

ANALYSIS OF TOOLS FOR LEAN MANUFACTURING

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Abstract

The paper deals with the drivers of changes in the manufacturing research over the next decade. Defined major dimension of manufacturing research. Shows the portfolio research priorities formulated by the U.S. and the EU. The common manufacturing research themes that have been identified as priorities are: sustainable, resource-efficient manufacturing, production technology to exploit the potential of emerging technologies.

Key words: Manufacturing research, foresights for manufacturing, manufacturing innovation.

INTRODUCTION

At present, our international project work starts from the border through cooperation Hungary - Slovak Republic LEAN LAB HUSK/1101/1.6.1. Our aim is to develop a methodology of teaching Lean Management, ending engineers to provide an opportunity to immediately work in the manufacturing process of knowledge management that Lean Management provides; at present there are no such forms of teaching this topics. Lean is only partially included in some specialized subjects. Manufacturing engineers need to ensure not only theoretical knowledge of Lean tools and techniques, but also practical experiences that are available directly in the production and training laboratories.

Article provides a brief overview of definitions and principles Lean Manufacturing. It analyses the main approaches to the selection of tools and Lean manufacturing on the basis of a comparison of formulating the concept of training specialized training under the project objectives.

GENERAL PRINCIPLES OF LEAN MANUFACTURING

Many definitions exist online, in books, and in company- adopted lean initiatives, but the one from the source says it all. Taiichi Ohno, founder of the Toyota Production System, said that the purpose of lean is to “just produce what is requested by the customer“ [5].

Lean manufacturing is a Business philosophy that continuously shortens the time between customer order and shipment by

eliminating everything that increases the cost and time [4].

Doing more with less by employing 'lean thinking. Lean manufacturing involves never ending efforts to eliminate or reduce 'muda' (Japanese for waste or any activity that consumes resources without adding value) in design, manufacturing, distribution, and customer service processes. Developed by the Toyota executive Taiichi Ohno (1912-90) during post-Second World War reconstruction period in Japan, and popularised by James P. Womack and Daniel T. Jones in their 1996 book 'Lean Thinking.' Also called lean production [12].

6 basic of Lean Principles [10]

- **Waste Elimination** – Many people think that Lean is about waste elimination only, but cutting waste is only one of many components. After you understand what your customer values, you can then go about systematically eliminating from your process the things for which your customer is not willing to pay (i.e. waste). Map all the steps in the value stream and eliminate the seven classic forms of waste (more on this topic in the next web letter).
- **Flow** – After waste has been eliminated, work to get the steps in the value stream into a tight sequence that flows smoothly towards the customer. Here is an opportunity to directly observe work (with your own eyes). Stand in the place that the work is performed and seek to understand why things are done the way they are. Look at this work from the “big picture” as a linked sequence of activities, connections, and flows.
- **Pull** – Once flow has been established in the process, it’s time to implement a pull system. Let customers, either external or internal, pull value from the next upstream activity by sending a signal, such as a Kanban, when they need more material or product.
- **Organizational** – There is a huge organizational component to Lean that must be addressed early—through clear channels of communication. Lean initiatives and their benefits are sometimes preceded by bad impressions of what this means to the employees. Clear communication from the beginning will help to diffuse any misconceptions. There must be agreement throughout the organization about what new terms and visual signs mean and how to use them.

One must create a learning organization that enables systematic problem solving to get to the root cause of issues.

- **Sustainability** – As transparency increases and waste is further eliminated, pursue perfection through continuous improvement. Always be setting goals and looking ahead to where you want to be in both the short-term and long-term.

General Principles of lean manufacturing are: To create continuous flow with direct link between suppliers and customers, To use tact-times and pull-systems to manage the workflow, To reduce batch sizes and inventories, To eliminate waste, To cross-train workers in order to deal with inherent variability, Selective use of automation, To install a Continuous Improvement competence.

Key principles of Lean are - The implementation of lean manufacturing techniques are identified and eliminated all the wastes from the system. There are different types of waste:

- Waste of inventory (space and time).
- Waste of Time (manufacturing time).
- Waste of Materials (Scrap).
- Waste of Equipment (machine time).
- Waste of plant space and movement of materials and objects.
- Waste of Labour (unnecessary actions).
- Waste of capital (idle times of resources).

The most famous definition of Lean manufacturing, which expresses the main tool, is the Toyota Production System. The popular definition of Lean Manufacturing and the Toyota Production System usually consists of the following: • It is a comprehensive set of techniques that, when combined and matured, will allow you to reduce and then eliminate the seven wastes. This system not only will make your company Leaner, but subsequently more flexible and more responsive by reducing waste [3].

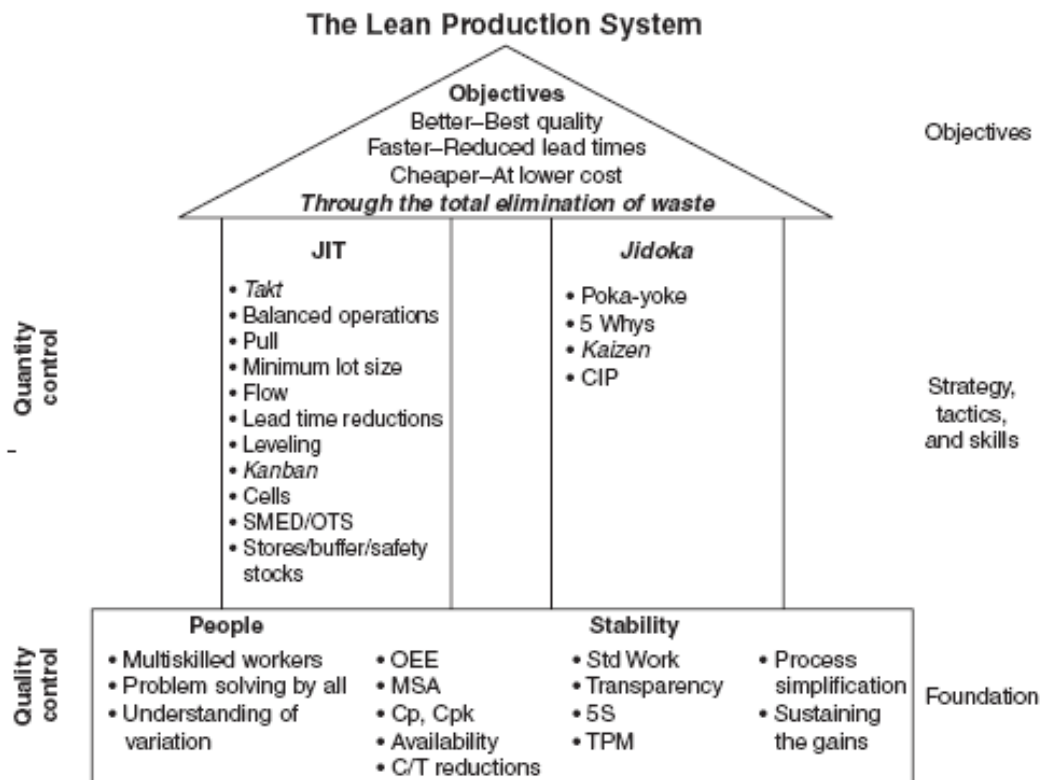


Fig. 1: House of lean manufacturing

Lean Terms of Japanese Origin [4]

Andon Seiketsu, Baka-Yoke Seiri, Chaku-Chaku Seiso, Gemba Seiton, Genchi Genbutsu Sensei, Hansei Shitsuke, Heijunka Shojinka, Hoshin Kanri Shusa, Jidoka Tsurube, Jishuken Yamazumi, Kaikaku Yokoten, Kaizen, Kakushin, Kanban, Mizusumashi, Muda, Mura, Muri, Nemawashi, Obeya , Poka-Yoke

ANALYSIS OF LEAN TOOLS IN LEARNING AND TRAINING PROGRAMS

Examined were the most selections lean tools used in major research studies, practice consulting institutions and educational programs of universities. As the first in Table presented a comprehensive set of lean tools from organization Lean production.

Table 1: Top 25 Lean Tools [6]

Lean Tools	
5 S	Sort (eliminate that which is not needed), Set In Order (organize remaining items), Shine (clean and inspect work area), Standardize (write standards), Sustain (regularly apply the standards)
Andon	Visual feedback system for the plant floor that indicates production status alerts when assistance is needed, and empowers operators to stop the production process.
Bottleneck Analysis	Identify which part of the manufacturing process limits the overall throughput and improve the performance of that part of the process.
Continuous Flow	Manufacturing where work-in-process smoothly flows through production with minimal (or no) buffers between steps of the manufacturing process.
Gemba (The Real Place)	A philosophy that reminds us to get out of our offices and spend time on the plant floor – the place where real action occurs.
Heijunka (Level Scheduling)	A form of production scheduling that purposely manufactures in much smaller batches by sequencing (mixing) product variants within the same process.
Hoshin Kanri (Policy Deployment)	Align the goals of the company (Strategy), with the plans of middle management (Tactics) and the work performed on the plant floor (Action).
Jidoka (Autonomation)	Design equipment to partially automate the manufacturing process (partial automation is much less expensive than full automation) and to automatically stop when defects are detected.
Just-In-Time (JIT)	Pull parts through production based on customer demand instead of pushing parts through production based on projected demand. Relies on many lean tools, such as Continuous Flow, Heijunka, Kanban, Standardized Work and Tact Time.
Kaizen (Continuous Improvement)	A strategy where employees work together proactively to achieve regular, incremental improvements in the manufacturing process.
Kanban (Pull System)	A method of regulating the flow of goods within the factory, suppliers and customers. Based on automatic replenishment through signal cards that indicate when more goods are needed.
KPI (Key Performance Indicator)	Metrics designed to track and encourage progress towards critical goals of the organization. Strongly promoted KPIs can be extremely powerful drivers of behaviour.
Muda (Waste)	Anything in the manufacturing process that does not add value from the customer's perspective.
Overall Equipment Effectiveness (OEE)	Framework for measuring productivity loss for a manufacturing process. Three categories of loss are tracked: Availability (e.g. down time), Performance (e.g. slow cycles), Quality (e.g. rejects)
PDCA (Plan, Do, Check, Act)	Iterative methodology for implementing improvements: Plan (establish plan and expected results), Do (implement plan), Check (verify expected results achieved), • Act (assess; do it)
Poka-Yoke (Error Proofing)	Design error detection and prevention into production processes with the goal of achieving zero defects.
Root Cause Analysis	A problem solving methodology that focuses on resolving the underlying problem instead of applying quick fixes that only treat immediate symptoms of the problem. A approach is to ask why five times – each time moving a step closer to discovering the true underlying problem.
Single Minute Exchange of Die (SMED)	Reduce set-up (changeover). Techniques include: Convert set-up steps to be external (performed while the process is running), Simplify internal set-up (e.g. replace bolts with knobs and levers), Eliminate non-essential operations, Create standardized work instructions
Six Big Losses	Categories of productivity loss that are almost experienced in manufacturing: Breakdowns, Adjustments/Adjustments, Small Stops, Reduced Speed, Start-up Rejects, Production Rejects
SMART Goals	Goals that are: Specific, Measurable, Attainable, Relevant, and Time-Specific.
Standardized Work	Documented procedures for manufacturing that capture best practices (including the time to complete each task). Must be living" documentation that is easy to change.
Tact Time	The pace of production that aligns production with customer demand. Calculated as Planned Production Time / Customer Demand.
Total Productive Maintenance (TPM)	An approach to maintenance that focuses on proactive and preventative maintenance to maximize the operational time of equipment. TPM blurs the distinction between maintenance and production by placing a strong emphasis on empowering operators to help maintain their equipment.
Value Stream Mapping	A tool used to visually map the flow of production. Shows the current and future state of processes in a way that highlights opportunities for improvement.
Visual Factory	Visual indicators, displays and controls used throughout manufacturing plants to improve communication of information.

Further modifications recommended Lean-manufacturing tools that are not in the list of 25th:

Select from Lean tools [3]

1. **Benchmarking:** Lean benchmarking is the process of using a successful organization as a reference for identifying ways for another organization to improve. It can be conducted as a comparison with the best practices at other organizations, or it can provide a tool for comparing practices within an organization over time to prevent backsliding of performance.
2. **Bottleneck Analysis:** Bottleneck Analysis studies a process to identify the step in the process where the capacity available is less than the capacity required. That process is

- known as the constraint. The next step is to identify ways of removing the constraint.
3. **Cellular Manufacturing:** Cellular Manufacturing organizes processes into flexible cells comprised of sequential steps. This organization allows for a number of processes to be completed on a part in quick succession with limited movement between steps.
 4. **Dynamic Scheduling:** Dynamic Scheduling adds flexibility to a scheduling system by creating update procedures to refine and change a schedule as new information on supply and demand factors is obtained.
 5. **Lean Supermarket:** A lean supermarket is an inventory organization and storage system designed to centralize components when continuous flow is not possible. The supermarket regulates inventory levels and replenishment. Whenever one-piece flow cannot be accomplished, a Lean supermarket is often employed as a way of managing buffer inventory and allowing employees to have easy access to the parts they need.
 6. **Visual Metrics:** Lean requires constant attention and focus, and implementing visual metrics is an effective way to provide this focus. Visual metrics can cover any aspect of an organization. In lean, some of the more common metrics that are tracked and posted are throughput, quality, safety, productivity, machine uptime, and customer service.
 7. **Zero Quality Control:** Zero quality control is a methodology designed to shift quality to the process and eliminate the need for external quality inspections. A zero quality control system typically includes error proofing, "source inspection" and employee empowerment as well as other quality initiatives.

Productivity Australia list of the Lean Tools [9]:

- Tool Box Meetings
- Multi Skilling
- A3 Reporting
- Quality Planning (CTQ, SOP, SPC)
- Failure Mode & Effects Analysis (FMEA)
- Corrective Action & Problem Solving
- Project Management

Lean Concepts and Tools [2], [7]:

- Toyota Production System as the basis for the concept of Lean enterprise.

- Components of Lean enterprise concepts: Lean Manufacturing, Lean Logistics, Lean Supply Chains, Lean Product Design and Development, Lean Innovation, Lean Administration.
- Implementation of the concept of Lean, Kaizen, Management and Lean business strategy, Six Sigma Method.
- Integrating approaches Lean and Agility.

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