

FRI-2G.404-1-EM-07

A PRIORI RESEARCH ON LEAN TOOLS IN BUSINESS ¹

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***Abstract:** This a priori research of Lean tools in business is expected to help companies, researchers and business consultants to identify the key steps in organizations applying lean business model. The purpose of this paper is to discuss the common used lean tools as part of company management and possibility for organizations to apply these instruments, including Six Sigma, TPS, TQM, Toyota style, Kaizen, Kanban, etc. The concept is to find which of them are industry applicable and how management could invest as least as possible resources to obtain as much as possible customer satisfaction including covering their demands. In most of companies mistakes are done through applying the Lean model. The conclusions drawn from the conducted research, the presented arguments, methodology, results and guidelines can be structured in the following main directions per the objective and tasks set: 1) theoretical features of 25 Lean tools are analysed; 2) opportunities to improve production system using lean tools are discussed; 3) some preliminary benefits and misunderstandings of Lean tools are demonstrated.*

***Keywords:** Lean Tools, Operations Management.*

***JEL Codes:** L23, M11.*

INTRODUCTION

Lean thinking is a model for creating value added benefits for organizations and eliminating waste from production process. One of the crucial points is to be reduced the waste. It means that companies can look for increasing the production capacity on behalf of manufacturing model. Nowadays the production is exceeding the expectation staying behind the industrial “mass/common/usual” production from the previous century and it is searching for applying of more competitive and time wasting production (operations) systems.

According to Liker (2003) after the World War II the Toyota management team shows the World that there could be created different models of production including optimized supply chain management, customer’s management models, creating of new products with increased value, and optimization. Here comes the challenge: “common” vs. “lean” production?! Nowadays, the issue is not solved, yet. It is not quite pure from point of efficiency and effectiveness of any production system what model to apply.

Speaking on that topic the dilemma is how to avoid Muda in all **seven** variety types and how to encourage management to minimize and/or avoid mistakes, defects in the production, overproduction, idle (waiting) time, unnecessary process in the production, unnecessary movement of production or unnecessary movement of the people?! In fact, the design of the products that are not complying with customers’ demands is the new component of the range of the well-known seven types of waste (Womack & Jones, 2003).

¹ The paper is presented on October 25, 2019 by Adriana Simeonova, MSc.

Most of managers are evaluating products based on their opinion. Lean thinking turns the benefits through the customer point of view because if a company is ensuring wrong products (including services) by the right way, this will be accepted by client still as “Muda”.

The objective of this paper is to identify how the Lean toolbox can improve industrial production factories. It marks key points in implementation process of common production to lean production. Most common mistakes are identified as well as most crucial benefits for the organizations. The management skills and techniques are part of the successful implementation and they can be not underestimated. This paper marks some issues that can be used as guidance during the production process without underestimating the importance of other standards and/or approaches.

EXPOSITION

Theoretical Background of Lean Toolbox

Lean thinking push the companies to deliver higher quality with lower levels of waste, defects, and mistakes. Sounds, easy?!

A waste defining could be a model or long-term heavy procedure depending of the company mindset and the toolbox that company apply certain performance level. From theoretical point of view, in this research will be reviewed 25 Lean tools (Lean toolbox), which could be used during the process of change over from usual/common production to lean production (adapted from Vorne Industries Inc., 2019):

- **5S** – eliminate the waste through organizing the working area. The key principles are: sort, set in order, shine, standardize, and sustain (Fig. 1).
- **Andon** – it is visual system for plant feedback that provides opportunity for the management to react as soon as possible to any eventual alerts within the production. The system encourages the operators to stop the process immediately. The problems could be addressed correctly to the people responsible for their solving.
- **Bottleneck Analysis** – identify where the “low” and narrow places are within the manufacturing cycle and improves them. The analysis improves the wear places within the production (Fig. 2).



Fig. 1. 5S Workplace organization
|Source: Brady Worldwide Inc. (2011)

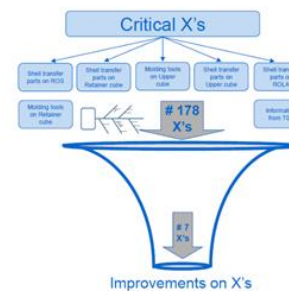


Fig. 2. Bottleneck analysis
Source: Contribution by Adriana Simeonova

- **Continuous Flow** – production with minimal (or no buffers) between steps, smooth production cycle within the manufacturing process. A lot of waste is eliminated as waiting time, transport, inventory, and unnecessary movement of people or machines).
- **Gemba (The Real Place)** – the methodology reminds to the managers to get to the real place, where the production is and where the problems occurs. It promotes understanding the process by first hand and by interviews with the plant employees.
- **Heijunka** – manufacturing model that is encouraging production of smaller batches by mixing the product variants within the same process. It reduces lead time, because each product is manufactured more frequently and the batches are smaller.

- **Hoshin Kanry (Policy Deployment)** – there is a meeting point philosophy between the strategy, tactics and the action of the senior management, middle management and plant floor employees. This method eliminates the waste that is coming from poor communication between the people.
- **Judoka (Automation)** – automation of the manufacturing process, typically the partial one is less expensive than the full automation. The system is designed with automatically stop when defects are detected. It is reducing labor cost and improving quality.
- **Just in time (JIT)** – pull parts based on customer demands instead of pushing production process based on the manufacturing program. It is usually synchronized with Kanban, takt time, Heijunka.
- **Kaizen (Continuous Improvement)** – strategy for effective work of the employees together and proactively within the manufacturing process. Eliminating waste within the process/operation and movement of inventory and people.
- **Kanban (Pull System)** – a method that is regulating the flow of goods indicating where more goods are needed. There are used signal cards. It prevents the overproduction and storage of physical inventories/ goods.
- **KPIs (Key Performance Indicators)** – they could encourage the organization to complete certain indicators. Here it is extremely important to be appointed the right KPIs indicators that will drive the successful behavior.
- **Muda (Waste)** – are aligned with anything that is waste of the customer point of view. The main concept staying behind the Lean thinking model is to be eliminated everything that is non-value added by the customer prospective.
- **Overall Equipment Effectiveness (OEE)** – it is measuring system for indicating the loss during the manufacturing process including Availability (downtime), Performance (slow cycle), Quality (rejects); 100% OEE means perfect production cycle – only goods with perfect quality,
- **PDCA (Plan-Do-Check-Act)** – improvements model for control and review of the achieved results within the organization. If the results are not corresponding with the plan, then it is expected the organization to reassess and to do it again.
- **Poka-yoke (Mistake Proofing Toolbox)** – the concept staying behind poka-yoke model is to prevent error occurring in the production process. The target is to be minimized the defects level and even it is used as Health & Safety model for worker's prevention. The goal is Zero tolerance defects production.
- **Root Cause Analysis** – a problem solving method that helps to be identified the symptoms staying behind the problem. It is commonly used 5 why approach- moving a step closer to the root cause of the critical point. This tool eliminates any types of waste that is connected with improperly treated problems within the manufacturing process.
- **Single Minute Exchange of Dies (SMED)** – it reduces the changeover time to be less than 10 minutes though different types of techniques including: 1) Setup is performed while the process is running; 2) Simple internal setup (the bolts are replaced with knobs and levers); 3) Standardized Working instructions; 4) Non-essential operations are removed; 5) The production is converted in smaller batches, which improves customer's responsiveness.
- **Six Big Losses** – there are six categories of different types of loss that are almost universally experienced in the manufacturing: 1) Breakdowns, 2) Setup/adjustments; 3) Small stops; 4) Reduced speed; 5) Start-up rejects; 6) Production rejects. Most types of the waste are coming as a result of the six big losses.
- **SMART goals** (specific, measurable, attainable, relevant, time-specific) – it helps to be ensured that the company goals and production targets are clearly defined and well-

supported for the production purposes.

- **Standardized Work** – there are documented procedure for manufacturing, which could be described as best practices guidance. There are including the time for completing each task. Though standardized work is defined the best practices that forms baseline for future improvement.
- **Takt time** – manufacturing of one piece in every 34 seconds that aligns with customer's brand. It is calculated based on the real production time and the customer's demands. It helps to precise the planning of: employees, shifts, inventory and supply chain. There is effective system to be measured what is the target and where we are as achieved levels, as well.
- **TPM (Total Productive Maintenance)** – it is approach that is expected to help to the companies to maintain properly the operational time of the equipment. The focus is held over the operators that is expected to maintain properly their attention over the equipment.
- **Value Stream Mapping** – it is mapping the production flow indicating the current and the future state of the processes (Fig. 3). The mapping is done in a way that marked where our weak points are and where we could try to find a better opportunity for development of the production processes, etc. The VSM is marking where is the process waste (waiting time, people, and inventory).

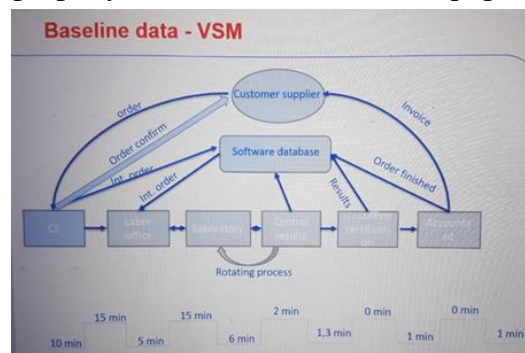


Fig. 3. Value Stream Mapping

Source: Contribution by Adriana Simeonova

- **Visual Factory** – visual indicators and displays highlighted the manufacturing plan and the areas where it could be improved. The conditions of the production are shown in a transparent way for all employees, visitors or stakeholders.

Some papers dealing with related topics can be used as a fundamental reading during the process of Lean toolbox implementation (Liker, 2003; Kirova, 2011b; Womack & Jones, 2003; Vitlemov, 2013) including risk assessment (Kirova, 2011a; Kirova, 2012). On other hand, a framework for service management with some lean instruments are presented for service management (Nedyalkov, 2012; Yorgova, 2015). It means that there is no general framework for improvement of the company process based on Lean Toolbox.

The company should be able to read and use the collected data in aspect to direct the changes, which are needed to be implemented. The data and the pictures will be useful for standardization and implementation process in the easiest and quickly adaptive for the current organization way.

Practical Application of Lean Toolbox

First step is to analyze the current position and to assess where and what is the desired direction of the company. For example, JIT method sounds for the some companies like almost unknown provoke the production to be manufactured only that what is ordered by the client in the desired by the client quantity. JIT is one of the two major shares of Toyota that is production example for minimal stock keeping and transportation waste. JIT is focused the attention of the properly selected layout for the production, essentially, following the production flow. Cellular manufacturing is acting based on the group of the machines in a layout decreasing transportation costs and increasing efficiency and effectiveness of labor force.

SMED examples are appropriate for production, which didn't want to invest a huge amount of materials in non-finished production forced by that the time for changing of machines is long and the lead time for a single product is increased significantly. Marking of the production batches with color tapes and additional training of the personal will help to be decreased the time for

exchange of the machines.

Training rooms with real manufacturing and health & safety equipment inside help to the employees to understand where are the most dangerous equipment and what could be avoided in their daily routine. Some of the best examples of the training rooms are giving examples for the viscosity of the oil liquids, the importance of the ordinance of the equipment, lot standardization for work with the machines, etc.

All this good practices are aiming to be prevented Health & Safety accidents for employees and visitors and to be increased the level of the responsibility of the personnel for the importance of their actions (Fig. 4).



Fig. 4. Company internal training room
Source: Contribution by Adriana Simeonova

Lean examples could be applied for the aircraft industry where the most of the airplane companies are applying what is the most adequate for them instead to think about the customers prospective. It is commonly happening nowadays to use Airplane Company for a flight from the direction Sofia-Sarajevo for example and the transition path to be connected through Rome. The travelling distance for just 1.5 flying hours is extended to 4 hours with 1.5 waiting time. By customer point of view, it is a waste. The direct flights are double and triple more expensive than the extended option with different transfers and idle time. All this is a crucial area in the airplane services can be significantly improved through the methodology of Lean tools.

Most of our everyday devices are equipped with error proofing system including poka-yoke. They are aiming to prevent the biggest issue that could happen in case of misunderstanding; forgetfulness; wrong identification; lack of experience or lack of standardization; poka-yoke tool is intended to prevent any defects/ incidents or injury during the usage of the equipment and could be easily implemented in the manufacturing system successfully with another instruments.

Benefits of Lean Toolbox Application

Lean toolbox is suitable for the companies implementing it step by step and especially if the management is calibrating the Lean application with another organization standard like ISO 9001, ISO 14001, ISO 45001, etc. The benefits that are expected to be gained by the manufacturing organizations are: 1) Improving of the quality level; 2) Decreasing of the waste (all seven types); 3) Improving the Health & Safety working conditions; 4) Improving the supply chain structure; 5) Improving the connection with the customers and the feedback process; 6) Higher competitiveness; 7) Decreasing of the cost for transportation, inventory, etc.; 8) Zero defects level.

As a result of the implementation the technology not only the human mistakes are expected to be controlled and decreased but as well there is expected the training time for the employees to be decreased in a less time consuming frames. Rejection time of units should be decreased and quality is expected to be quickly improved.

The fundamental idea of poka-yoke tool is that the work should be done by the first time, which means that all operations should be performed with zero tolerance defects in their operational cycle. If the company is planning correctly its production and the process is carefully

monitored during all steps of the operations, poka-yoke (and lean concept in general) could bring a lot for their management teams.

CONCLUSION

The implementation of Lean toolbox is expected to help managers and the organizations to achieve better quality results with lower level of waste (including the 7 different types of waste) and matching with quality optimization process. So, it is expected that the level of the accidents will be significantly decreased and eliminated as a key factor in the company portfolio. The unnecessary movements of machines and staff, and idle time will be reduced as well as the shop floor will be used optimally.

Most of the Lean techniques could be used with mixed variety including their synchronization with standards like ISO 9001, ISO 14001, ISO 45001 and it is expected to be a catalyzing process as a competitive advantage for companies.

The application of traditional approaches for quality control and defect prevention is not completely effective in production process, which is giving to Lean toolbox better control on risk management, coming as a benefit for managers working in uncertain environment.

Most recently applied Lean instruments based on expert research in the area are: 5S, Kaizen, Poka-yoke, PDCA, Kanban, Root Cause Analyses, Total Productive Maintenance, and Value Stream Mapping.

The philosophy of Kanban, Kaizen, SMED & Heijunka are coming from the same root cause and most of organizations are applying them commonly as a mix according to individual understanding and development of production process. Blending Lean instruments could be even more effective and efficient than applying single tool, increasing the continuous improvement process, decreasing the waste level and defects in organizations from a global prospective point of view.

Another questioning (per expert opinion) is that SMED approach could be treated with special attention by the companies that are new in the Lean application due to the lack of the understanding of the process. If it is not applied properly, it could be a reason for health & safety accidents, waiting time for machines or a break down in the continuous flow. When applying SMED the company should be based on the floor chart, organization chart, production plan and synchronizing all of them to be selected the most optimal stage for single minute exchange of the production line. The engineering backup and support by all managers on operational and senior level is a key pillar in the success of the Lean concept.

Wrongly applied 5S model could be a reason for ineffective used floor organization, blocked fire extinguishers or first aid section, not clearly understood by the employees' location of the most crucial equipment on site.

Value Stream Mapping, PDCA, Six Sigma are fuel for the organization to be efficient and effective with lower level of risk and defective production. The key benefit is coming from customer point of view based on the expectation that are demanded by stakeholders, clients, suppliers, competitors and market in general. They pushed the management to go beyond the "comfort zone" line and to achieve more than the average for the organization.

However, the risk of implementing Lean tool is available such as employees who are often pushing back from applying any new concepts just because the production is working like this "since several years" or "because nobody does this like that". The routine is giving an advantage to know the process, taking all operational benefits but is pushing the most of the organizations away from any new achievements behind their "comfort zone".

Furthermore, tools as JIT and Kanban, Muda, SMED, Heijunka, Gemba and especially Six Sigma are not quite considered and applied in developing countries. Of course, there are excellent illustrations (organizations) excluding this preliminary research.

As a final conclusion can be cited John Shook who says: *"There are three kinds of leaders. Those that tell you what to do. Those that allow you to do what you want. And Lean leaders that come down to the work and help you figure it out."*

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