Identify the Lean Tool for Different Industrial Sectors in India

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***Abstract*— Use of Lean principles and lean tools has a predominant role in different industrial sectors in India. The competitive market faces a lot of problems and to overcome the problems certain strategic measures have to be taken up which for eliminating various wastes arising out of the sub processes in industries by prioritize. The aim of lean is to eliminate the waste found in respective industries by using the different lean tools. The main purpose of this study is to identify the different types of lean tools use in different industrial sectors. The methodology used for identification is industrial visits, discussion with industrial professionals, experts from lean sectors. The knowledge and information available at source is only the limitation.**

***Index Terms*—Lean Tools, Industrial Sectors**

I. INTRODUCTION

Lean Manufacturing is derived from the methods of the successful Japanese automobile manufacturer, Toyota. Lean Manufacturing became internationally recognized as a result of the book, The Machine That Changed the World, by James Womack and Dan Jones.

Lean organizations are capable of producing high-quality products economically in lower volumes and bringing them to market faster than mass producers. A lean organization can make twice as much product with twice the quality and half the time and space, at half the cost, with a fraction of the normal work-in-process inventory. Lean management is about operating the most efficient and effective organization possible, with least cost and zero waste. In lean manufacturing, the value of a product is defined solely based on what the customer actually requires and is willing to pay for.

Seven main types of wastes were identified as a part of the Toyota Production System. However, this list has been modified and expanded by various practitioners of lean manufacturing and generally includes the following:

1. **Overproduction**: Overproduction is unnecessarily producing more than demanded, or producing it too early before it is needed. This increases the risk of obsolescence, increases the risk of producing the wrong thing and increases the possibility of having to sell those items at a discount or discard them as scrap. However, there are some cases when extra supplies of semi-finished or finished products are intentionally maintained, even by lean manufacturers. (Capital, 2004).
2. **Defects:** In addition to physical defects which directly add to the costs of goods sold, this may include errors in paperwork, provision of incorrect information about the product, late delivery, production to incorrect specifications, use of too much raw materials or generation of unnecessary scrap. (Capital, 2004).
3. **Inventory:** Inventory waste means having unnecessarily high levels of raw materials, works-in-process and finished products. Extra inventory leads to higher inventory financing costs, higher storage costs and higher defect rates. (Capital, 2004).
4. **Transportation**: Transportation includes any movement of materials that does not add any value to the product, such as moving materials between workstations. The idea is that transportation of materials between productions stages should aim for the ideal that the output of one process is immediately used as the input for the next process. Transportation between processing stages results in prolonging production cycle times, the inefficient use of labour and space and can also be a source of minor production stoppages. (Capital, 2004).
5. **Waiting**: Waiting is idle time for workers or machines due to bottlenecks or inefficient production flow on the factory floor. Waiting also includes small delays between processing of units. Waiting results in a significant cost insofar as it increases labor costs and depreciation costs per unit of output. (Capital, 2004).
6. **Motion:** Motion includes any unnecessary physical motions or walking by workers which divert them from actual processing work. For example, this might include walking around the factory floor to look for a tool, or even unnecessary or difficult physical movements, due to poorly designed ergonomics, which slow down the workers. (Capital, 2004).
7. **Over-processing**: Over-processing is unintentionally doing more processing work than the customer requires in terms of product quality or features- such as polishing or applying finishing in some areas of product that will not be seen by the customer. (Capital, 2004).

II. Lean Tools in Brief

1. **Value Stream Mapping (VSM)** - is defined as all the value-added and non-value added actions required to bring a specific product, service, or combination of products and services, to a customer
2. **5s** - Organize the work area:
   a. Sort (eliminate that which is not needed),
   b. Set in Order (organize remaining items)
   c. Shine (clean and inspect work area)
   d. Standardize (write standards for above)
   e. Sustain (regularly apply the standards)
3. **Just –In-Time (JIT)** - Pull parts through production based on customer demand instead of pushing parts through production based on projected demand.
4. **Kaizen (Continuous Improvement)** - A strategy where employees work together proactively to achieve regular, incremental improvements in the manufacturing process.
5. **Kanban (Pull System)** - A method of regulating the flow of goods both within the factory and with outside suppliers and customers. Based on automatic replenishment through signal cards that indicate when more goods are needed.
6. **Heijunka (Level Scheduling)** - A form of production scheduling that purposely manufactures in much smaller batches by sequencing (mixing) product variant within the same process.
7. **Jidoka (Automation)** - Design equipment to partially automate the manufacturing process (partial automation is typically much less expensive than full automation) and to automatically stop when defects are detected.
8. **SMED (Single Minute Exchange of Die)** – Reduce setup change over time.
9. **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.
10. **TPM (Total Productive Maintenance)** – A holistic 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.
11. **Visual Management** - Visual management systems enable factory workers to be well informed about production procedures status and other important information for them to do their jobs as effectively as possible.

III. Methodology

To identify the lean tools, as described above, various industries have been considered as a part of study. Industrial Sectors choose as per stated by various industrial associations. On the website of these organizations, various industrial sectors have been classified. On the basis of that various Industrial sectors chosen as a part of research study. To get the information about the use of Lean Tool in respective industry experienced personnel were interviewed and discuss various aspects of use of the Lean Tool for that industry. Also literature survey carried out for finding any previous work done on this topic. Also found the articles of different industry practioners, who have presented research paper on Lean Tools in respective industries.

IV. Result and Discussion

After following, the methodology and literature survey, following are the findings of the research work. The data gathered was structured in Pie Chart, which is shown here to get idea about the Role of Lean Tools in different Industrial Sectors

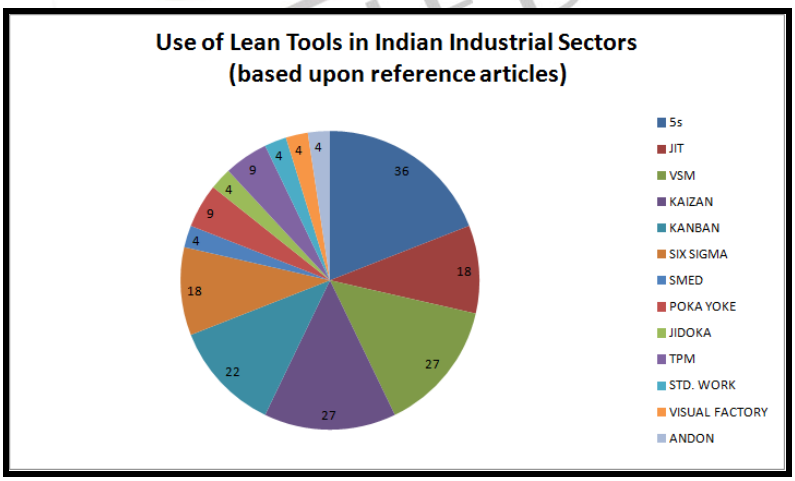

Fig. 1 Lean tools identify in Indian industrial sectors

Table 1 : Lean tools and Industrial sectors (number indicate the Reference number of article found for study)

	Lean Tool												
	5s	JIT	VSM	KAIZAN	KANBAN	SIX SIGMA	SMED	POKA YOKE	JIDOKA	TPM	STANDARDIZED WORK	VISUAL FACTORY	ANDON
Industrial Sectors													
Automobile	✓		✓	✓	✓	✓							
	[1]		[21]	[1]	[1]	[15]							
Coal and Mining	✓				✓								✓
	[2]				[2]					[2]			[2]
Electronics						✓			✓				
		[3]				[3]			[3]				
Fabrications	✓												
	[4]												
Forging			✓	✓									
			[5]	[5]									
Kitchenware			✓	✓									
			[6]	[6]									
Textile/ Garment			✓	✓	✓	✓	✓	✓					
	[7], [16]		[7],[16], [20]	[7],[16]	[7],[16]	[16]	[7],[20]	[7]					
Process	✓			✓									
	[8]	[8]								[8]			
Manufacturing	✓		✓	✓	✓								
	[9]	[9]	[13]	[10],[17]	[9]								
MSME					✓			✓			✓	✓	
	[10], [17]	[18]	[17]		[10]			[17]			[10]	[10]	
Plastic	✓												
	[14]												
Pharma						✓							
						[19]							

Figure 1 and Table.1 it would be suggested that, 5S; Just in Time, Kanban and Value Stream Mapping have major contribution in Industrial Sectors. Almost all industrial sectors preferred 5S as a Lean tool as the waste elimination tool. One or more industries preferred more than one tool such as combination of combination of 5S and VSM. Six Sigma is also preferable tool with other lean tools. Kaizan and Kanban are also used in many industries. Major application of maximum tools found in Textile, Automobile, Manufacturing, Process and MSME sectors.

V. Conclusion

Aim of Study is to identify the various lean tools used in various industrial sectors and that has been identified. Study was carried out on small number of industrial sectors. It could be further including other sectors which have longer history with lean tools, so that the effect of lean tools could be marked easily. Proposed areas of study could be validated and improved by performing case study on any one sector or industry.

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