

TEACHING FORMULA OF THE TRAINING FOR OPERATORS ON EFFECTIVE APPLICATION OF LEAN MANAGEMENT TOOLS

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ABSTRACT

The first part of this paper presents the most popular on-the-job training methods and comments on their effectiveness. Then Training Within Industry (TWI) program, that originated in US in 1940s, is described. TWI program includes the Job Instruction method focused on improving on-the-job training efficiency. Problems with the knowledge transfer associated with the application of Job Instruction method are described in the next part of the paper. Finally, the newly designed Method Instruction focused on knowledge transfer is introduced. The Method Instruction is based on the philosophy of TWI program. Presentation of the structure of the Method Instruction is presented on the 5S System example. The last part of this paper presents where should be applied the Method Instruction in training process in industry companies and how the Method Instruction is a supplement to the Job Instruction method.

KEYWORDS

training, lean manufacturing, education, skill based production.

Methods used for teaching purposes

The manner and form of training affects the capacity of students' knowledge assimilation. It applies both to teaching provided at school and on site. Teaching methods, created in ancient times, were being developed for centuries. Today four teaching methods can be distinguished, based on: lecture, observation, measurement and practical activity [1]. It happens frequently that these methods are combined in order to increase the effectiveness of the knowledge transfer, which may vary depending on the method used (Fig. 1).

In general, on-the-job training in production companies is understood as an effective presentation of key points, necessary for the realization of objecti-

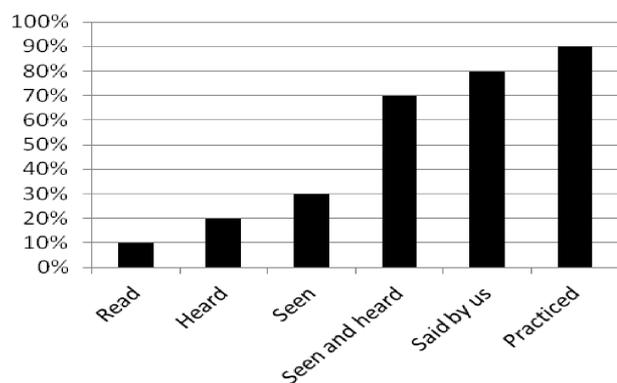


Fig. 1. Percentage of information which is remembered depending on the type of teaching method used [1, 2].

ves [3]. On-the-job training conducted in production companies is based mainly on lectures and observation [4]. Such a way of knowledge transfer, accord-

ing to research presented on Fig. 1, is hardly effective. On-the-job training in most companies is conducted by foremen, leaders or experienced operators. Very often, apart from practical expertise in production operations, operators working directly on production process are required to possess knowledge and skills of using chosen Lean Management methods e.g. 5S, SMED, TPM. Usually operators receive all-day training presenting the application of particular method or are trained by their supervisors. This approach does not necessarily have to be effective.

Job Instruction method, adapted from training within industry program, as a recipe for effective on-the-job briefing

Training Within Industry program was developed in the United States of America during The World War II. It was the US Department's of Defence answer to demands of the reinforcement industry for new employees. Implementation of the program gave unexpectedly good results. According to the report drawn up in 1945 (600 companies participating in the program were analyzed) [4]:

- 86% increased production to at least 25%;
- 100% reduced Training time to 25% or more;
- 88% reduced labour-hours to over 25%;
- 55% reduced scrap to at least 25%;
- 100% reduced grievances to more than 25%.

After the war TWI was incorporated as the main assistance program for Japanese companies. In short time it gained such recognition that it became not only a productivity improvement method but also culture of work applied in Japanese companies. Up to this day it is believed that TWI was a cornerstone of development of Toyota Production System, and later Lean Manufacturing [4, 5]. The aim of the TWI program is to quickly train new, talented production personnel in order to ensure productivity and quality growth. TWI program includes the development of three skills which production supervisors (mainly: leaders, foremen) should possess [4]:

- Job Instruction skills;
- Job Methods skills;
- Job Relations skills.

Job Instruction method (referred to as JI) is the method of effective personnel training on how to perform tasks correctly and without errors. The supervisors using this approach are able to train new employees more effectively, and, as a result, reduce the number of work errors and improve the efficiency. Proper training is possible only when the trainer follows the JI 4-step method (Table 1). This method is not focused only on the time of on-the-job train-

ing but also the phase of preparation of employee for training and his/her supervision at his/her workplace. Further parts of the article introduces the term trainer to identify a foreman (or other experienced employee) who conducts training, and the term student to identify an employee who undergoes training text.

Table 1
Four steps of Job Instruction method [4].

Step	Elements to be executed by the trainer
1. Prepare your student	<ul style="list-style-type: none"> • create a relaxed atmosphere, • specify the scope of work, • learn what a student can do, • make your student interested in the subject matter, • seat your student so he/she can see what is being done.
2. Present the scope of work	<ul style="list-style-type: none"> • presentation 1, clearly indicate each important step, • presentation 2, underline each key point, • presentation 3, explain causes for the presence of key points.
3. Check your student	<ul style="list-style-type: none"> • a student performs the work – correct the errors, • a student performs the work – emphasizes each important step, • a student performs the work – emphasizes key points, • a student performs the work – explains causes for key points.
4. Supervise your student	<ul style="list-style-type: none"> • let your student work on his/her own, • indicate a person he/she can ask for assistance, • often check on your student, • encourage to ask questions, • gradually reduce the level of supervision.

Problems with the application of TWI JI Method for Knowledge Transfer

TWI JI method is, by default, targeted at on-the-job training when main practical skills are being transferred (showing how to perform the work), and a discussion serves only the purpose of highlighting main steps of a given work and indicating necessary executive key points. Other work specifics are presented during the training. During the training based on any method (e.g. Lean Management methods), a student must obtain theoretical knowledge first (get to know the method), and only after that can apply it in practice. Such a training type is difficult to conduct with use of standard TWI JI method

because, by definition, the primary factor identifying this method is the presentation of work, not discussion. Normally, TWI JI method is used for practical skills transfer rather than theoretical knowledge transfer. Verbal Description of training according to TWI JI should only supplement the presented activities. Table 2 describes in which steps of standard TWI JI knowledge transfer is impeded most.

Table 2
Difficulties with application of standard TWI JI method for transfer of knowledge [own study]

Standard stage of TWI JI method	Difficulties for knowledge transfer
STEP 2 of JI method – trainer presents the works	
Presentation no. 1. Trainer presents the work and discusses every important step.	Normally, during a briefing conducted according to TWI JI method, the trainer, during his/her first presentation, practically demonstrates the work, emphasizing important steps. In the second presentation, he/she performs the work again, emphasizing the important steps, and adds key points. In his/her third presentation the trainer additionally, apart from important steps and key points, describes the causes for their occurrence. In the case of briefing devoted to the transfer of knowledge it is difficult for the trainer to present practical application of the method because the student does not possess sufficient knowledge on the subject. Training on any method requires gaining the knowledge, and only after that, its application in practice.
Presentation no. 2. Trainer presents the work and discusses the important steps and key points.	
Presentation no. 3. Trainer presents the work and discusses the important steps, key points and the causes for their occurrence.	
STEP 3 of JI method – student performs the work	
Presentation no. 1. Student performs the work – the trainer corrects his/her mistakes.	Normally, when applying TWI JI method it is assumed that after the work is presented three times and discussed by the trainer, the student should start to perform it on his/her own. Whatever method is taught, a student should not be required to use it in practice before the trainer is sure that the student has knowledge about the method.
Presentation no. 2. Student performs the work emphasizing the important steps.	The presentations are shown during standard training with the use of TWI JI method not only in order to ensure that the student is able to perform the work, but also to show that he/she can discuss important steps, key points and reasons for its application. In training of any method it is not possible for a student to discuss it and practice its application at the same time. It is essential to gain the necessary knowledge first and then polish the practical skills.
Presentation no. 3. Student performs the work and emphasizes important steps and key points.	
Presentation no. 4. Student performs the work and emphasizes important steps, key points and reasons.	

Application of the modified TWI JI method for knowledge transfer

TWI JI method used in the process of knowledge transfer must be appropriately modified (Table 3). A new method, focused on knowledge transfer was called Method Instruction (referred to as MI). Below presented is an outline of training conducted according to MI, intended for a production employee, on the use of 5S system. 5S is a system focused on establishing and maintaining high quality and organization of the workstation. It is a basic tool of Lean Management philosophy [6].

Table 3
Construction of MI method focused on knowledge transfer [own study].

Step	Elements to be executed by the trainer
1. Prepare your student	<ul style="list-style-type: none"> • create a relaxed atmosphere, • specify according to which method you will teach your student, • learn what a student can do, • make your student interested in the subject matter, • seat your student so he/she can see what is being done.
2. Present the method	<ul style="list-style-type: none"> • the trainer discusses the method, clearly emphasizes each important step, • the trainer discusses the method, emphasizing each key point, • the trainer discusses the method, explains reasons for key points' application, • the trainer applies the uses the method in practice, emphasizes important steps, key points and reasons for its application.
3. Check your student	<ul style="list-style-type: none"> • the student discusses the method, emphasizes each important step, • the student discusses the method, emphasizes each key point, • the student discusses the method, explains reasons for key points' application, • the student applies the method under supervision. He/she demonstrates it on the example. The trainer corrects the mistakes.
4. Supervise your student	<ul style="list-style-type: none"> • let your student work on his/her own, • indicate a person he/she can ask for assistance, • often check on your student, • encourage to ask questions, • gradually reduce the level of supervision.

Prepare your student – step 1 of MI method

This step is devoted to student's preparation for the training. The trainer should start the entire training process from relaxing the atmosphere. This is a very important element of the training as students may feel insecure in a new situation. Next stage involves informing the student on the subject matter of the training. In the presented example the trainer informs the student that he/she will teach him about 5S system. The trainer should also ask if the student has ever heard or used the system before. At this stage the trainer checks the student's knowledge in a given field. The trainer should present 5S system as interesting for the student, as it would increase student's commitment during the teaching process. At this stage the trainer may tell the history of 5S system which was developed by Japanese production companies and is devoted to organization of the workstation, and that its motto reads: "everything has its place and everything should be on its place" [6]. The final stage of this step is to seat the student in a place from which he/she can see what operations are performed by the trainer.

Trainer presents the method – step 2 of MI method

In this step the trainer should present 5S system. Before the beginning of training the trainer should prepare Job Breakdown Sheet (referred to as JBS) presenting the important steps, key points and reasons of 5S system construction. During the training the trainer should have an additional empty, large format JBS which he/she will be filling in successively during the training. The simplified JBS for 5S system is presented in Table 4. The trainer should discuss 5S construction three times and next present its application on the prepared practical example.

- **Trainer's no. 1 presentation – discussion of important steps.**

In this presentation the trainer will discuss each important step and write it in the prepared JBS. In the case of 5S method the trainer will specify 5 important steps.

- **Trainer's no. 2 presentation – discussion of important steps and key points' application.**

With each important step the trainer fills the JBS with key points pertaining to each step, and discusses them. Key points' aim is to facilitate remembering how to perform a given step correctly. An important step answers the question what a given method consists of, and a key point specifies how to perform the method [4].

Table 4
JBS for 5S system [own study based on 6].

Important steps	Key points	Reasons
1. Sorting	1. Separate all the tools, instructions, components which you use on everyday basis from those that you do not use.	1. It is easier to maintain order at your workstation when you have only necessary things there.
2. Setting in Order	1. Divide your workplace into spare parts' section and tools' section 2. Make use of the colour 3. Specify limits, levels and directions	1. You will always know what is missing 2. Visual control 3. Have only as little things as you need for your work
3. Shine	1. Clean your workstation, search for faults	1. Cleaning means checking
4. Standardizing	1. Set standard for all elements	1. Workstation must be organized in a way so everybody can work there – not only you
5. Sustaining the Practice		

- **Trainer's no. 3 presentation – discussion of important steps, key points and reasons for its application.**

At this stage the trainer writes reasons and explains why each key point is important. The purpose of this stage is to make the student aware why it is important to comply with and apply the key points.

In this step the trainer should present 5S system. Before the beginning of training the trainer should prepare Job Breakdown Sheet (referred to as JBS) presenting the important.

- **Practical application of the method by the trainer**

At this stage the trainer should present how to use 5S system in practice. Before the training the trainer should prepare a workstation which is not arranged according to the principles of 5S system. The student should be presented with the entire process of method's application. 5S method is applied to the prepared workstation and the trainer discusses each important step, emphasizes each key point and reason for the key point. The instructor should make use of previously prepared JBS.

Verification of knowledge acquired by the student – step 3 of MI method

In this step the trainer asks the student to fill in JBS on his/her own, including the important steps of

5S system. If the student has problems with recalling the name of important step, the trainer can help him. The student should not see the prepared JBS before. If the previous step of the training is conducted correctly, the student should be able to fill entire JBS on his/her own. After filling in the important steps the trainer will ask the student to add key points and later reasons, explaining why application of each key point is important. The step should end with practical application of 5S system by the student. For this purpose the trainer should prepare another workstation which is not arranged according to the 5S principles, and ask the student to apply 5S system, emphasizing each important step and key point, and explaining the cause behind each key point. This is the most important part of the training as the student applies the acquired knowledge in practice.

Supervision over of the student – step 4 MI method

Last stage of the training is devoted to control of the student. The trainer asks a student to apply the 5S system at his/her workstation. The trainer informs the student that should he/she have any problems, he/she can ask the trainer, or a person indicated by him, for assistance. Implementation of 5S at the workstation is not an immediate process, therefore the trainer should check on the student on the regular basis. An important element in this phase of training is to encourage the student to ask questions. This should prevent the student from acting on his/her own rather than asking how to perform a given task. After some time, when the trainer is sure that the student can apply the method on his/her own, the supervision is gradually reduced.

Possible application of the MI method in industry and conclusions

A correctly conducted on-the-job training improves the effectiveness of production process by reducing shortages, errors and accidents. Such an opinion is emphasized by Hayes and Clark who stress that a company may achieve their goals only when their managers put a particular emphasis on the process of working post trainings [7]. The authors emphasize that an effective briefing is reflected in improvement in the productivity of employees in a longer period of time, therefore it is important to devote time to training, so as to achieve improvement in the effectiveness of production processes in the future. Effectiveness should be understood as achieving maximum production capacity at currently available factors and technology resources [8]. It is also defined as

the relation of production time of good quality products in the assumed, available time [9]. The two most important elements affecting effectiveness are [10]: the productivity of employees and capital. The productivity of employees is understood as the relation of total generated production to the amount of human resources used. Capital productivity is the total size of manufactured goods in respect of the total expenditure of capital, incurred in order to produce this product. Every company must increase their effectiveness, at the same time reducing the costs. It is important particularly in the present times when a company achieves competitive advantage by delivering to customers high-quality products, in the required time and at competitive prices [11]. Therefore, it is important to measure effectiveness of machines operation in the production process, and then its improvement. The effectiveness of machines should be measured during the phase of operation when the machine performs production tasks planned for it [12]. Operation of machines is connected with performing utility, service, power supply and management activities. The use of machine should be understood as its use in accordance with the intended use and properties within the available time of operation. Service activities are related to maintenance of machine's availability by regulation, changeovers, cleaning, maintenance removal, repairs. Supply activities are related to delivering material and energy to the machine, while management activities are related to planning-decision-making and reporting – analytical processes [12]. Elementary processes of machines, namely processes affecting manufacturing the final product, include utility and service activities. This means that during the time of use, machines are alternately used and operated by the operators. The JI method is dedicated to production operators training in performance of application and service activities on the machine, during which Three fundamental classifications of work are alternately performed [4]:

- material handling,
- machine work,
- manual work.

To improve the effectiveness of machines and processes use, production companies use tools and techniques which belong to the philosophy of Lean Manufacturing. The Lean Manufacturing philosophy is currently the most popular approach to management and production processes organization in the world [13]. Nowadays, production companies require the operators not only to perform operating activities on machines, but also to involve in implementing methods and tools belonging to the philosophy

of Lean Manufacturing. Effective use of these methods and tools by operators requires appropriate briefing in which, as it was proven in this article, the JI method cannot be effectively applied. This is a result of the fact that the JI method is focused on transferring only practical skills, and the use of methods and tools requires, first of all, acquisition of theoretical knowledge, and then its practical application. The developed MI method is a supplement to the JI method. Thanks to it, superiors may train operators on how to effectively use the methods and tools of Lean Manufacturing to increase the effectiveness of production process. Table 5 shows the activities being the responsibility of operators for which the following methods may be used: JI and MI.

Table 5

Possible application of JI and MI methods for briefing in the manufacturing process [own study based on 5].

Job Instruction (JI) Application	Method Instruction (MI) Application
Briefing of operators on how to perform utility activities on a machine: <ul style="list-style-type: none"> • performing manual activities necessary to manufacture the product, • current product quality control, • loading the product onto the machine, • unloading the product off the machine, • adding raw material to the machine during its operation, • controlling and setting production parameters during the machine's operation, • filling in production documentation, • etc. 	Briefing of operators in the scope of correct application of methods and tools of Lean Manufacturing, e.g.: <ul style="list-style-type: none"> • 5S system, • SMED (Single Minute Exchange of Die), • standardization work, • TPM (Total Productive Maintenance), • Kaizen system, • problem solving process, • Ishikawa diagram, • 5xWhy methodology, • improvement methods, • safety rules, • etc.
Briefing for operators on how to perform servicing activities on the machine: <ul style="list-style-type: none"> • identification of faults on the machine, • daily autonomous cleaning the machine, • daily autonomous maintenance of the machines, • controlling the technical condition of the machines, • removal of micro failures (including breakdowns), • removing large failures, • changeovers, • etc. 	Briefing for experienced operators on how to effectively train other operators with the use of the JI method – teaching the JI method with the use of the MI method.

JI method adapted from TWI is an effective method of training. It is devoted mainly to foremen and leaders who train the operators in the field of production. As opposed to the JI, MI method provides knowledge on how to use Lean Management philosophy tools effectively. The JI and MI methods are a complex programme of production operators development, both on how to perform standard operational activities, as well as how to correctly perform the entrusted organizational tasks.

The next research stage will be an analysis of application of MI in other areas related to production.

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Research Highlight

- TWI Job Instruction method is only dedicated to learning practical skills
- We prepared method based on TWI program which can be used to transfer knowledge
- Operators are required to possess knowledge of using Lean Manufacturing methods
- We presented Job Breakdown Sheet of 5S method which can be used to instruction

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