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The impact of different training approaches on learning lean: a comparative study on Value Stream Mapping

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Abstract. More and more often, companies that follow a lean implementation path realize that the results deriving just from the application of the most basic tools often guarantee temporary results that are only satisfactory in the short term. An aspect that is often overlooked, but essential for the effective achievement of a lean structure, consists in the training of operators and, more generally, of all actors in a given company. The aim of this paper is to understand how different training methods, such as the instructor-led classroom training, on-the-job training, vestibule training, and coaching lead to different learning results in the context of a lean implementation. The results are contextualized within the process mapping phase, specifically in the adoption of Value Stream Mapping at three different companies, for each of which a different training program was designed.

Keywords: Training, Lean Management, Value Stream Mapping.

1 Introduction

Since its popularization in the 1990s, Lean Manufacturing (LM) has proven its effectiveness in increasing and maximizing productivity and efficiency [1, 2]. However, though this improvement paradigm has been embraced by countless manufacturing companies, very few have been able to fully exploit and make LM methodologies their own. Indeed, as pointed out by many studies, 70 - 90% of companies adopting LM achieve short-term relevant results that rapidly vanish over the course of a little amount of time [3]. The main reason for this unsatisfactory outcome lies in the adoption of “ready-to-use” practices, which grant immediate satisfying results but without developing a mindset of continuous improvement and learning [4]. This weakness underlines the strategic importance of properly transferring lean thinking through appropriate and efficient approaches. In this respect, “teaching lean” literature describes the way workers and employees should be trained on LM principles, concepts and tools, and then transfer them to their day-by-day activities [5]. Nevertheless, although multiple training

approaches with unique features in the learning process have been elaborated over the years by scholars and practitioners, they are often proved to be inadequate or at least characterized by inefficient training methods, thus limiting the development of successful LM programs [6]. Such a limitation has led to an urgent need to identify the most suitable training approaches enhancing learning of LM principles, not only in terms of acquired knowledge or skills, but also in relation to the attitude and confidence users place in the adoption of LM tools and techniques.

On these premises, this paper proposes case-based research aiming to understand the effects of the application of different training methods in learning LM principles. In particular, the study, conducted in three companies that have recently launched a lean manufacturing program through the introduction of Value Stream Mapping (VSM), focuses on a set of training methods identified in literature to assess their influence on participants' learning. The paper is structured as follows: the next section provides a theoretical background on training theories and learning process; section 3 illustrates the methodology through which the different case studies were analyzed, while the case study and the achieved results are presented in section 4; the conclusions, limitations and further developments are finally reported in the last section.

2 Theoretical background

Training plays a fundamental role for the development of any organization [7]. In particular, proper training of human resources is considered necessary for the development of successful change management programs. According to Chatzimouratidis et al. [8] the main training approaches currently adopted in industry can be categorized into nine groups, as described in Table 1.

Table 1A. Main training approaches [8]

Training approach	Description
On-the-job training	Employees are directly trained on a one-to-one basis while they perform their job. Thanks to its effectiveness, on-the-job training is considered very popular.
Coaching	A person with advanced experience, called mentor or sensei, personally follows the development of a worker with very little experience, named mentee [9].
Apprenticeship	Skills are acquired in the workplace while getting paid, through a combination of on-the-job training and classroom instruction [9].
Vestibule training	Employees perform the job in a simulated environment, similar to the real workplace [10]. This prevents any training-related incident.

Table 1B. Main training approaches [8]

Training approach	Description
Web-based learning	Self-paced instructions are provided through interactive multimedia, training software and teleconferencing programs [11].
Instructor-led classroom training	Face-to-face training is provided by an instructor in a classroom. Trainees can ask questions and complete tasks and exercises under the strict guidance of the instructor.
Programmed self-instruction	The employee studies training material on his/her own, without the guidance of any teacher or mentor, in a self-paced way.
Role playing	Interactive approach that allows employees to act out situations that may happen in their workplace.
Systematic job rotations	Employees are transferred to different jobs or rotated among different workstations in order to acquire a wider knowledge and increase motivation.

Although many training approaches are available, none can be considered suitable for any training program in isolation. Indeed, since training is a situational process, each specific context requires adopting an appropriate training strategy [12], often combining different approaches into an integrated and distinctive training plan. In this regard, Chatzimouratidis [8] proposes an evaluation criterion based on cost, time, applicability, efficiency, and employee motivation through which companies can identify the training approach best suited to the context in which it is implemented.

Regardless of the implemented training strategy, any training plan must necessarily be evaluated to measure its effectiveness. In this regard, Kirkpatrick's model represents the most common and versatile framework for the evaluation of training [13], as it assesses both formal and informal training methods and rates them considering four levels of criteria [14]:

1. **Reaction:** measuring the initial response of participants allows the trainer to understand whether the content is aligned with expectations of attendees and participants perceive what he/she desires to communicate.
2. **Learning:** measuring how much information has effectively been absorbed during the training program and how much skills have changed from before to after the training, provides the trainee with a clear indication of the effectiveness of the training program.
3. **Behavior:** assessing how participants apply achieved skills on their day-by-day activities allows the trainer to understand whether what it was delivered has become part of the participant's behavior.
4. **Results:** measuring and analyzing the impact of training on productivity, quality, efficiency, and customer satisfaction, allows the trainer to understand if what has been learned has translated into a tangible benefit for the company.

3 Research design and methodology

As the aim of this research is to understand how different training approaches convey LM principles, four training methods were selected for the study: 1) instructor-led classroom training; 2) vestibule training; 3) on-the-job training and 4) coaching. The choice was made in accordance with the criteria of applicability and motivation of employees indicated in Chatzimouratidis' framework. Indeed, when training goal concerns transferring knowledge about tools that must be implemented on a daily basis, such as a VSM, full involvement of employees becomes crucial, as employee's training fulfilment increases post-training organizational commitment, self-efficacy and motivation [15, 16].

The selected training methods were then applied to three SMEs that have recently launched a lean optimization project characterized by a similar organizational structure and based on the implementation of a VSM. For each company a basic instructor-led classroom training was first carried out to develop a common knowledge on LM principles and VSM tools. Subsequently, a second training session was conducted using a distinctive training approach, namely vestibule training for Company A, on-the-job training for Company B and coaching for Company C.

As the main goal is to evaluate the influence of each training method in terms of acquired skills, competencies and knowledge, as well as attitude, confidence and commitment gained during the training process, the evaluation was carried out mainly referring to the 'Learning' phase of Kirkpatrick's model. Consistently, the Italian Ministry of Education's learning evaluation model [17] was selected to assess participants learning according to its dimensions, namely autonomy (the ability to use what has been learnt without the help of the trainer), continuity (the ability to continuously demonstrate what has been learnt), context (the ability to apply what has been learnt in different contexts and situations), resource (the ability to use the right tools and competences to solve a problem). Table 2 provides a brief description of 4 different evaluation levels.

Table 2. Learning levels

Level 4 Advanced	The trainee completes his/her tasks autonomously and with continuity, adapting the available resources to the context in which he/she operates.
Level 3 Intermediate	The trainee completes tasks in known situations independently and continuously. He/she faces unfamiliar situations using multiple resources discontinuously and not autonomously.
Level 2 Pre-intermediate	The trainee completes his/her tasks in known situations and uses the resources provided autonomously but discontinuously, or rather with continuity but with the support of the trainer
Level 1 Basic	The trainee completes his/her tasks only in known situations and with the full support of the trainer, using specific tools and resources provided.

To avoid any interference or bias in the evaluation, assessment of each participant was carried out by an independent university researcher with long term experience in LM, different from the (external) training provider, who evaluated the progress of the mentees in two different moments: right after the instructor-led classroom training session, by testing participants ability to properly adopt VSM tool to solve a simple case exercise of which main issues, improvement suggestions and most appropriate solutions were already provided by the text [18], and at the end of the second of the training program, by evaluating through direct observation how each participant applied the learnt notions on a real case study carried out in their company. Finally, achieved results were gathered and analyzed, to identify the best training method as well as to understand how each training method influences personal learning.

4 Case studies

Company A (an SME) is a producer of meal distribution systems that deployed a VSM program with the support of an external consultant. The latter also acted as responsible for the training plan of the implementation team, made up of 6 members, namely the operations manager, the foreman of production and 4 workers. To properly train the participants about the VSM tool, an instructor-led classroom training followed by an 'on-the-job' training session approach was adopted, where the mentor assisted the operators in the process of observation, identification of different activities and issues within the process.

Company B is an Italian SME specialized in the production of lift components. In 2020 it launched a VSM program training to enhance the productivity of its operations. The group of participants in this project included the production manager, 2 foreman and 3 workers. The training plan consisted of instructor-led classroom training followed by a 3-session coaching in which, upon a simple tour of the production department, the mentor assigned the participants tasks to be accomplished, concerning the mapping process or possible ideas for improvement, consistent with the lean methodology. Progresses were then monitored in the following sessions and updated according to individual pathways.

Company C is a company involved in the extraction and production of inert materials, concrete and asphalt. Similar to Company A, training was held by an external consultant, specialized in optimization topics, hired by the company itself. Participants to the project were 6: the chief of the production department, the foreman, the maintenance worker of the factory and 3 factory workers. For this third case, an instructor-led classroom training followed by a vestibule training session was undertaken.

5 Results and discussion

As shown in Figure 1, which displays the average training evaluation, according to the Italian Ministry of Education's model, inclusive of all the 6 operators who were involved in the lean program for each company, the instructor-led classroom training approach has led pretty much to the same results across all companies, with slight changes

due to different contexts and everyone's predisposition towards learning. One third of the participants have maintained a basic level, while two thirds have reached a pre-intermediate level. Conversely, what has changed significantly is the final outcome following the second phase of training provided with the on-the-job training (company A), coaching (company B), and vestibule (company C) training approaches, respectively. In particular, collected data indicate that coaching is the best training method when it comes to training people on the adoption of VSM (3,17/4,00). In fact, all operators who have experienced this type of training have reached an intermediate level except for one operator who has achieved an advanced level of learning. The on-the-job training also brings appreciable results (2,83/4,00), while the vestibule training with a final evaluation of 2,33/4,00 seems the less appropriate approach to adopt. In this case only 2 out of 6 participants have reached an intermediate level of learning while the level of the other participants remains pre-intermediate. The rationale mainly depends on the nature of vestibule training, which takes place in the laboratory without providing any support on the understanding of the working environment. This results in a very limited approach in terms of potential, usefulness and applicability of a tool such the VSM.

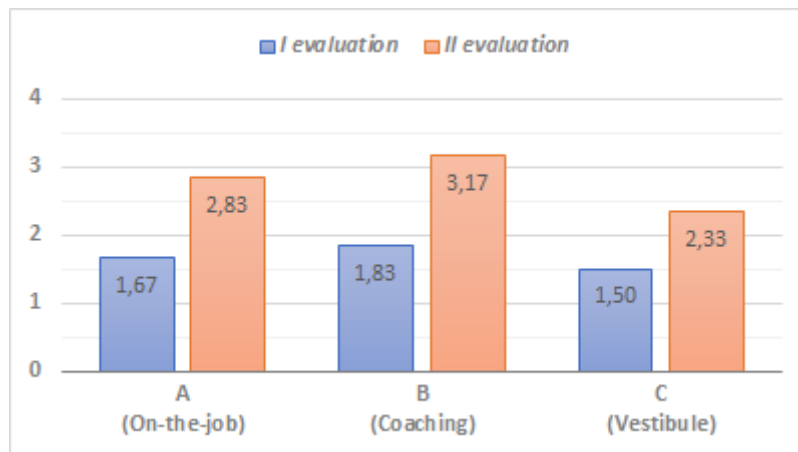


Fig. 1. Intermediate and final results for each case study

Despite the strategic relevance played by coaching activities, each training method provides marked outcomes for some specific dimensions of learning, as shown in Figure 2. For instance, vestibule training, although being the less effective method overall, provides the best results in terms of resources. Results of the analysis show that approximately 83% of participants in this type of training were able, at the end of the training program, to use all of the resources made available. This peculiarity is probably due to the nature of this training approach, that lets mentees deepen and consolidate the acquired knowledge, as learners can receive immediate feedback and ask questions more easily [19]. On the other hand, on-the-job training and coaching approaches show similar results, with a slight preference for coaching approach. This outcome is probably

referable to the duration of the training process: while on-the-job training took place only in a one-day session, coaching sessions were organized on three occasions, given the more ‘long-term’ nature of this method.

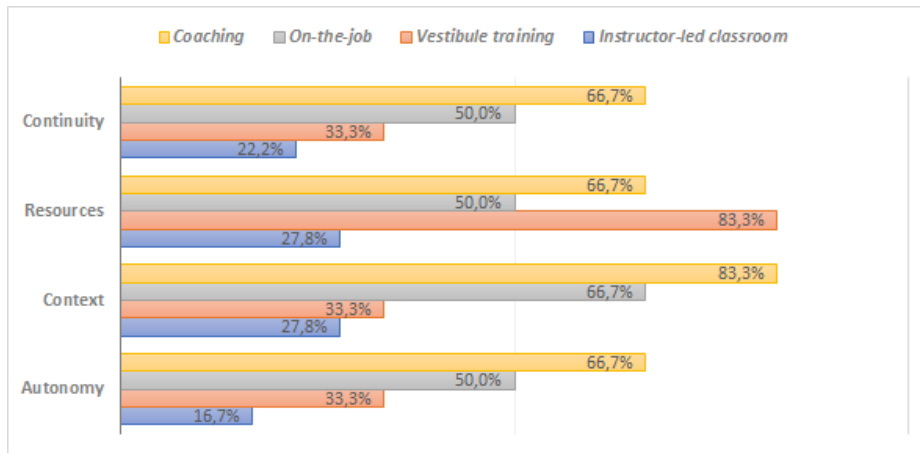


Fig. 2. Training outcomes according to the four training evaluation dimensions

In conclusion, the achieved results suggest that training approaches are not alternative, but rather complementary to each other, and may be all considered whenever designing a training program, especially if the training plan is developed around the Shu-Ha-Ri cycle [20]. In this perspective, instructor-led classroom and vestibule training emerge as fundamental to provide the basic knowledge required in the Shu (obey the rules) phase. Conversely, on-the-job training and coaching can prove useful as they put the mentee in front of the real challenges on the shopfloor, prompting him/her to acquire a complete awareness of the tool and adjust its usage, in relation to the context in which he/she operates.

It's then up to each company to decide whether adopting all the mentioned training approaches rather than, depending on available resources in terms of costs and time, focus more on specific methods. Typically, a firm may start with a first instructor-led classroom training followed by a on-the-job training session which may eventually evolve to a coaching training, if the training time frame goes for the long-term.

6 Conclusion

The aim of this research was to find out how different training methods have a specific impact on the learning of LM practices and in particular the implementation of VSM. Results show that, following a first instructor-led classroom training session, which levelled out the level of lean knowledge among the different companies, vestibule training, on-the-job training and coaching respectively have an increasing effectiveness on learning results. Moreover, all of the adopted training approaches emerge as valid in

some way, as they provide significant outcomes in specific dimensions of learning and, so, can be integrated to accomplish a valid and comprehensive LM training program.

Nevertheless, the considerations emerging from this study refer to the learning phase only and therefore cannot be considered exhaustive since, according to the theory, a successful training project presumes that the acquired competences should be applied to the work context to generate tangible results for the company. In addition, consistently with the lean thinking paradigm a successful implementation of LM practices involves transferring of skills, competences, attitudes, and commitment to other workers to establish a virtuous circle of mutual learning among people. This consideration suggests the need to expand the future research by assessing the effects of different training methods on the other dimensions of the Kirkpatrick's model, namely reaction, behavior, and results, as well as to assess not only people's ability to take hold what has been learnt but also to transfer it to others. Finally, this analysis does not take into account any variations in the learning outcomes due to the influence of the working environment/context or the individual predisposition to learning. Also, the personal predisposition of the external mentor towards the different training approaches may have played a role in the final assessment of the participants. For this reason, even though quantitative results have been provided along the paper, the research may be intended more as led with a qualitative approach, to orientate research into a defined set of training methods. Therefore, further research regarding this aspect may be of interest, as well as testing other training approaches, of the nine listed in the second section, to check if they can eventually lead to better results.

7 Acknowledgements

The authors would like to acknowledge support from the research council of Norway for the project Lean Digital.

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