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A Framework and Qualitative Comparison on Different Approaches to Improve the Lean Skillset

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Abstract: Lean Manufacturing is considered to be one of the major frameworks in improving manufacturing performance. Yet, a majority of lean improvement projects fail to generate a benefit for the organization. The problem usually lies with an incomplete understanding of lean manufacturing by the personnel involved. Therefore, industry is very interested in improving lean skills. This paper gives a qualitative overview and comparison on how to improve the abilities of the personnel to do lean, as well as suggestions on how to combine these approaches for a well-rounded improvement of the ability to do lean. It shows opportunities both for corporations as well as individuals on how to improve lean performance.

Keywords: Lean Manufacturing, Operational Excellence, Training, Lean Skillset

1 Introduction

Lean manufacturing based on the Toyota Production System is one of the significant frameworks for manufacturing optimization (Womack 1990). It includes a multitude of different methods and philosophies, from eliminating waste, fluctuations, and overburden to improving quality. Lean was also either the basis or a significant inspiration for other process-performance-related frameworks like six sigma, Agile, and others, and is often related to topics like Industry 4.0 (Buer et al. 2020; Lai et al. 2019).

Lean can have significant positive effects on the performance of a production system (Fleischer and Liker 1997; Krafcik 1988; Shah and Ward 2003). However, doing lean is not easy. By some estimates, 70–90% of all lean projects fail or at least do not generate any measurable benefit (Ignizio 2009). This may be due to different reasons. Some papers look in more detail at the implementation techniques (Sundar, Balaji, and Kumar 2014; Mostafa, Dumrak, and Soltan 2013). Others look in more detail at the different tools of lean manufacturing (Pavnaskar, Gershenson, and Jambekar 2003; Feld 2000). Again others look at the role of people for lean (Jeretin-Kopf et al. 2016).

2 Problematization

This paper looks at the options for training individuals in lean manufacturing. How does one become a lean expert? How do you turn your employees into lean experts? There are different approaches to learning, and the success also depends on the personality of the learner (Romanelli, Bird, and Ryan 2009). (Dinis-Carvalho 2021), besides giving an overview of the topic also looks at collaborations between academia and industry.

Based on our industry experience, the state of lean training leaves much to be desired. Much lean training in industry is based on classroom training, sometimes augmented with simulation games. As described further below this has the advantage of quickly and inexpensively introducing many people to lean concepts. Unfortunately, it lacks practical use, and is often not very effective (Negrão, Filho, and Marodin 2016; Shrimali and Soni 2017).

Often, industry also falls back on certifications, often six sigma white/yellow/green/black/master black belts. While some of these certificates have an honest aim to teach lean, there are also many low cost online certificates of dubious quality available.

Hence, the state of lean training often leaves much to be desired, despite lean training being one of the key factors for a successful lean transformation (Netland 2015; Yamchello et al. 2014). In this paper, we will look in more detail at the different training approaches and how they can be combined.

3 Overview of Common Lean Learning Approaches

There are a number of common approaches to train lean, or for that matter almost any subject in industry. They are loosely sequenced by their effectiveness from least effective to most effective. Unfortunately, this is also roughly the inverse of the effort needed to train, in that the easiest approach is also the least effective one.

3.1 Theoretical Training

A popular approach in industry is theoretical training. This is most commonly an in-classroom training with a trainer, but it may also be a self-taught course using videos, written texts, and/or other materials. This approach is popular because it is comparatively inexpensive, and a large number of people can be trained simultaneously. However, it is also usually not very effective. The challenge is that the trainee may or may not be mentally engaged, and may even have misunderstood or missed parts.

3.2 Interactive Training and Simulations

A better approach is to motivate the learner to be engaged. In its easiest form, this could include exams or quizzes to test the learner's knowledge. However, it is difficult to narrow down such a complex topic as lean to a few quiz questions.

Simulations, games, and other interactive training models also require more engagement. This may also be called "gamification." Such simulations are a transition toward learning by doing, albeit a simulation environment is often an environment with limited complexity and geared toward easier problems.

3.3 Learning by Doing

Another approach to train lean is by simply doing it. This is also called on-the-job training (OJT). Doing lean projects helps people to become better in lean. This can be done by the trainee on its own, or in a small group. However, done incorrectly it can also lead to and reinforce bad behavior. Hence, it is advised to not rely solely on learning by doing, but instead to use this as part of a larger framework. Coaching especially is useful for the initial phase in a lean journey.

Key to a successful learning-by-doing approach, or lean in general is the well-known lean principle Plan, Do, Check, and Act (PDCA) (Matsuo and Nakahara 2013). The trainee must thoroughly verify if the lean implementation actually works (the Check part) and implement countermeasures if it does not (the Act part).

3.4 Being Coached

Very related to learning by doing is coaching. The trainee is actively coached, supported, and occasionally challenged by a mentor or coach. This approach is somewhat overlapping with learning by doing, where a group leader can also take the role of the coach. The coach should have a good knowledge of lean, and should be able to guide the trainee in the right direction. It is common in lean coaching to not give the answers to the trainees directly, but rather to ask the right questions and let the trainee find out the answers him/herself.

3.5 Teaching and Coaching of Others

The ultimate learning experience is to teach and coach others. Teaching others requires the coach to thoroughly analyze and understand the lean approach. Furthermore, the questions of the trainees challenge the coach to expand his horizon. Finally, the trainee may have different ideas or views, which also furthers the understanding of the coach. Effectively, for the coach this training and mentoring is also a form of learning by doing for the coach.

4 Comparison of Lean Learning Approaches

The approaches above all have different benefits. Mostly it is a trade-off between the quantity of knowledge gained on one hand, and the ease and cost thereof on the other hand. Table 1 gives you an overview thereof.

Approach	Number of Trainees	Speed of Training	Knowledge Gain	Expense
Theoretical Training	Many	Fast	Very Low	Low
Interactive Training and Simulations	Many	Fast	Low	Low
Learning by Doing	Few	Slow	Medium	Medium
Being Coached	One	Medium	Good	High
Teaching and Coaching of Other	One	Very Slow	Very Good	Medium

Table 1: Overview of the different aspects of lean training approaches

5 Combination of Approaches

For a more effective way to learn lean manufacturing, it is advised to combine these approaches. Similar to obtaining a driver's license for a car, a combination of learning by doing and theoretical training will be the backbone of the early stages of the lean journey.

Figure 1 shows the use of different learning approaches throughout the lean journey. Learning by doing is, especially at the beginning, the key approach, supported by theoretical trainings and interactive simulations and trainings as needed. Often, the lean journey is started with a theoretical introductory training, albeit it may be better to start with learning by doing, and add specific theory as the trainee encounters problems in his practical work. In this way, the trainee is more actively engaged in the theory training, as he is actively looking for a possible solution to resolve the problem in his practical work.

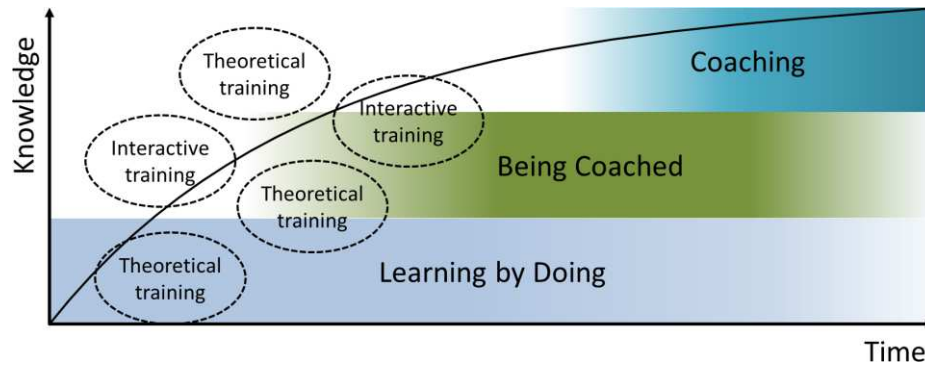


Figure 1: Learning styles throughout the lean journey

The learning by doing never really ends, no matter how far you advance in your lean journey. However, as the trainee (or by then, the expert) reaches the coaching stage, the *learning by doing* shifts to *learning by having others do*.

Learning by doing is supported by a small group of learners with various levels of experience. As the trainee advances, the learning by doing is best supported by individual coaching, where a skilled expert guides not the group but coaches the individual learner. Hence, coaching and mentoring is usually limited to few participants due to the need for a qualified coach or mentor, albeit it gives a much deeper understanding and knowledge. The primary author was for many years a lean coach in industry, doing multiple six-month programs with two trainees per coach. These were very successful, albeit training a large number of people is usually economically infeasible. Hence this is usually reserved to train lean experts.

Finally, the coaching of others is only advisable for learners who have already progressed far along their lean journey. Yet, the coach will also learn while coaching others.

6 Summary

Overall, building knowledge in lean manufacturing is a longer process, depending on the desired level of expertise. Different approaches to transfer and build knowledge should be used at different stages of this lean journey. Our subjective impression is that many companies focus more on theoretical trainings and interactive trainings and simulations, which allow the training of many trainees simultaneously and inexpensively. However, we believe that such a theoretical training is best used only as a support for the actual problem-solving process in the learning-by-doing approach of understanding lean manufacturing.

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