

LEAN METHODOLOGY AND ITS DERIVATES USAGE FOR PRODUCTION SYSTEMS IN MODERN INDUSTRY

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Abstract:

With lean methodology usage being the only way to stay competitive on nowadays market, it is important to implement it and spread it through the organization.

In this paper, purpose of lean is explained, the most important definition and tools are given and differences between problem solving approaches are explained.

It can be concluded that problem solving approaches are in first look different, having also different number of steps, but they are adapted to the company in which they are used and that they depend on the size, complexity and expected closing time of project.

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1. INTRODUCTION

The concept of lean methodology is nowadays widely used in companies around the world in order to maximise production by minimising losses at the same time. Roots of integration of entire production system done in flow was made by Henry Ford in 1913. However, true usage of lean concept was started by Toyota owner Kiischiro Toyoda and engineer Kaiichi Ohno after WWII, and finally summarized in 1980s rebranding their TPS (Toyota Production System), later described in book "The Machine That Changed the World" [1]. Usage of this concept lead Toyota to become the world largest automaker company in terms of annual sales. Following their success other but not only automotive industries started implementing this concept by transforming their production systems.

This concept requires commitment and involvement from all levels of company, starting from commitment and support from top level management down to production workers on the shop floor and their involvement in daily activities that leads to continuous improvement. Accordingly, there are two approaches to problems and project development: top-down

which is initiated by management and bottom-up initiated by people on shop floor.

Therefore, TPS is used in many industries and companies, adapted to its products and needs and now defined as common used methodologies such as: Lean [1], Lean Six Sigma [2], World Class Manufacturing, Toyota Production System [3], Ford Production System, Bosch Production System, etc...

Purpose of this paper is to show tools widely used in these methodologies and present their main foundations.

2. AIMS OF THE LEAN CONCEPT

Using lean, manufacturing can be more efficient by using less manpower, less space, with lower cost and less used material for same final product [1]. All types of losses should be attacked [4]. To do so there are 7 waste and losses which should be avoided:

- Defects – losses due to correction of defective products or information
- Overproduction – producing more products in comparison with needs

- Transportation – unnecessary movement of people or material between processes
- Waiting – people or material waiting for process to be finished
- Inventory – building or storing extra services or material which is not having value added
- Motion – unnecessary movement of people, material or machines within process
- Excess Processing – processing of product which is beyond standard required by customer or not having value added

Eighth loss is considered wasted potential employed people meaning their talent is not fully utilized.

Another definition is given by Phillippe Crosby by asking for 'zero defect' (ZD) [5]. He asks for setting target to be absolute quality, and doesn't accept any errors or defects, otherwise company is not reaching for continuous improvement.

According to Sobek et al. "Lean is an approach to operations management that considers any resource expended that does not add value to the end customer to be waste. Lean emphasizes an array of tools and methods to aid managers and workers in improvement, each designed for specific types of problems to illuminate and remove sources of waste through systems redesign. These tools and methods include value stream mapping, Kanban and pull, demand levelling, single-piece flow, 5S, kaizen events, A3 reports, visual management and more" [6].

Nowadays, lean methodology and its application is extended to other industries including even business, economics, management and tourism. According to Kadarova and Demecko [7], lean management is not a new concept, but in recent years it's been deployed in Healthcare, IT services and Public administration. In meaning of production it's not the same, as people or informations are not product, but in meaning of complexity they are not behind. Therefore, application in these services is highly desired.

Andres-Lopez et al. [8] provided practical guideline for implementation of lean service. Due to the current economic situation services need to implement lean management as said above. However, it can be hard to achieve expected results when services are trying to apply technical tools, which are developed for industrial processes. Therefore, they gave redefined values and waste concepts, focused on intangibility, perishability,

inseparability, variability and lack of ownership. In short, they did analysis of lifecycle of customer process, from one end to another and provided guideline.

Even the tourism sector is now implementing lean management. Due to potential future economic turbulences and general difficult time tourism businesses are applying parts of the Lean management methods which are suitable for them and which have possible potential for optimization. In their paper Rauch et al [9], referred to a case study in hotel company where they show implementation of several widely used methods.

Lean management is also being applied even in an Airline Cabin. First airline industry to include lean management was Icelandair, Iceland's largest airline [10]. Thorhallsdottir in his paper is showing that Icelandair is using the lean management to reduce waste and improve their performance from their flight attendants, but also giving benefits to their passengers and crew.

3. 5S AND KAIZEN DEFINITION

Implementation of Lean principle always start with tool called 5S to keep basic condition and requires *Kaizen* projects to improve the process.

The most important tool is usage of 5S. It is consisted of 5 Japanese words:

- Seiri (Sort) – elimination of unnecessary items from the workspace
- Seiton (Set in order) – arranging the items so they are easy to use, find and put back in position
- Seiso (Shine) – keeping the workspace and items neat and clean
- Seiketsu (Standardise) – standardisation of tasks and procedures for the workspace
- Shisuke (Sustain) – Retaining the previous steps by making a habit and daily activity of respecting the standards

Kaizen is Japanese word for continuous improvement. It is derived from two words: *Kai* (change) and *Zen* (good or for better). It means change to the better or striving to better. According to the level of kaizens, they are divided by 2 main separators.

They can be divided by size on small, medium and large (in some methodologies like WCM – quick, standard, major, advanced). This is done according to their complexity meaning that small (quick) kaizens can be done by production workers

on line, medium (standard and major) by specialist, and large (advanced) by big interdisciplinary teams. Large kaizens also require high level of commitment by management.

Second separation is done by extension level of kaizens and they can be: point, line, plane and cube kaizens. Point kaizens are done on specific place; line kaizens on model line; plane kaizens are spread on similar model lines and cube kaizens are spread through whole shop, plant or enterprise.

Approach to kaizen problem solving is usually referred to Deming PDCA cycle, but it can be also referred to DMAIC (used by Lean) [11-13], A3 (mostly used by Japanese companies) [14] or 8D (used by Ford) methods [15].

4. DISCUSSION ABOUT DIFFERENCES BETWEEN PROBLEM SOLVING APPROACH

Differences between approaches used for problem solving are shown in a Table 1.

Table 1. Differences between approaches in project problem solving phases

PDCA	DMAIC	A3	8D
Plan	Define	Clarify the problem	Identify the team
	Measure	Breakdown the problem	Define problem
		Set a target	Contain Symptom
	Analyse	Analyse the root cause	Identify root causes
		Develop countermeasures	Choose corrective actions
Do	Improve	See countermeasures	Implement corrective actions
Check	Control	Evaluate results and processes	Make change permanent
Act		Standardise success	Recognise the team

Deming’s PDCA (Plan, Do, Check, Act) cycle is the most known, and it refers to problem solving in 4 steps. Plan phase should be the biggest one, meaning that project definition, team selection and phenomena description should be done in this phase. Also, it is expected that project planning and timing is defined in this phase. Root cause analysis and solution definition are also done in planning phase. Do phase means implementation of solutions. Check phase follows the results of

implemented solution and gives benefit/cost analysis. Act phase standardise solutions and looks for expansion places. An example of PDCA is given on Fig.1.

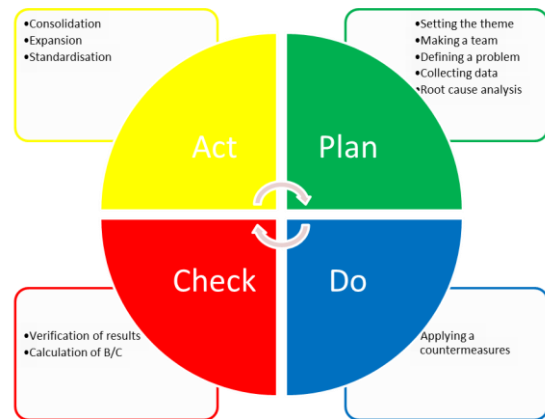


Fig.1. PDCA approach

DMAIC approach is actually PDCA given in 5 steps used by, but not limited only to Lean Six Sigma [16]. It is usually used for bigger amount of statistical data and requires more time to solve meaning it is mostly used for medium and large scale kaizens. If large kaizen is implemented its lead time can exceed 3 months. An example of DMAIC with description of each phase is given on Fig.2.



Fig.2. DMAIC approach

A3 approach, developed and used by Toyota, is an eight step PDCA approach used for small and medium kaizens. Its main idea is that all projects with problem definition, solution, checking and standardisation can be explained on one A3 sized paper. Otherwise, if you can’t explain kaizens on that paper size it means that you still do not know your process and solution well. This is usually used for kaizens which can be solved in maximum one to two weeks. This approach is also good for teaching new employees how to systematically approach to problem solving. Using 8 steps instead of 5 is giving new employees more detailed and helpful suggestion in which way to think and solve the problem. It also gives them opportunity to understand that if a person finds solution, he or she shouldn’t stop there and be satisfied but to try

to standardise solution in order to extend it on other places where it is applicable, but also to share it to other plants. Sharing between plants in means of best practices is good as probably someone already had experience with same problem and standardised it so others can use their problem solving and immediately apply it to reduce time needed to close the project.

8D approach is used by Ford Production System for problem solving. It is actually 8 steps PDCA with focus on fast reactions to recurring problems, meaning that preliminary solution is given fast, and first three steps should be finished in first three days. Similar methodology is used in aerospace industry and it is called PSP. One of the main users of this methodology is NASA.

5. CONCLUSION

Lean methodology and its derivatives are nowadays only way to have competitive production in modern industry. Striving for absolute quality with reduced losses and cost is a must. In this paper overview of methodology is given and different approaches in companies are explained. According to size and methodology used it is shown that problem solving can have 4 to 8 steps. It can be seen that some approaches like 8D are oriented to fast response. It can be seen from experience that level and complexity of kaizen rises by the time from starting of introduction of lean methodology in plant. In the beginning small problems are usually first attacked, as they bring big savings with small efforts and investments, while as time passes recurring but harder problems remains. With increased know-how this problems are being recognised and understood and therefore attacked. But, it means bigger investment, bigger lead time for project closing and finally bigger commitment from top management. At that time it is important to look for future savings and accept bigger investments and resources usage.

Value of this concept of lean management is also shown in usage in structures and businesses other than production industry. It has been shown that lean management can be used in banking, services, airline and economics. It found its usage even in tourism industry. However, like in automotive industry where different companies requires and develops different methodology based on TPS and lean, it is also necessary to separate and develop new tools for other businesses according to their needs. It means

reducing some wastes, recognising other new wastes, finding new aims and target, like customer and information, and striving to best result possible without excuses.

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