate to help the ever-increasing number of plants requiring assistance. Despite the fact that a large portion of TWI's initial effort was expended in promoting its services, the drain on its resources steadily increased. TWI

[5] 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. 126.
[6] 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.

had developed bulletins, surveys, and speaking engagements in order to "sell" its program. This process was not easy: many plants had not yet felt the pressure of training issues while others thought that they did not have the time available for training.

Despite the need to sell TWI services, the strains of taking on too much work continued to weigh down the TWI. As the TWI leaders soon discovered, problems developed because TWI personnel were needed as consultants; manufacturing plants were continually asking for TWI assistance with their various in-house problems. As a result, these two issues quickly overloaded the limited resources of TWI's network. Trying to tackle problems from a consultant's point of view consumed a large amount of time, which would not work if TWI members were already to help the war supply industry as a whole. The in-house problems companies need assistance with included machinery, material, and manpower – from labor disputes to safety problems. Beyond this, the number of defense plants continued to mushroom. Although the period during TWI service grew to be chaotic, it gave its leaders a great lesson about what TWI should focus on to truly transform industry in the war effort.

The Second Effort

The initial chaos of trying to organize the TWI Service redirected TWI toward a new plan that changed the focus of its efforts. A paragraph out of Walter Dietz's book explains how this happened.

> 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.[7]

The new objective gave TWI the it would need to be successful throughout the rest of its tenure. The focus on supervisors and their interface with employees would be the critical factor needed to support the war effort. This factor is also one of the key foundations from which Japanese management methods evolved- as will be illustrated below.

[7] Walter Dietz with Betty W. Bevens, 1970, *Learn by Doing: The Story of Training Within Industry 1940-1970* (Summit, NJ: Walter Dietz), p. 13.

TWI leadership realized that the methods developed would need to be taught successfully by a wide range of trainers with differing amounts of experience and skill in an expansive variety of industries. In addition, this information would be delivered to an enormous number of plant supervisors possessing various levels of knowledge and experience. It was quite a daunting task and the training methods would have to be absolutely bulletproof. Fortunately, this is where Charles Allen's 4-Step method would play a significant role.

CHAPTER 2
The Origin of the TWI Methodology

What would be the cornerstone of TWI Service's training program was developed from methodology introduced by Dooley, Dietz, and Kane. All three gentlemen had been involved in training assignments during World War I. They used this experience to develop the TWI training programs used during World War II.

Charles R. Allen

During World War I, the Emergency Fleet Corporation of the United States Shipping Board implemented an urgent training program to support the training of shipyard workers due to a ten-fold increase in the demand of workers required. Due to this demand, only non-experienced workers were available. Therefore, they needed to be trained, and Charles Allen would successfully take up this charge.

Charles Allen had been a vocational instructor who had developed and presented his views on industrial training prior address the vast training need of the shipyard workers. Allen used his 4-Step method, as described below, to train the shipyard workers:

> …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. [8]

Charles Allen's methods and philosophies also describe how to choose the best trainers; defines the role of an industrial trainer; what he needs to know and do. Furthermore, it details the essence of what is and is not

[8] Charles R. Allen, 1919, *The Instructor, The Man, and The Job: A handbook for Instructors of Industrial and Vocational Subjects*, (Philadelphia and London: J.B. Lippincott Company), p. 129.

effective instruction. These and many other of Allen's lessons are completely interwoven in the methods and practices of the TWI program. In fact, within the first few pages of his book, Allen states its purpose:

> This book is intended, therefore, to serve two purposes – to serve as a handbook to instructors in industrial plants, and also to serve as "instruction notes" in instructor training courses.[9]

Allen's 4-Step method was the basis for all of the training programs developed and implemented by the TWI program during World War II. Since it had been intensively developed and used in vocational training in shipbuilding during the first part of the 20th century, it was a known and proven method that had been around for thirty years. Barring a few dated phrases, the methods presented in Allen's book are just as valid and applicable today as they were in the early part of the century (World War I) as well as the middle of the century (World War II).

The Importance of Training

Allen recognized and stressed the importance of proper training in industry. He discussed how improperly trained employees create excess cost and how the cheapest method to use is only well-trained people from the start. Allen described this as "three factors in efficient production…The instructor, because it is through effective instruction that we can secure efficiency in training. The man, because when properly trained he does the best work. The job, because production efficiency comes from well instructed men doing good jobs."[10]

To achieve the best training, four principles must be applied: standards must be set, good instruction must be established, continued training must be maintained, and training must not end too soon. These principles must become an integral part of a company's process of business. Although it may

[9] Charles R. Allen, 1919, *The Instructor, The Man, and The Job: A handbook for Instructors of Industrial and Vocational Subjects*, (Philadelphia and London: J.B. Lippincott Company), p. iv.
[10] Charles R. Allen, 1919, *The Instructor, The Man, and The Job: A handbook for Instructors of Industrial and Vocational Subjects*, (Philadelphia and London: J.B. Lippincott Company), p. 3.

seem like common sense, how many companies have this type of program in place and have mastered it even if they do?

Allen devotes much of the book to not only his 4-Step method of training, but to methods of instruction and effective conditions of instruction as well. He illustrates much of his work with shop examples and emphasizes the importance of getting the "interest" of the learner, or making the learner want to learn. He also covers extensively the importance of selecting the correct people to be trainers, how the trainer should and should not instruct, and how the trainer should develop, organize and deploy the training.

At the end of Allen's book, he concludes that most of us currently involved in manufacturing could stand to be "taken out back for a good horse-whipping" due to the horrid training methods that are common in much of industry today – the twenty-first century.

The 4-Step Process

Charles Allen's 4-Step process was the basis for TWI's training program. The first step, preparation, focuses on creating in the learner's mind a connection between past experience and the lesson to be taught. Although the learner may have no industrial experience, a good instructor will find an analogy or story, which will lead the learner to relate the present teaching objective to something he is familiar with. Allen emphasizes that even when teaching the simplest skills or jobs, preparation is key to increasing the effectiveness of instruction. It may be stated that tying in a past experience, whether it be simple or only indirectly related,

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.

Table 3: Allen's 4-Step Process

directs the learner's thoughts to the task at hand and establishes an "interest" for the learner. It is most likely for this reason that Allen dedicates several chapters to the methods of capturing the interest of the learner.

According to Allen, preparation (the second step) is, "to lead him to 'get' the new idea which the instructor desires to 'tack on' to what he (learner) already knows."[11] Presentation imparts a piece of knowledge to the person being trained, andeach piece is only a small part of a larger lesson. An effort must be made by the instructor not to give too much information in one dose. This leads to focusing on the individual point to be taught. The format of the presentation step is a well-organized process established prior to the lesson with methods chosen to allow the best direction and theme of the lesson. The presentation process developed is selected from a variety of methods, as detailed throughout the book, based on both the type of job and the characteristics and level of the learner. Moreover, the effectiveness of developing the best method of presentation is completely dependent on the skill of the instructor in the following areas: selection of the proper method, organization of the lesson points, and emphasis of the most important points.

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.

Table 4: Allen's 4-Step Process

Application, the third step, establishes if the learner can "do it". Even though the learner may be in the right frame of mind (step 1) and the instructor did an excellent job of presenting the lesson (step 2), the question remains if the new knowledge can be absorbed and applied. Allen stresses in step 3 that the learning contains no value unless the person can actually do it and do it *correctly*. The application step has two purposes:

1) …since power to apply a thing is different from simply knowing it, he must be trained in actually applying, or putting into practice what was presented

2) …to check up the degree to which the learner has grasped all the points in the lesson[12]

[11] Charles R. Allen, 1919, *The Instructor, The Man, and The Job: A handbook for Instructors of Industrial and Vocational Subjects*, (Philadelphia and London: J.B. Lippincott Company), p. 136.
[12] Charles R. Allen, 1919, *The Instructor, The Man, and The Job: A handbook for Instructors of Industrial and Vocational Subjects*, (Philadelphia and London: J.B. Lippincott Company), p. 139.

Another important point Allen discusses is that no matter how well the lesson has been taught, mistakes will be made and must be corrected in this step.

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.

Table 5: Allen's 4-Step Process

The final step, testing, is simply allowing the learner to do the job unaided, but viewed by the instructor. If the learner fails to do the work independently, it is a result of the instructor not implementing the proper teaching method. The instruction must be improved and repeated. He emphasizes that if each of the lesson steps had been carefully and properly developed and taught, the learner would not have failed during the test step. The fault lies completely with the instructor. Allen explains how this situation is common and that true instruction is not an easy skill to learn. Much practice and experience are part of developing a good instructor. Thus, the person who can successfully achieve the fourth step with a learner is a rare and valuable asset. The final step is as much of a test for the instructor as it is for the learner.

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.

Table 6: Allen's 4-Step Process

Allen's 4-step method of instruction is a series of building blocks with each one completely dependent on the previous step to be successful. Allen's

explanation of his 4-Step method indicates that it is a method of correctly stringing together a series of *One-Point* lessons, which is common today in many companies that use lean principles or Japanese Management methods. Each individual lesson within the overall lesson must have a stand-alone point that needs to be conveyed to the learner via the larger picture of the entire lesson. Although the explanation of the 4 steps are only four chapters of Allen's book, nearly all of the other chapters present ideas, philosophies, examples, procedures, and methods on how to understand, prepare, develop, and deliver the 4 steps successfully, or simply: how to be an effective instructor, which gives a deep context beyond just simply teaching and delivering the 4-StepMethod. Having this deeper understanding of behaviors and practices supporting the 4-Step Method is key to successful long-term success and developing the infrastructure necessary to sustain and support these methods and practices for the organization as a whole.

The Courses

The connection between Charles Allen's methods and TWI's Service training program came directly from the leadership of TWI. Kane had been a member of the Emergency Fleet Corporation group under Charles Allen during the First World War. Dooley and Dietz had been on assignment for the War Department during World War I and knew Allen and Kane, as well as Allen's training methods. In fact, in *The Training Within Industry Report: 1940-1945*, significant discussion is given to the work of Allen and his emphasis on stressing the difference between "teaching and telling" and "instructing and showing". The importance of teaching and instructing instead of telling and showing became the main foundation of the TWI programs, ***learning by doing***, which translates to solving problems on the job with the guidance of a properly trained instructor.[13] The *learn by doing* approach would become an integral part of TWI's philosophy of training.

The Five Needs of a Supervisor

TWI continued to "sell" its service to production facilities. In order to explain to manufacturing plants why the TWI programs were beneficial, TWI developed a philosophy, which was delivered continually and became a standard part of the TWI Service. This philosophy became recognized as the following:

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[14]

The first two needs were the responsibility of the plant or company to establish for the supervisor. This information covered equipment, products, and the skills required to manufacture them, as well as company policies, agreements, and schedules. TWI assisted companies in giving their supervisors the training to attain the last three needs. As will be discussed below, each of the three "J" programs targeted one of the three supervisor skills. These skills must be learned and practiced in order for production levels to be met and increased, especially with industry circumstances in the United States at the time.

Today, these same five needs are as critical in manufacturing as they were in industry during the war effort in the 1940s. Supervisors are the front-line personnel directly responsible for understanding and leading those who are creating value – the shop employees. In the author's opinion, nothing less than the best people with the best knowledge and training should be in the supervisory positions. Industry must understand the deficiency of its infrastructure in this area, which is presently a significant problem.

The J-Programs

The "J" programs, as they became known, were modeled from Allen's 4-step method for training. Kane used the 4-Step method during one of TWI's initial program requests. A shortage of trained lens-grinders and polishers resulted in a severe lens shortage and thus, a call to the TWI Service. Kane used the 4-Step method to develop a 7-Step method

[14] 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), pp. 48-49.

combined with a "key points" concept to decrease the time required to train lens-grinders and polishers from years down to months. The "key points" concept was developed during the lens crisis. Kane discovered that, although there were a large number of operations to learn to manufacture lenses, only a small number of the operations were difficult to master. Also, only a few steps within the vital operations were critical to understand how to successfully master the technique. As Dietz would later state, "In essence, "Key Points" means simply this: much of the supposedly difficult work in any industrial operation is relatively simple". [15] Combining his modified "Steps" with the newly developed "Key Points", Kane had not only significantly improved training for the lens crisis, but also established what would become the cornerstone of TWI's training program.

Job Instruction

Charles Allen's 4-Step method of industrial instruction would be used to develop the five-session (two hours each) training program for Job Instruction. The first two sessions would cover the presentation and discussion of the instruction method developed and the last three sessions were used for actual practice of the method. All of the participants were to use an instruction method being taught to members of their department for actual application of the methods presented and then report back to the group during the sessions. This actual application was based on the powerful slogan adopted by TWI, "If the learner hasn't learned, the teacher hasn't taught"[16]. This approach was yet another philosophy that the TWI Service borrowed from Charles Allen. Allen had repeatedly reinforced this statement, or rather this attitude, in his book and in his own instruction. TWI's mission would incorporate this approach during development and implementation of its training programs.

Job Instruction would not be officially released until it had been used, evaluated, and revised multiple times. In fact, all of the training programs would be developed in this same manner. TWI would develop the instruction method by using it in many plants and then use the feedback from the plants along with their own assessment of how effectively it accomplished its task. This approach was used to develop a sure-fire method to be successfully used in all industries, and also so that it was a method developed for industry by industry. The leaders of the TWI Service, even though they were from industry, believed that "for industry

[15] Walter Dietz with Betty W. Bevens, 1970, *Learn by Doing: The Story of Training Within Industry 1940-1970* (Summit, NJ: Walter Dietz), p. 4.

[16] 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. 193.

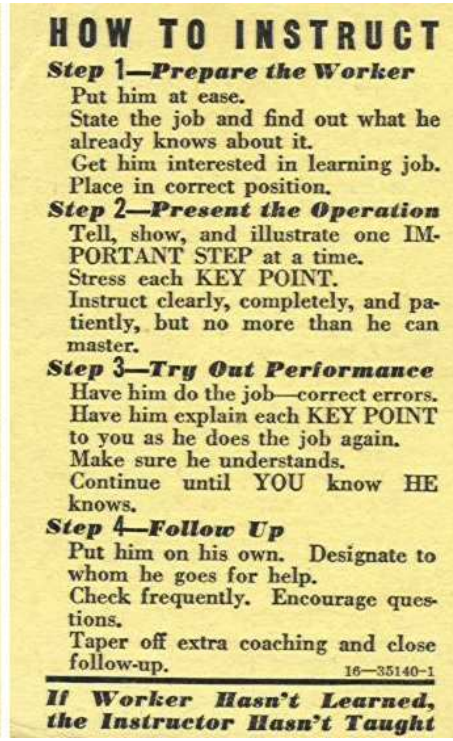
by industry" was critical for the program's acceptance and success. Job Instruction focused on "instructing employees rather than 'letting them learn'"[17]. This focus was present even prior to development of the training program and continued throughout the existence of the TWI Service. A training manual developed by the Western Electric Company during the war was published by TWI and re-emphasized this focus. It also relied on Charles Allen's 4-Step method and job analysis technique for developing good training methods. The manual developed, *Job Instruction: A Manual for Shop Supervisors and Instructors*, reads like a summary of Allen's book and references two of Allen's training books in its bibliography. The manual states:

> Good teaching is helping people to learn without getting in their way of learning. Poor teaching may actually hinder their learning.[18]

The Job Instruction training manual was developed to tackle one of the first issues realized after TWI refocused their efforts. With the steady increase in production demand combined with the decrease of experienced employees, training new personnel became a critical factor. TWI introduced Job Instruction training to help alleviate this problem. With Allen's 4-Step method as the backbone of the training, significant improvements were made in multiple war production facilities.

The Job Instruction training manual referenced the use of Job Instruction cards during the training sessions. All persons attending were issued a card. The front of the card outlines the instructor or supervisor's procedure for preparing to instruct. This procedure is similar to Allen's technique. The back of the card outlines the 4-Step method of *How to Instruct*. The small pocket-sized card was an important training tool; it was to be carried by the supervisors at all times as a reminder of and reference to the methods they had been trained to use on their jobs. Pictures of the original Job Instruction cards are displayed in Figure 1.

[17] 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.
[18] Labor Division, War Production Board, Training Within Industry Service, date not given, *Job Instruction: A Manual for Shop Supervisors and Instructors* (Washington D.C.: U.S. Government Printing Office), p. 1.



Front of the Job Instruction Card **Back of the Job Instruction Card**

Figure 1: TWI 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.

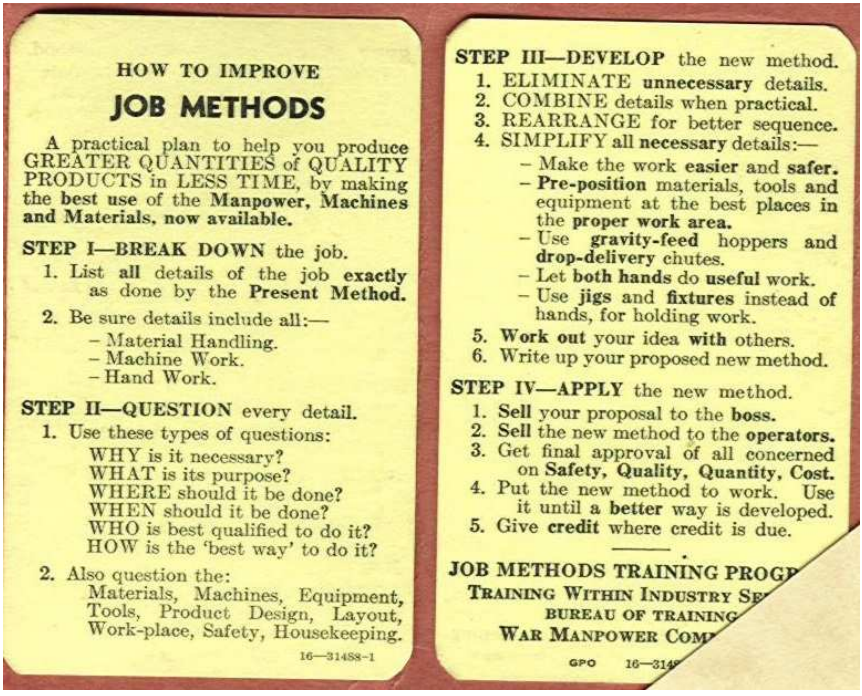
Job Methods

The objective of Job Methods training was to give supervisors a technique to achieve obvious improvements in the work area using a practical approach instead of a technical approach. Use of this philosophy provides a universal procedure that would be successful in all types of war production plants.

> …the objective of 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.[19]

[19] 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. 230.

The 4-Step method was again used to develop the training procedure. Within the method, a procedure for breaking down jobs was critical for developing a new and improved way to do the job. A simple demonstration of assembling a radio shield was used during the training session to illustrate how to break down the "present" method and implement a new way for the "proposed" or improved method. The aim of the Job Methods program was to prevent supervisors from presenting ideas that were incomplete or flawed. By following the 4-Step Job Methods procedure, the supervisors would discover improvements during this process and create a feasible solution before presenting it to management. Next, an outline of the procedure, like Job Instruction, was printed and given to the trainees on a small pocket-sized card for continued reference. An illustration of the Job Methods card is shown below. A similarity to the method used for implementing KAIZEN can be seen in the steps detailed on the card. The reason for this will be discussed later. Job Methods proved to be another very successful program for the TWI Service.



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.

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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 of the Job Methods Card **Back of the Job Methods Card**

Figure 2: TWI 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.

Job Relations

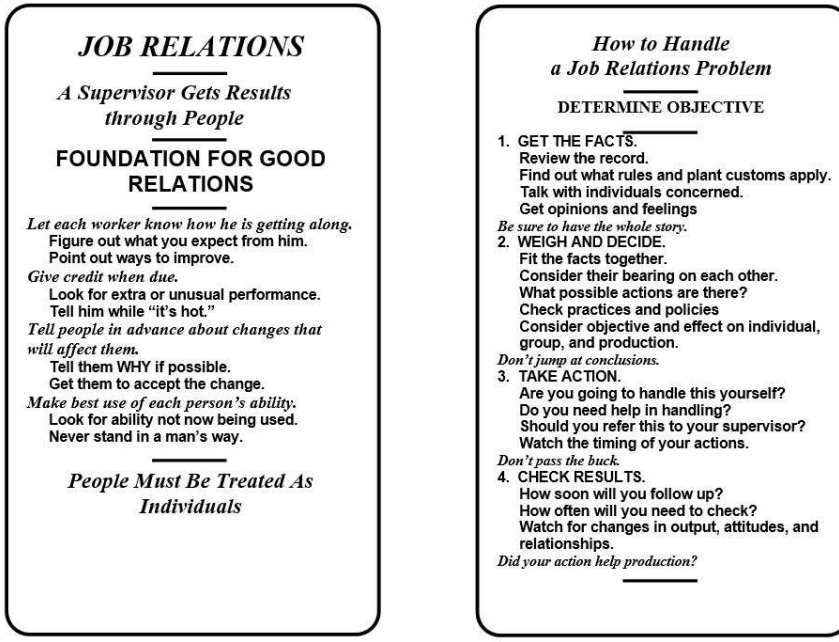
The Job Relations program was implemented mainly due to need:

> …that supervisors needed a great deal of help in human relations – the art of handling men.[20]

Although the need was that of human relations between supervisors and their subordinates, it was titled with the term "job" in order to relate the program to the job, as were all of the "J" programs. With this emphasis in mind, a theme of "poor relationships caused poor results" in production and "good relations lead to good results" on the job would be the underlying objective of the Job Relations procedures developed.[21] Thus, much of the program's emphasis was placed on teaching the importance of understanding and resolving small issues before they became large, widespread issues. During development of Job Relations training, some universal and fundamental elements were discovered. These elements then became the foundation of the Job Relations program with the most vital skill for any supervisor to achieve being: "*People Must Be Treated As Individuals*"[22]. Other critical elements centered on developing your people and giving direct communication in the form of coaching your people.

As with the other two "J" programs, the 4-Step method was used to develop the Job Relations procedures, thus securing the underlying principles. The training sessions consisted of explaining the principles using everyday case studies involving a fictitious supervisor and his employee. Each of the four steps would be presented in a case study showing how the supervisor handled the situation. Then, this method was used to present the lesson to the group. Each attendee was then required to use the process in their area of responsibility and report the results back to the class. Again, a Job Relations card was made and given to each training attendee for reference. The outline for the Job Relations process is listed on the Job Relations card illustrated below.

[20] Walter Dietz with Betty W. Bevens, 1970, *Learn by Doing: The Story of Training Within Industry 1940-1970* (Summit, NJ: Walter Dietz), p. 19.
[21] Bird McCord, "Job Instruction," in Robert L. Craig (ed.), 1976, *The Training and Development Handbook – A Guide to Human Resource Development*, 2nd ed. (New York: McGraw-Hill), p. 32-17.
[22] 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. 40.



Front of the Job Relations Card **Back of the Job Relations Card**

Figure 3: TWI 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

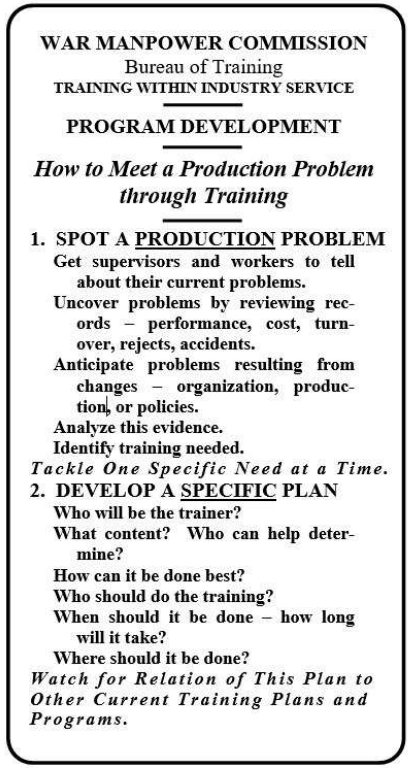
Union Job Relations

In February of 1945, the TWI Service released a Union Job Relations training manual. The creation and issue of this manual was due to many plants with unions using marked-up copies of the Job Relations manual in training of their union stewards. The Union Job Relations manual was a modified version of the Job Relation manual with the highlight on union stewards instead of supervisors. It also used union problems in the four case studies to be taught.[23] The basic format was the same as the Job Relations manual. Union leadership throughout the country was very supportive of the "J" programs and found them helpful to their membership.

[23] 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), pp. 220-221.

Program Development

Program Development was organized as a means to show plants how to setup and administer training within their own facility and staff. As was now standard, TWI utilized the 4-Step method and Key Points to present procedures for plant personnel to solve their company's own production problems through a training program using the "J" programs as a base. Program Development was developed using input from many experts within industry to maintain TWI's premise of "for industry by industry". A series of conferences was used to gather information, put together an outline, and develop the procedure into an accepted and usable form. Several iterations of Program Development came about during its evolution including different names for the program. Upon its final release, a Program Development card was available and listed the 4-Step method as it appears in the illustration below.



WAR MANPOWER COMMISSION
Bureau of Training
TRAINING WITHIN INDUSTRY SERVICE

PROGRAM DEVELOPMENT

How to Meet a Production Problem through Training

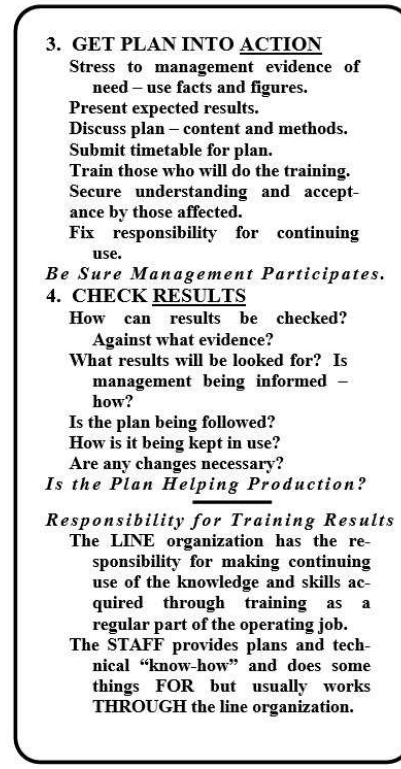
1. SPOT A PRODUCTION PROBLEM
   - Get supervisors and workers to tell about their current problems.
   - Uncover problems by reviewing records – performance, cost, turnover, rejects, accidents.
   - Anticipate problems resulting from changes – organization, production, or policies.
   - Analyze this 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.

Front of the Program Management Card



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.

Back of the Program Management Card

Figure 4 TWI 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.

The introduction of Program Development followed a familiar path for those plants that had already received the three supervisory programs.

> The P.D. Institute Conductor followed standard TWI practice and described a production problem, then demonstrated how a training director solved it through use of a 4-step method.[24]

Program Development would be the last service that TWI would develop and deploy. By the time the last revision of it had been put into use, the end of the war was in sight and this meant the end of TWI was also on the horizon.

The Multiplier Principle

One critical technique used by the TWI Service was key to disperse the training programs on a broad scale throughout all of the country's war production facilities. It was known as the *Multiplier Principle*. The multiplier principle was simple in concept, but powerful in its application. Simply put, it stated:

> Develop a standard method, then train the people who will train other people who will train repeated groups of people to use the method.[25]

The use of the multiplier principle allowed TWI to certify over 1.7 million supervisors and trainers throughout the United States in its brief five-year existence.

Coupled with the multiplier principle was TWI's requirement for strict adherence to follow the training programs exactly as intended. Trainers were expected to follow the manuals exactly or they would lose their license. The manuals were designed to be read from up to five feet away so that trainers could easily reference and read from them during training sessions. Each manual had reference sections explaining detailed information, font changes and symbols to denote exactly what trainers should do, emphasize, and even write on the blackboards. The Job Instruction manual had the phrase, WORK FROM THIS OUTLINE – DON'T TRUST TO MEMORY, on every page as a

[24] 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. 46.
[25] 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.

reminder to strictly follow the format of the booklet. Each of the three "J" program manuals had a letter to the War Production Trainers from Dooley, which contained 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.[26]

All of these methods, along with the multiplier principle, allowed TWI to present a very standardized curriculum to a large number of plants using many individual trainers with a wide range of experience and ability. This technique was its method of maintaining quality control of their service. TWI felt that once it had developed the Job Instruction training program, as well as the other programs, trainers must follow the sessions exactly as intended for success to occur.

[26] 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.

CHAPTER 3
The Kaizen Technique

The most interesting aspect of what TWI accomplished, aside from the huge success industry in the United States had during its war production effort, is KAIZEN. Kaizen has become one of the most recognized and emulated techniques of Japanese management methods or of the Toyota Production System, TPS. Although kaizen is just one of the many tools and/or philosophies of lean manufacturing, its origin can be traced back to the early part of the Twentieth century. In essence, Charles Allen's 4-steps may be the grandfather of kaizen.

Job Methods – The Original Kaizen

In review, the objective of Job Methods was to give supervisors a method for improving production using a practical approach instead of a technical approach. TWI desired and succeeded in giving supervisors a simple yet effective method for making improvements in their work area on a continual basis. The purpose of the pocket cards was to keep this idea, along with the procedures, with the supervisor at all times.The term *kaizen* is usually translated as *continuous improvement for the better* or simply *continuous improvement*. A point that TWI stressed about Job Methods could literally be a definition for kaizen today.

> 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.[27]

This statement is not only an important account about the purpose of Job Methods during World War II, but also, it is what kaizen targets in industry today. Masaaki Imai, who has written about Japanese management methods and worked to bring these methods to the West, states that "KAIZEN is the basic philosophical underpinning for the best in Japanese management"[28]. Research and writing by Alan Robinson of the University of Massachusetts also confirmed that Job Methods is the pre-cursor to kaizen in Japanese management methods. In referencing the Job Methods training, Robinson states:

> The aim of this program was to teach supervisors the importance and techniques of continuous improvement.[29]

[27] 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), pp. 38-39.
[28] Masaaki Imai, 1986, *Kaizen: The Key to Japan's Competitive Success* (New York: Random House), p. xxxi.
[29] Alan Robinson, ed., 1991, *Continuous Improvement in Operations: A Systematic Approach to Waste Reduction* (Cambridge, MA: Productivity Press), p. 18.

More detail of how the TWI programs were disseminated into Japanese industry will be explained in the next section. As will be seen, it is evident that Job Methods is the foundation of today's kaizen methods.

The Shingijitsu and the Kaizen Workshop

Masaaki Imai's book, *Gemba Kaizen*, and Jeff Liker's book, *Becoming Lean*, made reference to Training Within Industry material. Research of these documents led to *The Training Within Industry Report: 1940-1945*. As detailed previously, the report defined the program, how it developed, what it developed, and those involved throughout its five-year existence. It also references the work of Charles Allen several times throughout the report, thus acknowledging his influence on the TWI leadership. However, the most significant correlation between kaizen and the TWI programs was the outline for the Job Methods 4-Steps, which read like the kaizen training materials offered by the Shingijitsu consulting group in their *5 Days and 1 Night* seminar from the early 90s.

For those not familiar with the Shingijitsu Consulting Group, they are a Japanese consulting group specializing in helping companies implement lean manufacturing techniques. They were introduced to the West by Masaaki Imai in the late 1980s and continue their consulting service today. Several pupils of Taiichi Ohno from Toyota and its group companies founded the Shingijitsu group. Their specialty has been kaizen workshops, which have grown throughout North American and European industry since their inception.

Listed below are phrases commonly heard by anyone participating in a kaizen workshop. They highlight eliminating waste, making work task improvements, and a perpetual drive to maintain improvement activities.

> "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."[30]

The ironic quality about these common kaizen workshop phrases is that they are actually taken from the 1943 Job Methods training manual used by the TWI service. Therefore, it would seem that the kaizen workshop is just an extension of the former TWI training session. They both use the same methodology for implementing improvements and both emphasize the *learn by doing* approach. In fact, anyone who has attended the Shingijitsu's workshop can attest to the hours, even into the night, spent on making changes out in the shop; or *learning by doing*.

As with most good and usable ideas, they are not generally new. It can be stated that kaizen is not new. In fact, kaizen is fifty years old when going back to Job Methods. Industry could be celebrating the Golden Anniversary of kaizen, but, again, that may not be true:

The principles of the Job Methods plan are not new. They were developed thirty years ago.[31]

This statement is from the Job Methods training manual (1943) and is in reference to Charles Allen's development of his 4-step method for instructing techniques. So now, we may well be closing in on the 90-year anniversary of the original kaizen principles. It is surprising that an industrial philosophy considered to be a modern and foreign method is actually a very old hometown practice that has just been forgotten.

[30] 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), pp. 29 - 34.
[31] 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. 37.

CHAPTER 4
TWI May Be Lean's (Not-so-Distant) Great Uncle

Upon review of the information detailed above, the impact the TWI Service had on today's Japanese management methods becomes clear. How did this program disseminate into Japanese industry? What other areas in modern management may have been effected?

John Shook, who went to work for Toyota in 1983, may give the answers. He was directly involved with the transfer of Toyota's management methods and production system (TPS) to North America. He sheds light into TWI's influence on one of Japan's (and the world's) most effective manufacturers.

> I discovered them in a roundabout way in the process of "adapting" some of 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.[32]

TWI's Dissemination into Japanese Industry

TWI's introduction to Japan's industry began with the end of World War II.[33] During the Allied Occupation of Japan after the war ended, General Douglas MacArthur was in command. His Occupation authorities quickly realized that due to the near complete destruction of the Japanese industrial base, civil unrest was feared to be a high potential. Instead of severe punishment, as many people in the West desired, they recognized that rebuilding Japanese industry was critical. A major objective of the rebuilding was to eliminate the intense militarism that existed before and during the war and to instill a democratic attitude within industry. Some of

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

[33] 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, refer to his work given in the bibliography.

the members of MacArthur's Occupation leadership were aware of the TWI Service and its success in the United States. They felt that the TWI programs were exactly the type of initiative that would help support the rebuildingand infuse democratic principles in Japan on a national level. In Alan Robinson's book, *Corporate Creativity*, he discloses a memo from 1949 which describes the situation in Japan at the time:

> 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.[34]

Perhaps the most disturbing point of this statement is not related to the situation in Japan in 1949, but the fact that it describes many of our manufacturing plants today. This method is common practice for today's supervisors in our "modern" industry!

The Occupation authorities moved forward and brought the TWI programs to Japan. The job was awarded to TWI Inc., from Cleveland, Ohio. Lowell Mellon who had been a TWI instructor in the United States during the war led the company. His job was to teach the courses in Japan while implementing the Multiplier Principle. Mellon, along with three instructors, spent six months training thirty-five "master instructors" and set the foundation for the Multiplier Principle to take effect. Upon Mellon's departure, several government agencies continued to spread the TWI training throughout Japan's industry. By 1995, almost 100,000 TWI instructors had been certified. The official number does not reflect the actual total because many instructors received their certified training and went back to their own companies to set up internal TWI programs. For instance, Toyota implemented TTWI, Toyota Training Within Industry. Takahiro Fujimoto, provides a detailed analysis of how the Toyota Production System evolved at Toyota, and noted TWI's influence in Toyota's management system:

> 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.[35]

[34] Alan Robinson and Sam Stern, 1997, *Corporate Creativity: How Innovation and Improvement Actually Happen* (San Francisco, CA: Berrett-Koehler Publishers), p. 74.
[35] Takahiro Fujimoto, 1999, *The Evolution of a Manufacturing System at Toyota* (New York, New York: Oxford University Press), p. 40.

Another interesting fact that Robinson relates is that although the Job Methods training was translated into Japanese in 1950, it remained unmodified for nearly twenty years.[36] Many of the elder executives of Japanese companies today were the young professionals at the end of the war who became responsible for rebuilding their industry. They were trained and influenced by the TWI programs (and several others) and carried these methods with them throughout their careers. As we will see below, TWI's infiltration in Japan's industrial management continues to have an impact today.

Learn By Doing

As we have seen, the principle *learn by doing* was the foundation upon which TWI was built. All of the training programs were developed based on the learner using the procedure on an actual shop issue and presenting it to the group – *learning by doing*. Throughout *The Training Within Industry Report: 1940-1945*, the phrase is used and its emphasis stressed. In fact, one of the "four essentials" upon which the training programs were built was:

> It must be built on the principle of demonstration and practice of "learning by doing," rather than on theory.[37]

This was the influence of Charles Allen. His 4-Step method was built upon creating the best possible environment to enable a perfect *learn by doing* situation for the learner. This feature is what the TWI Service successfully developed and promoted in the United States during the war and what the Allied Occupation brought and implemented in Japan after the war. It was such a fundamental aspect of the TWI programs that Walter Dietz's self-published book about TWI is titled, *Learn By Doing*. Its practice is still prevalent today.

[36] Alan Robinson and Sam Stern, 1997, *Corporate Creativity: How Innovation and Improvement Actually Happen* (San Francisco, CA: Berrett-Koehler Publishers), p. 77-79.
[37] 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. 32.

The author's experience with *learn by doing* comes from his first employer after graduating from college, Aisin Seiki. Aisin is a Toyota Group company and one of Toyota's biggest suppliers. As Aisin was transplanted in North America to supply the Toyota plants, the author was a manufacturing engineer who was constantly told that he must "go do by yourself", or go out in the shop to the manufacturing line and try it himself. This situation may not have been Charles Allen's or the TWI's best-organized manner of learning by doing, but it was a derivative of that process. The Japanese engineers who the author worked beside not only stressed "go do by yourself", but related how they had been told this same directive as "freshman" (new, fresh from school) engineers. After struggling through some CNC machine tool manuals (written completely in Japanese)-and accidentally machining a couple of fixtures incorrectly-the author eventually *learned by doing*. The author also spent quite a bit of time running the assembly and machining lines as an operator. As will be seen, this is another technique used to train under the *learn by doing* philosophy.

Another example of the *learn by doing* approach is related by John Shook in his article in the book, *Becoming Lean*. John's section "Lessons in the Toyota Production System" describes his first lesson:

> 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.[38]

John's experience with the method was spent working on the lines in Toyota's automotive plants including stamping, body weld, paint and final assembly. This practice is used to give engineers and managers an intimate understanding of the processes for which they will be responsible. There is no better way to understand something than by actually doing it – *learn by doing*.

As shown above, *learn by doing*, thought to be a Japanese style of training, actually has its roots in the TWI program brought to Japan after World War II.

Supervisor Development

TWI also introduced the use of supervisors to Japanese industry. Although supervisors have always played, and continue to play, a critical role in

[38] 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. 47.

manufacturing, the growing use and role of team and group leaders can be traced to TWI's focus on the supervisor role or interface between the supervisor and operator. For those familiar with the strong support role team leaders play at Toyota, the connection with TWI training is clear. The team leader plays the role of instructor, leader, advisor, fill-in, and improvement solicitor and implementer. These functions correlate to the three "J" programs and what 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.[39]

As both TWI and Charles Allen emphasize, the supervisor (instructor) has to have much more than just knowledge of the job. A supervisor must also have the ability to develop a procedure and instruct the learner to receive, understand, and apply the function of the job. TWI also, with Job Methods and Job Relations, required supervisors to lead people and use their ideas to improve and increase production. Today, the role of the team leader or supervisor in Japanese management philosophy reflects the role the TWI Service presented to industry for supervisors.

Top Management Support

Anyone who has either read about or worked to implement lean manufacturing understands the absolute support management must give for lean to be successful. This requirement is a mainstay for any type of change. Another interesting aspect of the TWI program is its *staunch* requirement for management support in the manufacturing plants where the training took place. Upper management support for TWI training had to be forthright before any training would happen. TWI developed directives for their and the hosting company's responsibilities. The model TWI developed for this plan is illustrated below.

[39] Alan Robinson and Sam Stern, 1997, *Corporate Creativity: How Innovation and Improvement Actually Happen* (San Francisco, CA: Berrett-Koehler Publishers), p. 75.

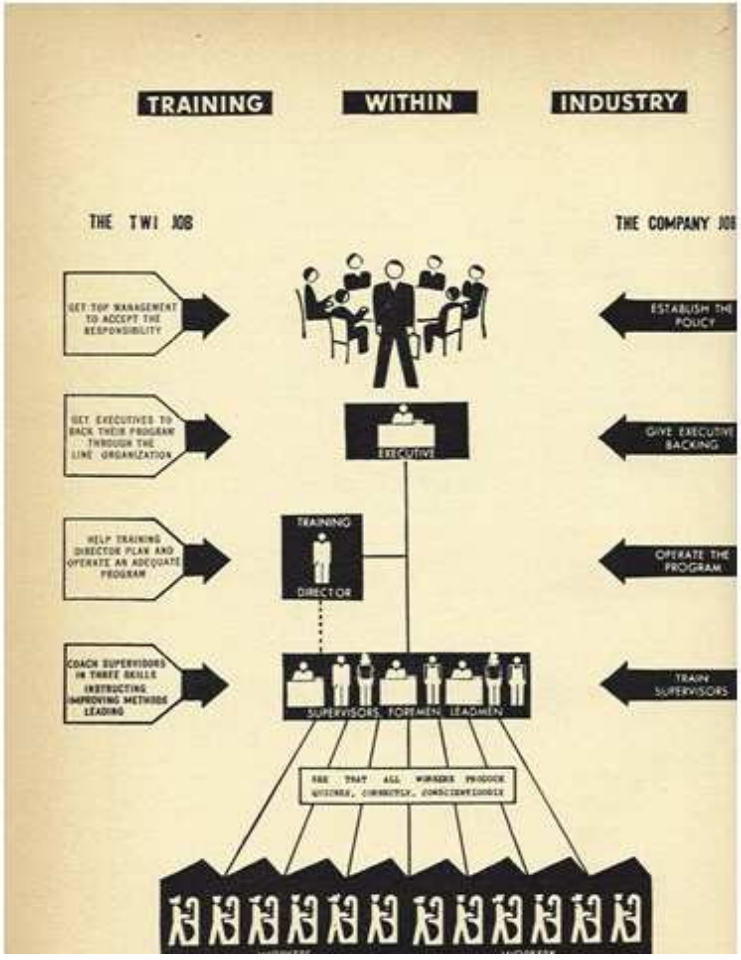


Figure 5: TWI AND HOST RESPONSIBILITY REQUIREMENTS

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.

This requirement was also a part of the "for industry by industry" attitude held by TWI leadership. In fact, Chapter 5 in *The Training Within Industry Report* is about the need of management support and it is titled, "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.[40]

TWI leadership had an excellent understanding of the need for top management support. They also realized that in order to get this support, they would have to "sell" the program to management. TWI developed a method to do just this. They presented training as a management tool and focused their promotion on selling results, not techniques. They understood that, ultimately, most management personnel were interested in bottom line results. This focus helped TWI achieve the initial buy-in and continued support by the large number of executives needed to make the service a success at a nation-wide level.[41]

Coaching

Another idea of the Japanese management philosophy is the use of "coaching" as a way to lead and guide employees. This term is discussed and taught among all levels of management as a great and improved, modern method of managing people. This is considered a shift from the "old" management style of being authoritarian to the "new" style of coaching. Yet, the use of coaching as a management method was repeated throughout the TWI Report. The report has a section dedicated to coaching and its continued use. TWI gave five points to guide plant trainers in the coaching process while instructing the "J" programs; Walter Dietz reiterates them in his book as well.

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.[42]

[40] 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. 61.
[41] 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). The details of TWI process are discussed fully in Chapter 5, "Working With Management", pp. 60 - 75.
[42] 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.172.

The TWI report continues with a brief definition and an explanation of what it means to coach someone in a plant environment. It also ties coaching to the programs themselves and stresses how it supports the Multiplier Principle.

> Coaching only means helping someone to do a better job of what he's trying to do.[43]
>
> 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…[44]

Today, companies prefer to promote this "new" technique to give their managers an improved manner in which to lead their people. Coaching is not new in industry as the TWI report reveals, maybe just forgotten for a time. By developing the four steps, the Four Horsemen learned the value of coaching in the shop from Charles Allen.

> The men will eventually think of the instructor as a "coach" rather than as a production foremen…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".[45]

[43] 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.173.
[44] 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), pp.172 - 173.
[45] Charles R. Allen, 1919, *The Instructor, The Man, and The Job: A handbook for Instructors of Industrial and Vocational Subjects*, (Philadelphia and London: J.B. Lippincott Company), p. 281.

Allen describes what sounds like an ideal situation between players and a coach-or similarly, the relationship between management and its workforcetoday. It appears that Allen and TWI were aware of, and promoting, what we refer to as a "team" environment within an organization.

Job Elimination due to Kaizen

Although the TWI Service remained focused on the training, it evolved into much more. Furthermore, because of its deployment at the national level, several questions were frequently asked during the Job Methods training. In fact, three questions were so frequently asked that TWI developed standard answers for them. One of the questions is commonly raised today when kaizen is implemented in a plant: "What should be done if employees are eliminated as a result of methods change?"[46] TWI emphasized that this issue was to remain the responsibility of the company. While TWI stood by this policy, they did issue a standard "suggestion" to companies in this situation.

> 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…[47]

Their suggestion is in parallel with the standard response recommended by those leading kaizen workshops today.

The 5W 1H and the 5 Whys

Job Methods discloses the source of the 5W 1H, which stands for Why, What, Where, When, Who, and How. This technique is used to break down a job and develop a new and improved method by questioning everything involved in an operation. Use of these questions was Step 2 of the Job Methods 4-Step procedure and served as the transition between the old and new methods. This strategy was targeted to help break down present procedures in order to help discover better methods for doing work.

> The first Job Methods sessions were frankly designed to develop a questioning attitude among supervisors with the result of getting from them ideas which already were close to the surface. The detailed questioning of the breakdown has meant that it is possible to go far below

[46] 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. 231.

[47] 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. 231.

the surface and really evolve ideas which never could have appeared on the basis of suggestions.

In making a Job Methods breakdown, it has been learned that, in order to really analyze the details, it is very helpful to look first at the verb (which normally is the first word in the detail). For example, take an assembly job breakdown which has these two details; "Reach down to box on floor" and "Pick up bolt." The first step in the questioning process is to ask "Why is it necessary?" If you ask "Why it is necessary to reach down to box?" the answer probably would be "in order to pick up the bolt." If you confine yourself to the verb, and say "Why is it necessary to reach down?" you are immediately led into considering the possibility that the box of bolts should have been up on the whole work bench.[48]

The 5W 1H are still used today in kaizen for discovering improvements. Use of these questions has virtually remained unchanged since the TWI service included them as part of Job Methods. Although Toyota uses the 5W 1H today, they also use a modified version as a direct problem solving technique: the 5W 1H or the 5 Whys and 1 How. Most often, this method is referred to as the 5 Whys.

When a problem occurs, if the manner of probing into the cause is insufficient, measures taken can become blurry. At Toyota, we have the so-called five W's and one H. The five W's are not the conventional "who, when, where, what and why," but every word is replaced by a "why," and we say "how?" In this way, we delve into the true cause that is hidden behind the various causes. It is essential that we come face to face with the true cause.[49]

For anyone who has been trained to use the 5 Whys, the sequence listed above from the 1945 Job Methods procedure is the basic process. Additionally, it makes sense that the 5 Whys are used to solve problems or

[48] 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. 234.
[49] Japan Management Association, 1986, *Kanban Just-In-Time at Toyota: Management Begins at the Workplace* (Cambridge, MA; Productivity Press), p. 27.

supplement kaizen. Kaizen is, in a sense, the resolving of work problems – or improvements.

Waste Elimination

As an extension of the 5 Whys, Job Methods is about job improvement or in today's terms, waste elimination. Further discussion is given about the job breakdown technique in the TWI report and how it supports the 4-Step method of Job Methods. As mentioned before, the outline of the 4-Step method very closely resembles the methodology used in kaizen workshops. Listing the details of an operation, questioning all steps presently involved in a job, developing new methods (combining, rearranging, simplifying), and applying the new methods are all part of both Job Methods and kaizen workshops. Basically, it is setting the original standard and then asking why, then improving it – the essence of kaizen. The center of both of these methods is waste elimination (removing unnecessary or non-value added activity from the current process).

> This improvement was not accomplished through speed-up, but through the elimination of unnecessary details.[50]

> Use it until a **better** way is developed.[51]

Maybe that is why Masaaki Imai states in his 1986 book, *Kaizen*:

> I would like here to propose KAIZEN as the overriding concept behind good management. It is the unifying thread running through the philosophy, the systems, and the problem-solving tools developed in Japan over the last 30 years. Its message is one of improvement and trying to do better.[52]

The TWI Service was doing nothing more than promoting good management practices as a means to improve production.

[50] 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. 224.
[51] 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. 227.
[52] Masaaki Imai, 1986, *Kaizen: The Key to Japan's Competitive Success* (New York: Random House), p. xxxii.

CHAPTER 5
Why Industry Lost TWI

So the questions arise: why did the United States, the developers, implementers, and teachers of such a simple and successful program - lose TWI? And why were they throttled by it in manufacturing markets decades later, while having no idea what was behind the Japanese management miracle? Both of these are good questions. No simple and straightforward solution can completely answer them. But there are certain factors which played a significant role in this event.

Top of the Industrial World

At the end of World War II the United States was at the top of the industrial world. Not only had it led in the victory of the war in both the Pacific and in Europe, but the U.S. had been supplying products to America and its allies before and during the war. An incredible build-up of industrial strength had occurred. The United States - due to its determination as a country, large amount of resources, and natural barriers (the Atlantic and Pacific Oceans) - had become a major Superpower and with no damage to its infrastructure. In fact, the U.S. was in quite good shape with high morale and a stronger than ever industrial base. It had achieved this stature despite many of the "boys" overseas fighting the war.

The "Boys" Return

With the end of the war, the men fighting overseas would return home and back to the plants in which they had worked prior to the war. The TWI Service was no longer in existence; it was no longer needed with the victory of the war and was shut down. The leaders of TWI understood the situation and realized well in advance that the end was inevitable. In fact, they relate in the report 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.

The adjustment of returning to civilian production was also quite a task. For instance, the men returning from the war effort had not been trained in TWI methods and the TWI's national support network no longer existed. With the United States on top of the world industrially and men untrained in TWI methods returning to fill their prior roles, the critical emphasis needed for the TWI effort was gone. Once settled in, it would be natural for the returning men to get back to their pre-war routine. This situation may be the biggest contributor to the loss of the accomplishments of the TWI Service. In fact, the leadership of TWI understood this concern and in the report relates information on how things may change once the war effort is finished.

> 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.[53]

It would appear that Dooley, Dietz, Kane, and Conover could sense the pending peril for the TWI programs after the conclusion of the war, which would terminate the need. As may be recalled, a good portion of TWI's effort was spent selling the need and services to the management of companies even with the critical demand for war production. The TWI leadership even suggests that perhaps as much time was spent on selling the training as was spent conducting the training. With this combination - the loss of the "need" and the untrained "boys" returning - it seemed destined for TWI principles to fade from the industrial landscape. Over time, this is what gradually happened.

Resistance to Change

One main factor should also be taken into account as a contributor to TWI's disappearance: the resistance to change. People's resistance to change is a natural occurrence, especially in the manufacturing industry. Most individuals will work to remain in a comfort zone, even if receiving pressure to change. This opposition has been the norm in industry as well. One technical reporter from the *American Machinist* magazine tells a story of when a friend of his was trying to show a head toolmaker a new type of tool system; he is accused of peddling some useless "newfangled" method. He was not selling anything, just trying to show what was going on in industry. [54] Interestingly, this story dates from back around the year 1904.

[53] 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. 261.
[54] Fred H. Colvin, 1988 (originally published in 1947), *Sixty Years with Men and Machines: An Autobiography* (Bradley, IL: Reprint by Linday Publications), pp. 42 - 43.

Industry has always resisted change. This is illustrated in the books *Lean Thinking* and *Becoming Lean*. Both books have information and stories about the difficulty of introducing change into a plant. According to these books, it is the implementation of lean that leads to resistance by industrial people. In a broad sense, today's difficulty implementing Japanese management methods and lean philosophies may be a repeat of the difficulty the TWI Service faced when working with companies sixty years ago to implement some of the same philosophies. Granted, Japanese management and lean philosophies are much more encompassing than the TWI programs were, but they are derived from the same roots.

CHAPTER 6
Conclusion

The arguments detailed above are certainly not the sole reasons that TWI methods and philosophies mirror Japanese management practices or lean philosophies; many factors contributed to their development and residual impact. But one thing is sure: TWI did play a significant role in the evolution of Japanese management practices and lean philosophies, some directly such as Job Methods, and some not so directly. The need for change in Japan began after the war, and the need continues even today. In the end, most have survived in Japan because they were superior techniques used in a comprehensive manner to help companies achieve a competitive advantage.

Although U.S. companies failed to continue using the methods developed and deployed by the Training Within Industry Service after the war, today's companies often resist change, refusing to emulate the Japanese kaizen techniques. But in fact, kaizen or Japanese management methods are not specifically Japanese or American techniques; they are the product of an evolutionary process with significant contributions from both. Based on direct intentions and unforeseen circumstances in industry, the practices advanced forward to what they are today. It may be that the ideas started with a man by the name of Charles Allen and continued with the contribution of thousands of people from both sides of the ocean and will continue to evolve as many more learn how to apply it – *learn by doing*. The chart below illustrates the timeline of TWI and its ancestors and descendants.

Even today the question remains, "Can these techniques be successfully implemented?" Many manufacturers incorrectly assume that Japanese management methods and kaizen are effective in Japanese companies because of their unique culture, but this is not true.

> Frustrated by their inability to replicate Toyota's performance, many visitors assume that the secret of Toyota's success must lie in its cultural roots. But that's just not the case.[55]

We have shown that these modern manufacturing techniques are, in fact, nearly one-hundred year old methods that have evolved over the years with their underlying themes unchanged. It is ironic that although U.S. industry developed

[55] Steven Spear and H. Kent Bowen, September-October 1999, "Decoding the DNA of the Toyota Production System", *Harvard Business Review* Vol. 77 (5), p. 97.

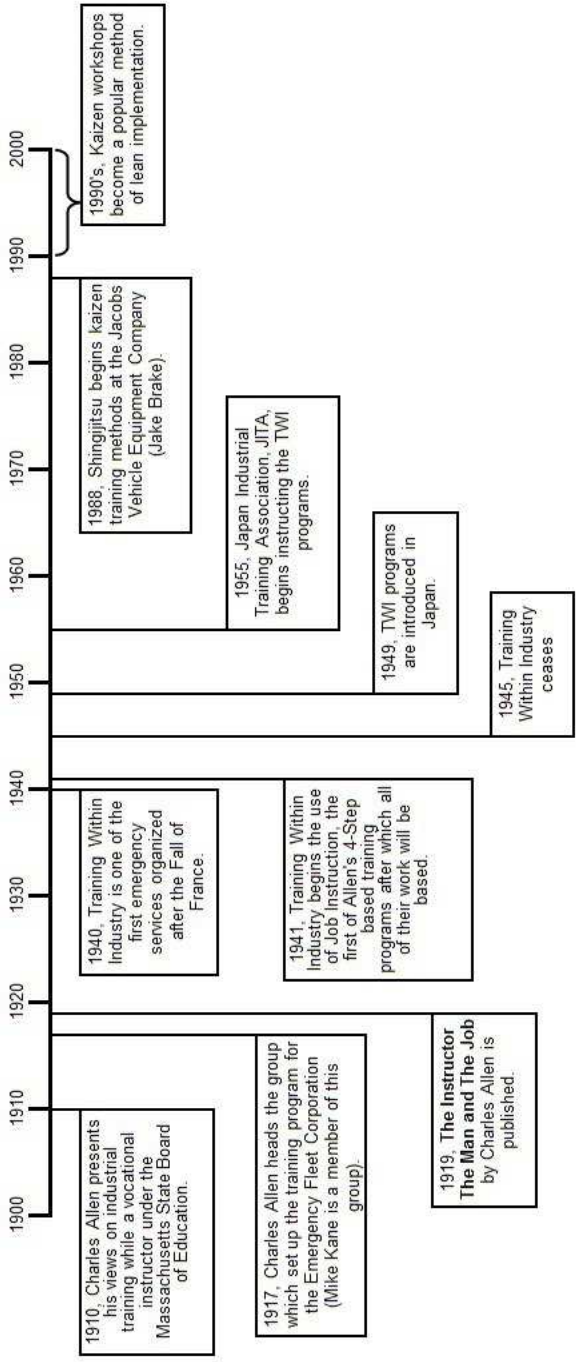


Figure 6: Timeline of TWI

the methods that form much of the basis of Japanese management and lean philosophies, the United States has struggled over the last twenty years to fully implement these philosophies in its present-day systems. Success in the future of U. S. manufacturing may depend on *if we can do what we have already done*.

We have shown that these modern manufacturing techniques are, in fact, nearly one-hundred year old methods that have evolved over the years with their underlying themes unchanged. It is ironic that although U.S. industry developed the methods that form much of the basis of Japanese management and lean philosophies, the United States has struggled over the last twenty years to fully implement these philosophies in its present-day systems. Success in the future of U. S. manufacturing may depend on *if we can do what we have already done*.

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Appendix:

Other Insights

Additional Articles on TWI

APPENDIX A

Bringing Back Training Within Industry to U.S. Manufacturing and Business

Jim Huntzinger

Lean Frontiers White Paper
July 2013

In 1997 the book *Gemba Kaizen* was published. Its author, Masaaki Imai, unknowingly set into motion the revival of TWI back into U.S. industry. I saw Imai speak at an American Society for Quality (ASQ) meeting in the Fall of 1997 in Milwaukee, Wisconsin and purchased *Gemba Kaizen* to read.

Gemba Kaizen is a timeless book of learning about what daily improvement is and how it impacts the lean enterprise. My copy is marked up with notes and a yellow highlighter. But what struck me the most was Imai's brief discussion on TWI.

I had been implementing one-piece flow and standard work into our manufacturing operations with a very aggressive group of engineers and operation managers. True 1x1 flow which impacted everything – tooling, layout, machine and fixture design, material flow, operator flow, and everything else. It was quite a feat. We made very positive and significant progress. But even though we developed very forward flow; that is, every cell had actual one-piece flow, and very well choreographed standard work for the operators, we still were not able to hit the consistent output per takt time that I had witnessed in Japan at Toyota's first-tier suppliers.

I knew something was missing. I had worked for Toyota's second largest supplier so I know there had to be *something* Toyota and its group companies were using to achieve their success with standard work, but I frustratingly did not know what that *something* was.

This was why Imai's discussion of TWI caught my unconscious mind. I began a year long process of research to find out what this TWI-thing was. What I would discover at the end of that search absolutely stunned me.

After I was greatly intrigued with Masaaki Imai's discussion of TWI in his book, *Gemba Kaizen*, I read the chapter written by John Shook in Jeff Liker's book, *Becoming Lean*, in which John also mentioned TWI. Upon reading that, I *had* to find out "what some WWII program had to do with the Toyota Production System!" Thus followed my year-long search to answer this

question. This search led me to call a variety of government departments in Washington D.C., make trips to the Milwaukee Public Library, and then more calls to universities.

After this year of searching I eventually located and received a copy of the TWI Final Report from 1945. I have to admit that I wasn't too excited to read a nearly 300 page government report, so on my bookshelf it went. For several months it sat there – but constantly gnawed on me to read it since I had spent a year working on finding it. So I pulled it down to read.

I was stunned by what I read. From these pages written in 1945 I was reading about many of the lessons and methods I had learned while working as a manufacturing engineer for Toyota's second largest supplier, and what I had learned from the *Shingijutsu consultants during the original 5 Days and 1 Night kaizen workshops with the Danaher Corporation. I realized I had found the missing piece.*

The 1945 Report also gave the titles of the actual training manuals used so now I could receive these original manuals firsthand through interlibrary loan. And that is exactly what I did. Once the first manual, Job Methods, arrived at my local library, I was shocked by what I discovered as I read through it.

When I arrived at my local library to pick up the original Job Methods training manual I had ordered, I immediately sat down at the library and began reading through it. My 'stunned' state grew! In this 1943 WWII training manual I was reading *the very process of kaizen*, but in significantly more detail than I had been taught working for a Toyota tier-one supplier or even in the training I had received from the *Shingijutsu.* We realize today that kaizen is actually the process of Job Methods, and that Standard Work is really applying Job Methods and Job Instruction within the boundaries of Job Relations.

I was so shocked by my (re)discovery that I was looking over my shoulder thinking someone had to be spying on me! I could not believe that this foundation to the lean enterprise was from the 1940s war effort. Not only had I found the "missing piece" that had haunted me for many years, but I had found it in great detail.

Since that time over a decade ago, many organizations have implemented TWI as a foundation to their lean business model. They are not only reaping the benefit of improved kaizen, standard work, training, stability and sustainability-- but also the discovery of developing their people into daily problem-solvers. They are making and keeping daily improvements in the operations and organization. This ability is a critical factor in changing your

organization's culture into a learning organization--a culture which will propel your business forward and make it a strong and growing competitor. And your people will enjoy their work, overcoming the challenges they face daily. *Your organization can begin the process of becoming a real lean enterprise.*

APPENDIX B

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

Jim Huntzinger

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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. 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 "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.

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.

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.

Steps	Charles Allen	TWI			Kaizen
		Job Instruction	Job Methods	Job Relations	
1	Preparation	Prepare	Breakdown	Get the Facts	Observe and Time Current Process
2	Presentation	Present	Question	Weigh and Decide	Analyze Current Process
3	Application	Try Out	Develop	Take Action	Implement and Test New Process
4	Testing	Follow Up	Apply	Check Results	Document New Standard

Figure 1: Comparison of Charles Allen, TWI and the Scientific Method

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: Comparison of TWI and PDCA

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

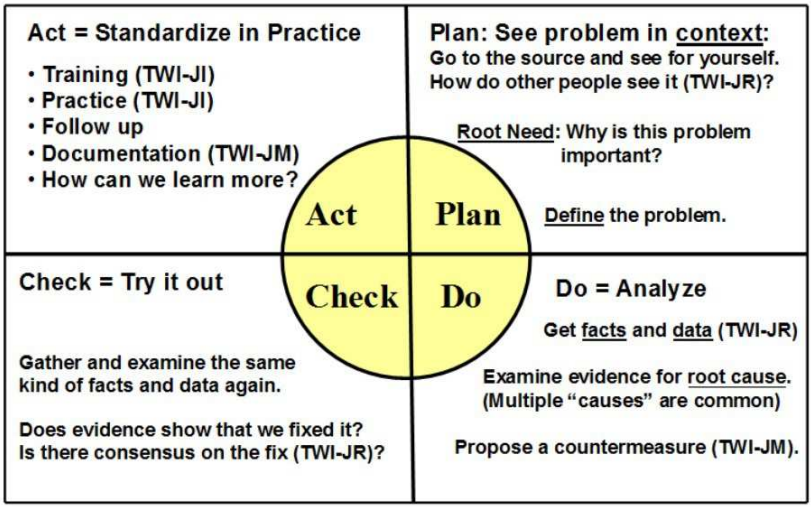

Figure 3: Rigorous Version of 5 Whys: Deming Circle

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 2-3 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.

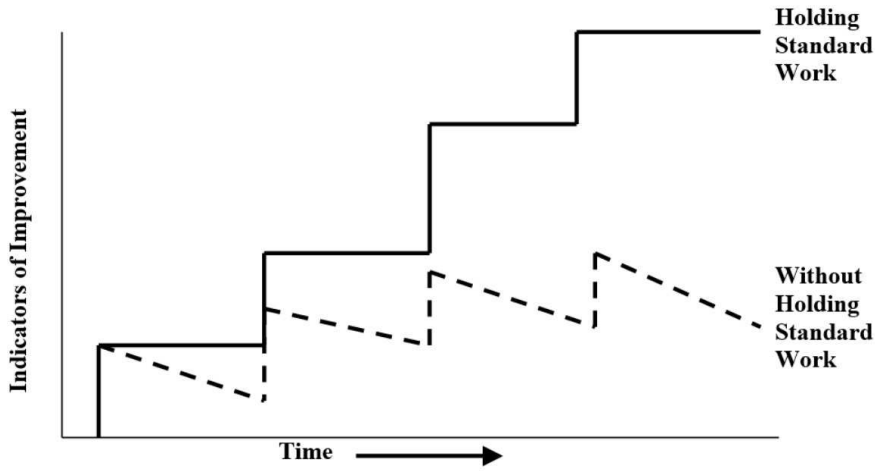

Figure 4: The Benefits of Having and Holding Standard Work

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, i.e. business standpoint, as well as, a humanistic standpoint. A team-like 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-Syracuse in Chittenango, New York. 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 2 months to 2 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 its 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 was 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.*

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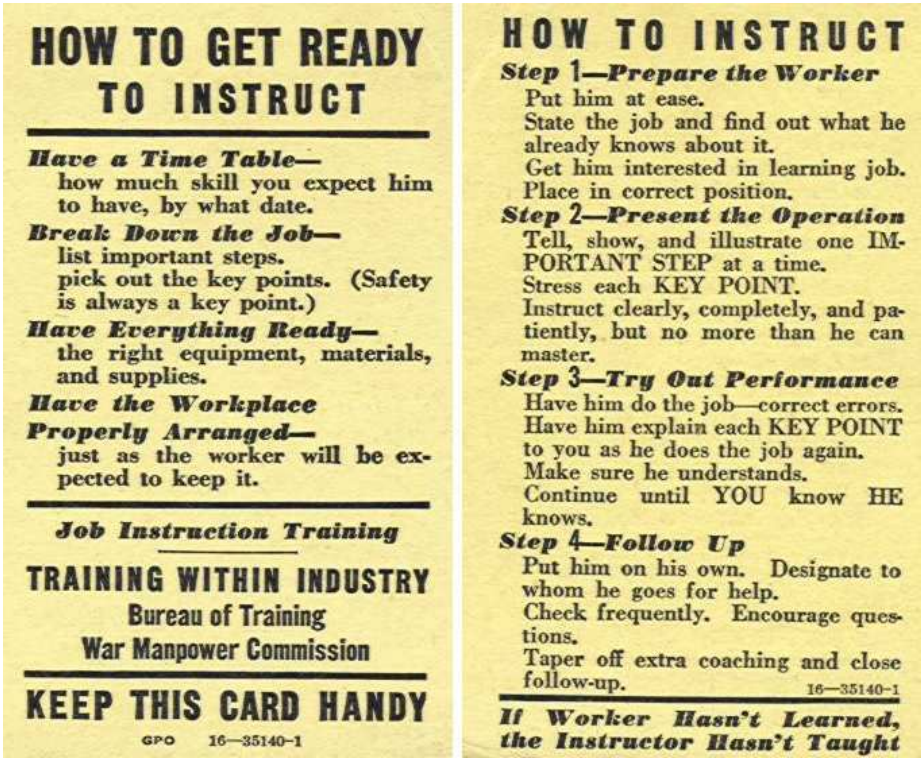
[1] Alan Robinson and Sam Stern, 1997, *Corporate Creativity: How Innovation and Improvement Actually Happen* (San Francisco, CA: Berrett-Koehler Publishers), p. 77.
[2] The PDCA cycle is often referred to as the Deming Circle (for W. Edwards Deming). This method is in fact originally known as the Shewhart Cycle, which was developed by Walter Shewhart in the 1930's. 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.

INSERTED BOX INFORMATION:

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.



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

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.

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 workforce. 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.

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.

TWI creates the behavior which mitigates and eliminates waste and instability in an operation or process. In applying and practicing TWI, massive fundamental learning takes place which changes thinking which strengthens vision and understanding which creates acceleration and depth of knowledge.

"There is no substitute for Knowledge."

W. Edwards Deming

Jim Huntzinger began is career as a manufacturing engineer with Aisin Seiki (a Toyota Group company and manufacturer of automotive components) when they transplanted to North America to support Toyota. Over his career he has also researched at length the evolution of manufacturing in the United States with an emphasis on lean's influence and development. In addition to his research on TWI, he has extensively researched the history of Ford's Highland Park plant and its direct tie to Toyota's business model and method of operation.

Huntzinger founded the **TWI Summit** in 2007.

Huntzinger is the President and Founder of Lean Frontiers and a graduate from Purdue University with a B.S. in Mechanical Engineering Technology and received a M.S. in Engineering Management from the Milwaukee School of Engineering. He authored the book, *Lean Cost Management: Accounting for Lean by Establishing Flow*, and was a contributing author to *Lean Accounting: Best Practices for Sustainable Integration*.

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