

## Impact of 5S and lean manufacturing techniques in various organisations to enhance the productivity

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Date of Submission: 01-08-2020

Date of Acceptance: 15-08-2020

**ABSTRACT:** In recent world, safety and standardization are very important parameters to increase the production of the product in any big or small industry. After globalisation and liberalisation, quality has emerged as most critical and crucial area of concern along with productivity for manufacturing organisations. With the reduction of different barriers and the pressure of competing in this tough global market, overall the operational effectiveness has become a necessity for the organisations. So the lean manufacturing technique attributes characterised by both the technology push and market pull have forced the organisations to realise the increment in performance, which continuously improves the products and its processes. 5S system is the business and industry approach, which focuses on the production ratio and improvement of its process. It contributes more than 50% of the industrial production in value additional term and one-third export revenue. This technique is used by the Japanese organisations, which includes 5 different S: Seiri (sort), Seiton (set in order), Seiso (shine), Seiketsu (standardize) and Shitsuke (sustain). This system helps to organise a workplace for efficiency and decrease the wasting and optimise quality and productivity via monitoring an organisation environment. This review paper highlights contribution of 5S technique in different industries and demonstrating the true potential of this technique to enhance the productivity and safety rules at workplace.

**Keywords:** - 5S technique; enhancing Productivity; Lean manufacturing; total quality management.

### I. INTRODUCTION OF LEAN MANUFACTURING

In today's competitive world, there are so many companies who actually develop their own area with few resources. And at the end, they need

more beneficial from the manufacturing of the product department. Means there are so many businesses, which opted few resources to get more benefits from it. One of the best ways to increase the effectiveness and efficiency of the product is to adopt the lean management technique. The manufacturing service, for profit, not for profit, education and health businesses can be improve through the help of this technique. There are number of businesses, which depend on the small industries. So the big industries are using fundamental components to define their importance in a different way. Different industries have been implementing the lean approach for producing better product in less time with fewer efforts [1],[2]. Company's situation depends in a large part from the rapid and random response of the customer requirements. So currently, the standard becomes to produce the product on time, in the desired quantity and quality and with the lowest competitive price. Manufacturers in any production based companies have always faced challenges such as rising customer's expectations, fluctuating demands, competition, product price, base level cost of the product, product quality and product quantity in the market [3],[4].

Basically, the lean manufacturing is one of the interesting trends to affect profitability as well as the way in which companies address overall efficiency. It is a concept, which allows the improvement of the production process and it presumes the elimination of all waste occurring on the production, which leads to a reduction in the transit time of the material by the process [1],[3]. In today's world of manufacturing, assembly work is routinely characterized by the short production cycle and constantly retreating batch sizes, while the variety of the product types and models continues to increase [5]. Lean manufacturing is a concept frame very well known in many small-big industries since the beginning of the 90's. Lean

manufacturing would be better explained as the elimination of the waste or non-value activities. In lean manufacturing, the change is supported in a cultural way, is more a managerial activity. Lean manufacturing is covered both the parameters of the production, which are technical aspects and cultural aspects [2]. The new uprising in the manufacturing goods and service sector has created a great challenge to the world's industrial market. The customer driven and highly competitive market has rendered the old-fashioned managerial style an inadequate tool to cope with the challenges. These types of factors are the big challenges for the companies in recent days, so to look for a new tool to continue moving up the ladder in a global, competitive and growing market, we need lean manufacturing technique or 5S techniques to eliminate the waste and improve the fundamental aspects of the production department [6].

The basic behind the lean manufacturing technique, which have been practiced for many years in Japan are cost reduction and employee empowerment. Lean focuses on the abolishing or reducing waste and on maximizing or fully initializing activities those added values from the customer's perspective. So, Yasuhiro concluded in his article that some of the production aspects are being changed according to the lean manufacturing, which are listed below [7],[8].

- Materials- Convert all raw materials into end products and try to avoid excess raw materials and scraps.
- Inventory- Keep constant flow to the customer.
- Overproduction- Produce the exact quantity that customers need.
- Labor- Get rid of unwarranted movement of people.
- Complexity- Try to solve problems that uncomplicated way rather than the complex way.
- Energy- Utilize the equipment and people in the most productive ways.
- Space- Utilize and arrange the equipment in a proper place.
- Defects- Eliminate the defects or set up defects department, so that the defect product can be useful in a different way.
- Time- Make the shifts of fixed amount of workers/employees.
- Transportation- Get rid of transportation of materials and information that does not add value to the product.

The most significant source of waste is inventory. When inventory is reduced, hidden problems can appear and action can be taken

immediately. There are so many ways to reduce the amount of inventory. It is clear that when inventory is reduced other sources of waste are reduced too. For example, space that was used to keep inventory can be utilized for other things such as to increase the facility capacity [6],[8].

## II. HISTORY OF LEAN MANUFACTURING

Japanese were lost their so many resources of their various businesses after World War II. They were faced with such a dilemma of vast storage of material, financial and human resources. One of the most important directions of the development in contemporary times is the necessary research, potentials and possibility of developing different methodologies and application tools and techniques, which aimed at improving the machine tool manufacturing industry [6],[9]. In 1910, Sakichi Toyoda was first visited to United States of the America and he saw that new automobile era is just begun. After that in 1929, Kiichiro Toyoda was visited to USA with the aim of scrutinizing the local companies in the automobile industry [10]. In these days, Henry Ford recognized the limitations and broke the assembly process down in 30seconds, which were performed almost a thousand times a day. In 1950's, Eiji Toyoda and Taiichi Ohno were merged their knowledge and skill of the master in craftsmen with the standardization and efficiency of the moving assembly line and added the concept of teamwork to create the "Toyota Production System (TPS)" [11].

During the late 1980's, many companies have taken Japan, as a rising manufacturing nation, as an example. Companies like Toyota, Nissan, Sony or Honda started to gain market leadership not only in the Japanese market but also in North America and Europe. The sudden and rapid rise of these companies set a quest for other market players, consultants and academics to find out how these companies designed, implemented and operated their manufacturing systems. These processes were to be called "lean production" processes. The origins of lean can be traced back to the American fears that the Japanese manufacturing companies within the car industry would take over and gain an unbeatable competitive advantage. These fears drove academics and western competitors to conduct a series of benchmarking activities in order to reach the roots of the Japanese success. After TPS was found in 1970, they applied lean system in their supply chain and in production chain. After applying in various departments, in 1988 named John Krafcik introduced the term

“lean manufacturing” to the world by his review paper on Toyota Production System. Then the results were published altogether in the publication “the machine that changed the world by Womack, Jones and Roos” in 1990. For western manufacturers this text provided the first written data concentrating on the Japanese success and on the huge gaps they would have to overcome in order to reach the Japanese success. The authors found the Japanese manufacturing model to use not only less effort, but also less of any resource invested in the manufacturing circle: fewer inventories, less space, less capital [12],[13],[11].

the supply chain. Lean can be applied to all aspects of the supply chain and should be if the maximum benefits within the organization are to be sustainably realized. Though lean manufacturing can result in improved organizational performance and challenges do exist. Convincing manager and employees to think and act in the ways that are foreign may be difficult. Although there are different tools to use and procedures to follow to be authentically lean, over the last few years the term has passed into the global consciousness in the same way as the global acceptance of the Hoover [11],[13],[14].

**Table 1.1** Comparison of Production System [13]

	Mass Production	Lean Production
Basic	Henry Ford	Toyota
People to design	Narrowly skilled professionals	Multi skilled professionals
People to production	Semi skilled of unskilled workers	Multi skilled professionals
Equipment	Expensive	Manual and automated system
Production Method	High volumes of the products	Production-according to customer needs
Organizational Philosophy	Management takes responsibility	Organization takes responsibility
Philosophy	Aim for good enough	Aim for perfection

According to the given table, the lean production gives more benefit to the manufacturing department and to the production department. As per the review mentioned by T.Melton, the lean production is more beneficial comparatively than mass production technique. However, lean drive in manufacturing has been relatively passive for many decades. Lean is achieved with the use of the machine tools, including mistake proving, value stream mapping, visual management and pull production method, which are world class tools and methods successfully applied in so many areas such as the automobile sectors [9]. Lean manufacturing is associated with benefits such as reduced inventory, reduced manufacture times, increased quality and flexibility, also increased customer satisfaction. Lean production has now expanded and lean thinking has been applied to all aspects of

### III. PURPOSE OF LEAN TOOLS

Lean is focuses on the values of the customers while consuming the least amount of resources of design, build and sustain the product. Lean thinking means to create wealth in the company or corporation by reducing the waste. Below are the points, which explain the objective of the “Lean Production” [15].

- Specific value
- Identify the value for each product
- Make value flow towards the customer
- Produced based on the pull of the customer
- Approach perfectly

Lean is concerned with eliminating all types of process wastages and improves the efficiency of time taken for the making in product. There are seven types of wastages, which can be effected to the production department. The waste is sometimes hard to see in ongoing process, but it can be classified by overproduction, time on hand, transportation, over processing, inventory, movement and defective products. An organization striving to be lean will want to have only the required inventory when needed, improve quality to zero defects, reduce lead time through setup time reduction, reduce queue lengths and sizes, incrementally revise operations and accomplish improvement at the minimum costs and resources [16],[17].

### IV. LEAN MANUFACTURING TOOLS AND TECHNIQUES

Lean emphasizes the learning by doing approach, where the members of a process improvement team are those most closely associated with adding value to the product. Whole process is defining the customer value, focusing on the value stream, making value flow and letting customer determine the product or service they want with a relentless pursuit of perfection in a timely manner at an appropriate price [18]. Lean

manufacturing is a concept, which boils down to the fact that all employees continually strive to reduce cost, shorten the delivery cycle and increase the quality of the product and all this in order to meet customer expectations and become more competitive in the market. It also focuses on eliminating the waste, which brings the cost and no added value. Applying lean also increases the competitive advantages while reducing the operating costs of the enterprise [19]. There are number of lean manufacturing tools, which are used in various ways in different industries. Below the table 1.2 shows the different tools and how beneficial there are.

**Table 1.2** Different Tools of Lean Manufacturing [20]

Lean Tools	What is it?
1.5S	Organize the work area
2.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.
3.Continuous Flow	Manufacturing where work-in-process smoothly flows through production with minimal buffers between steps of the manufacturing process.
4.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.
5.Kaizen	A strategy where employees work together proactively to achieve regular, incremental improvements in the manufacturing process.
6.Kanban	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.
7.Muda	Anything in the manufacturing process that does not add value from the customer's perspective.
8.Poka-Yoke	Design error detection and prevention into production processes with the goal of achieving zero defects.
9.Total Productive Maintenance (TPM)	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.
10.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.

Lean Manufacturing Principles: [21]

- Pull processing products are pulled from the consumer end (demand) not pushed from the production end (supply).
- Perfect first time quality- quest for zero defects revealing & solving problems at the source.
- Waste minimization- eliminating all activities that do not add value & safety nets, maximize use of scarce resources.
- Continuous improvement- reducing costs, improving quality, increasing productivity and information sharing.
- Flexibility- producing different mixes or greater diversity of products quickly, without sacrificing efficiency at lower volumes of production.



- Building and maintaining a long term relationship with suppliers through collaborative risk sharing, cost sharing and information sharing arrangements.

Organizations generally implement one or more lean tools in order to reduce non value added process. A majority of the articles on lean production study a single aspect of the lean and its performance in reducing waste [22]. Figure 1.1 shows the different aspects of lean manufacturing in various industries and use of lean tools.

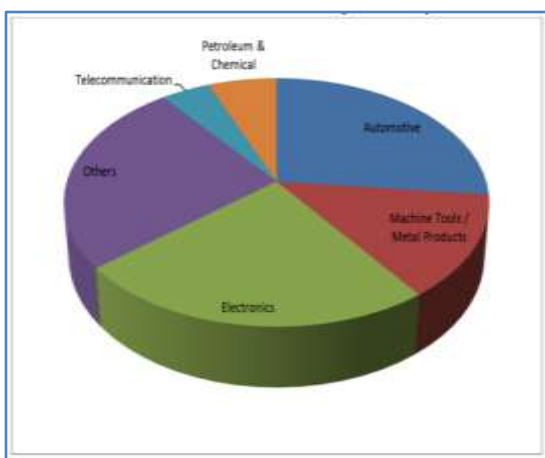


Figure 1.1 Different aspects of Lean tools in various industries [22]

There are six different categories taken to differentiate the number of companies according to their manufacturing of the products. It can be seen from the figure that all types of manufacturing industries are being represented adequately in the study; it is also worthwhile to note that although telecommunication has been mentioned as a service sector earlier, in this case it refers to a telecommunications equipment manufacturer. In order to maintain clarity and to properly convey the differences in the industries, only a few lean tools for which adequate data could be obtained were compared and studied [23],[24]. Some of the major lean manufacturing tools are explained here.

### Value Stream Mapping

- It is a lean production tool, used to design and analyze the production process. It is designed to create an easy way for managers to visualize the value flow. The value is defined as that thing which brings a product in the form desired by the customers who are willing to pay for it [25].
- The goal of the Value Stream Mapping is to help managers identify waste in all their

processes in order to eliminate them: the waste time of the production process resulting from a faulty organization of the working equipment, waiting, the time spent on handling the products from one stage to another of the production process, from the production workshops to warehouses, a production larger than it is required for the next stage of the production process, the undesirable characteristics that affect the product functionality or its appearance, the refuse, over processing, inventory [25].

- Value stream mapping is a graphic tool that helps you to see and understand the flow of material and information as a product makes its way through the value stream [21].
- Visual management can address both visual display and control. Visual displays present information, while visual control focuses on a need to act. Information needs to address items such as schedules, standard work, and quality and maintenance requirements. Visual control can address whether a production line is running according to plan; it can highlight problems [18].

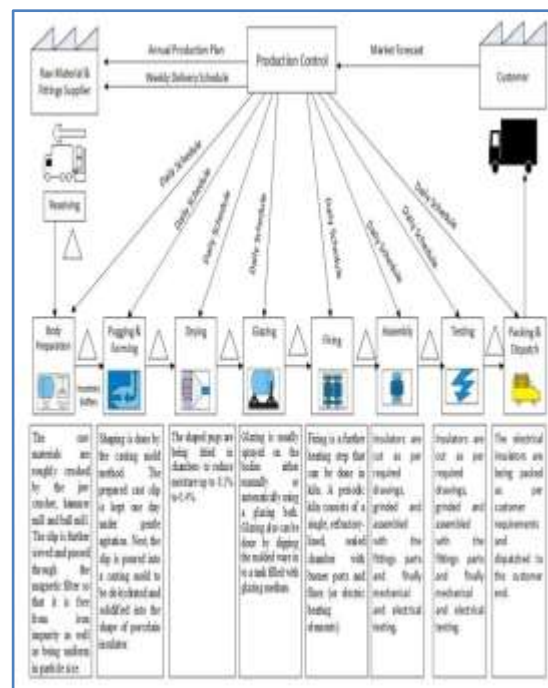


Figure 1.2 Current state of VSM of production process [26]

- Value Stream Mapping contrasts between value added activities and non-value added activities and focuses on improvement of value added activities and reduction of non-added

value activities. VSM enables analyzing and designing the flow of materials and information needed for production and delivering a product to the customer and can be applied to nearly any chain of manufacturing activities in ceramics industry [26].

#### **Poka Yoke (Error Proofing)**

- A poka-yoke is a mechanism that works with Jidoka to either prevent a mistake or make a mistake obvious at a glance; for example, an operator who creates customized assemblies from small bins in front of him: One approach would be to give the operator a list of parts to assemble by taking them as needed from the bin [18].
- This approach can lead to assembly errors since he or she might forget to include one of the parts or add parts not specified. A poka-yoke solution might be to install lights on all bins. When the operator is to create a new assembly, the bins that contain the specified parts for the assembly will be illuminated. The operator then systematically removes one part from each bin and places it in front of him [18].
- Poka-yoke offers solutions to organizations that experience frequent discrepancies in the packaging of their products – e.g., someone forgot to include instructions or forgot to include a mounting screw. Poka-yoke ideas or devices can be more effective than simple demands on workers to “be more careful.” Improvement focus should always be given to what can be done to error-proof a process more than on inspecting the quality of the finished product [18].
- Poka-yoke refers to any mechanism that helps staff to avoid errors. Its purpose is to eliminate product defects by preventing, correcting, or drawing attention to human errors. The Lean concept is criticised in the literature from the perspective of the personnel, because this side is less known, focusing primarily on techniques for improving the performance of the system [25].
- Poka Yoke (Error Proofing) Error proofing is a structured approach to ensure quality and error free manufacturing environment. Error Proofing assures that defect will never be passed to next operation. Poka Yoke means fool proofing, it is all about ensuring that the mistake doesn't happen. Error proofing is a manufacturing technique of preventing errors by designing the manufacturing process, equipment and tools so that an operation

literally cannot be performed incorrectly. The basic concept of this is avoiding the problems by correcting the process [21],[27].

#### **5S Method**

- Creation of standardized work is a primary reason for using the 5S method. It offers a basic housekeeping discipline for the shop floor and the office. It includes the following five steps: Sort, Straighten, Shine, Standardize, and Sustain [18].
- 5S creates a foundation for optimal running of machines and it incorporates five elements: [26]
  1. Sort: elimination of anything that is not needed in work area.
  2. Straighten: set in Order and organize the remaining items in a way to be easily reached when needed.
  3. Shine: clean and inspect the work area to make sure no dirt.
  4. Standardize: create standards for sort, straighten and shine activities.
  5. Sustain: develop a commitment to ensure regular application of standards
- One of the basic tools of Lean Manufacturing, from which the enterprise often begin their adventure with LM is 5S. 5S is the first step to improve production, and at the same time is universal - you can adapt it to all conditions, both in production and in the office. The aim of the 5S is to create an orderly and well-organized workplace. The implementation of this tool can improve the quality of the products and services provided, raise productivity, improve safety and hygiene of work, and as a result increase the stability of processes and reduce operating costs of the enterprise [19].

#### **Just-In-Time**

- The primary purpose of the concept of Just in Time is to ensure timely production and delivery, while minimizing inventories. Just in Time requires keeping stocks as low as possible, immediate detection and removal of damaged parts, materials and improper operation. JIT allows you to synchronize all the steps in the production process by using the pull system and continuous flow. In this method, they are used Kanban, which determine when the production process should be launched. Kanban are the clear signals, such as the availability or lack of a product range [19].

- Lean management was originally called JIT when it was adopted outside Japan. The lean management approach achieves supply of high quality products and services in perfect synchronization to customer needs with no waste. A philosophy of manufacturing based on planned elimination of all waste and continuous improvement of productivity. It encompasses the successful execution of all manufacturing activities required to produce a final product [21], [26].

#### **Kanban**

- Kanban is a stock control system, and it is usually performed by the FIFO method. Kanban is an effective tool which contributed to the functioning of the production process as a whole. Sugimori (1977) stated that the Kanban system has many advantages over computer technologies, such as: reduced cost of information processing, it is easy to obtain and transmit information in a dynamic environment, the demand for materials is judiciously sized. Sugimori criticized the lack of respect for the human being of the enterprises whose production was controlled by computer systems [25].
- The Japanese consider the Kanban system more transparent, allowing staff to understand the production process without the need to use complex software. Womack and Jones (1996) identified five principles of the Lean Production, in order to implement the concept in different industrial branches: the value is determined by the point of view of the customer (Customer Value), Value Stream, Flow, Pull and improvement. Womack and Jones (1996) consider Value Stream as being specific products with specific qualities offered at special prices through a dialogue with specific customers [25].
- A system that creates product that is then sold after it is produced is called a push system. If there is no mechanism to keep work in work-in-progress below some level that is consistent with product demand, production output can become excessive, which can lead to many problems, including product storage. In pull systems, products are created at a pace that matches customer demand. Kanbans are used to buffer variations in customer or next process step demands. A most familiar form of kanban is the American-style supermarket where each product has a short-term buffer, replenished at the rate of customer demand [21].
- The Japanese word kanban refers to the pulling of a product through a production process. The intent of kanban is to signal a preceding process that the next process needs parts or material. Kanban can dramatically improve a process that produces few defects within workstations. However, if there are workstations that have high defect rates (i.e., a hidden factory), the system can become “starved” for parts. This problem could be avoided by integrating kanban with an IEE measurement and improvement system. Kanban can be the relay signal between supplier and customer. Kanban signals can be generated by lights, colour balls down a tube, or a computer network. A food market can know when to stock by keeping track of product-volume sold through a barcode system. A stock person responds to a product pull by replenishing the prescribed number using first-in, first-out product restocking. The supplier knows the volume of product to supply because of the kanban system. A method for maintaining an orderly flow of material. Kanban cards are used to indicate material order points, how much material is needed, it should be delivered. Production Kanban are also used to control production [18], [21].
- The kanban system is very flexible and many types of kanban can be used. Likewise, as long as the company follows the basic rules of kanban, they can be used in a large variety of ways. This system is a powerful tool for reducing waste during production because it is direct communications to produce material in other words to supply and the customer. It is the pull signal to produce. Once the production is withdrawn by the customer, at that moment the kanban tells exactly what the customer is using and hence what the customer will need later [27].

#### **Kaizen**

- Kaizen is another pervasive tool since it is a focused methodology that uses teams for making improvements. If analysis indicates that this is the best systematic approach for an improvement project, then a Kaizen event should be undertaken. A continuous improvement process that empowers people to use their creativity, Kaizen can be used to fix specific problems, workflow issues, or a particular aspect of a business. Based on quantitative analysis, a good starting point is to look at the way people work – identifying

waste through a time and motion study of tasks with input from both workers and managers. The Japanese term for improvement continuing improvement involving everyone managers and workers. In manufacturing, kaizen relates to finding and eliminating waste in machinery, labour or production methods. Kaizen is a simple parts-movement system that depends on cards and boxes/containers to take parts from one workstation to another on a production line. The essence of the kanban concepts is that a supplier or the warehouse should only deliver components to the production line as and when they are needed, so that there is no storage in the production area [18], [21].

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- Kaizen is the Japanese for continuous improvement. It is a philosophy of continuous improvement of quality and productivity at work, which involves all employees and allows for rapid improvement in efficiency without the need for expensive investments. Production efficiency is a very important issue from the point of view of processes organised in a enterprise and in a supply chain. Improving the efficiency of a production process is therefore a very important factor in controlling actions. Kaizen should be implemented at the operational and tactical levels of management and among the employees directly forming products. The whole process should take place with the support of top management, whose task is to create an appropriate work culture conducive to continuous development. When a problem arises, do not solve it from behind the

desk, please go to the site, in which there is a problem and analyze it there. After proper solution of the problem should be developed procedures for determining appropriate standards [19].

## V. INTRODUCTION OF 5S TECHNIQUE

Nowadays in this dynamic and technological world, the secret of surviving for any kind of organization is to be competitive and pioneer in its products or services. One of the main parts of this way to succeed is continuous improvement and increasing the quality of product or service. Usually, this improvement has been achieved through implementation of best practices which are chosen to meet a particular objective. With increasing of the competition in the world, two major challenges are in front of organizations' managers: Firstly, in this competitive environment, managers have to make the best decisions and choose the best methods to achieve their objectives and not to lose very finite opportunities. Secondly, lack of knowledge is one of the most important problems of managers about familiarity with an appropriate method to successfully improve the performance of organization. In addition, the quality of performance also is vital to be evaluated and recognized. Such an evaluation can help managers to identify the improvement of performance. 5S is a way to improve the performance and organize the whole system which has been used first time by Japanese. It comes from five Japanese words start with S which is translated into English words to give the best explanation for them. As it will be discussed later, using 5S as a total quality management method is very effective and efficient for improvement of whole organization. It has dramatic impact on safety and environmental issues, loss of resources and many others that this study is going to investigate and prove [28], [29].

To remain in business arena it is of utmost important to win hearts of customer though quality and cost of the product or service. It is also crucial to have sustainable production with continuous improvement. The present need of the organization is to deliver high quality product through continuous improvement. However, manufacturing organization throughout the world is under great pressure to reduce the cost and meet the challenge of maintaining global quality standards. Lean Manufacturing is the hymn of survival and success of any organization through minimizing the wastage (Muda) of resources and moving towards implementation of lean manufacturing has become



one of the key strategies to achieve cost cutting. The goal of lean manufacturing is to minimize all types of waste or non value added activity through incorporating less human effort, less inventory, less time to develop product and less space to become highly responsive to customer demand, while at the same time producing good quality products in the most efficient and economical manner. The aim of this paper is to implement 5S methodology and measure the performance improvement in Krishna Plastic Company, a small scale industry situated at Amreli, Gujarat. 5S is Lean manufacturing tool for cleaning, sorting, organizing and providing necessary ground work for work place improvement. 5S is already selected using Analytic Hierarchy Process (AHP), a Multi Criteria Decision Making (MCDM) tool by considering different criteria for case company. AHP is a problem solving framework based on the innate human ability to make sound judgment about small problem. It is a quantitative technique use to facilitate decision that involves multiple competing criteria [30], [31].

5S system is a method using for set up and keeps quality of working environment in an organization. Such organization can organize and manage companies which require less space, human effort, time, quality and capital to make products with fewer faults and make a workplace well ordered, disciplined and cleans. 5S is a system to decrease wasting and optimize quality and productivity via monitoring an organized environment and use visual evidences to obtain more firm results. The columns of 5S are sort (Seiri), set in order (Seiton), shine (Seiso), standardize (Seiketsu), and sustain (Shitsuke). In routine activity of every organization, daily works that support company and neatness are fundamental to an efficient activities flow. 5S is an idea that reshapes how you think about a workplace and provides a foundation for significant improvement but it is not simply about cleaning up a shop floor. The initial stage in 5S is deciding what is essential in the work environment and what is not. The second stage is put the things where they provide the best support for the functions. The third stage is inspection, repairing and cleaning things to find and remove the root causes of damage and dirt. The fourth stage is team working and the members must have consensus on normal and new way of work. The fifth stage is personal discipline to follow the standards and to perform the personal characteristics, cleanliness and neatness of the organization [28], [32], [33].

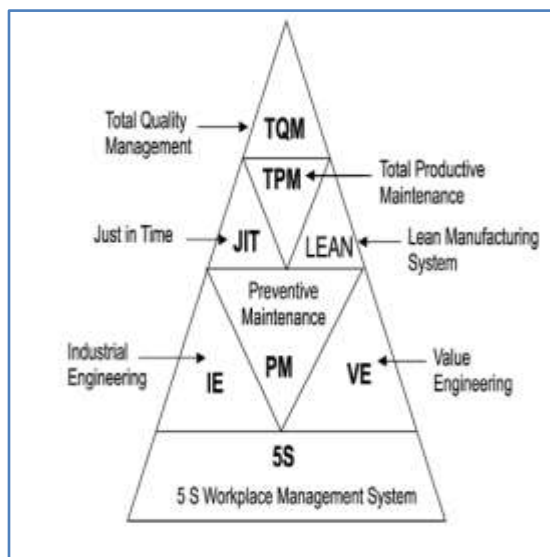
Productivity has been generally defined as the ratio of an extent of output to the unit of all of

the resources used to produce this output. Productivity usually deviates from production. Production concerns with an increment in output over a given span of time; productivity is concerned with the ratio of output to an input. Putting in another way, improving productivity has to do with how effectively people combine different resources to manufacture parts and services others dream to purchase. With the correct choices, improved production, higher values and elevated incomes can be accomplished for every hour worked. With rapid increase in demand of production, manufacturing industries need to increase their potentials in production & effectiveness to compete against their competitors. At the same time, the production process has to be ready with the ability to have abated costs with higher proficiency. Hence the route to simplify the problem regarding the production is of paramount importance. There are many ways i.e. Standardize Work (SDW), Setup Reduction (SUR), Cycle Time Reduction, Waste Elimination, etc. to solve the problems concerning & governing productivity [34]. 5S is a principle institutionalised in Japan and has yielded significant results in industrial and service sectors. These results are briefly known as incidents prevention, delays reduction, and productivity enhancement in work environment. The ultimate goal of 5S is to prevent losses. Despite seeming simplicity of 5S in concept and implementation, organisations have great difficulty in its execution. In fact, managers and executive personnel are not well aware of goals of 5S. Therefore, it is quite difficult to set appropriate ground for implementing 5S unless its principles are well comprehended. These principles are known in form of five Japanese words, beginning with letter S, which later formed the term 5S. There are several equivalents for 5S in English and Persian languages. 5S is the basic tool of running lean and it is a very good way to help the company to reduce the wastes and enhance the profits. The 5S concept comes from Japan. In TPS, 5S is a tool to help make problems visible and can be part of the process of visual control of a well-planned lean system; visual control systems are about improving value added flow. The original purpose of the 5S is to make the workplace orderly to improve safety and efficiency, reducing the product defects rates [35], [36].

## VI. 5S METHODOLOGY

5S operation model is one tool of the Lean philosophy. 5S philosophy has been accepted as foundation for lean manufacturing, since it facilitates the manufacturing organisations to

establish the system and operational stability required for securing and sustaining various lean manufacturing continuous improvements drives successfully. Sustainable manufacturing has often referred to as eco-efficiency, remanufacturing, green technology, cleaner production etc. 5S leads to improving the order and cleanliness and creating comfort and a safe working environment. The aim is to increase the productivity of labour. At the same time all the non-value adding actions, such as the time used for searching, should be cut out. 5S is an integral step towards kaizen and lean-site manufacturing with the primary goal of being able to supply the customer with the 'right product' at the 'right time' in the correct quantities. 5S has been envisaged as a philosophy for affecting continuous improvements in workplace productivity, quality, throughput and safety. The 5S pillars have been envisaged to affect workplace improvement by continuous identifications and elimination of wastes associated with manufacturing systems. It comes from five Japanese words start with S which is translated into English words to give the best explanation for them. 5S is an acronym for five Japanese words; each word starts with a sound of 'se' or 'shi'. They are Se-i-ri, Se-i-to-n, Se-i-so, Se-i-ke-tsu and Shi-tsu-ke. 5S is a very effective tool of TQM methodology is very effective and efficient for improvement of whole organisation. Figure 1.3 depicts the relationship of 5S with other lean manufacturing techniques [37], [38].



**Figure 1.3** 5S as a foundation for various lean manufacturing techniques [35]

In contemporary competitive environment, industry has to increase its demand without

increasing the sale price of their product. This has forced the manufacturing and service organisations to improve the effectiveness of production and other related operations to improve the bottom line by reducing their costs. Thus to achieve the aforesaid targets, there is an emergent need of holistic adopting 5S principles in the industry. 5S has emerged as an effective foundation for various lean manufacturing improvement drives for eliminating waste from the manufacturing process and improve the organisation's bottom line by affecting sustained improvement in organisational functions. Within a pure Six Sigma project where the savings are typically affected by a non-conforming product or service and customer dissatisfaction, the Lean tools commonly used are 5S, poka-yoke, visual control management, SMED, TPM and value stream mapping. 5S initiatives provide an organisation with the framework and discipline needed to successfully implement various lean manufacturing continuous improvement initiatives. The four key objectives of a 5S deployment program include: developing kaizen-minded people at workplace; evolving teamwork through entire workforce participation; developing managers and supervisors for practical leadership; and improving infrastructure for adoption of advanced kaizen technologies [39], [40].

5S is an approach to organise, order, clean, standardise and continuously improve a work area. 5S is not just about housekeeping. It is one of the efficiently-working tools of lean manufacturing. 5S initiatives Seiri, Seiton, Seiso, Seiketsu and Shitsuke have been referred to as the five keys to a total quality environment. These words when translated mean sort, set in order, shining, standardise and sustain, respectively. 5S is the beginning of a healthy, comfortable and productive life for everyone at work. In the workplace, 5S is used 'to organise the workplace, to keep it neat, to clean, to maintain standardised conditions and to maintain the discipline that is needed to do a good job'. 5S concepts are equally applicable to any sector or any business: manufacturing organisations, commerce and service organisations. The four key factors for successful 5S include: continued commitment and support by top management; Education and training; participation of entire workforce; and standardisation for sustained implementation of 5S on long term basis. 5S is defined as the baseline for a total quality environment. The inter-relationship between different '5S' initiatives has been depicted in Figure 1.4 [41], [42].

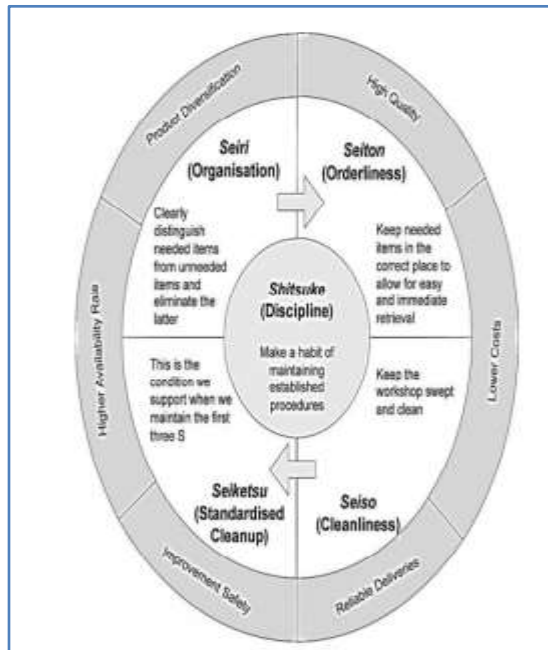


Figure 1.4 5S Concept [42]

5S is one of the most widely adopted techniques from the lean manufacturing toolbox. Along with Standard Work and Total Productive Maintenance, 5S is considered a “foundational” lean concept, as it establishes the operational stability required for making and sustaining continuous improvements. The primary objective of 5S is to create a clean, orderly environment- an environment where there is a place for everything and everything is in its place. Beyond this, many companies begin their lean transformation with 5S because it exposes some of the most visible examples of waste it also helps establish the framework and discipline required to successfully pursue other continuous improvement initiatives. The use of 5S applications for achieving business excellence has been evident in Japan since the World War-II. At first, various plant maintenance concepts were imported to Japan from the US and then, 5S was integrated with Kaizen philosophy by Japanese. The components, namely Seiri, Seiton, Seiso, Seiketsu and Shitsuke, bringing together the concept of 5S, are deeply embedded in Japanese life. For this reason, it is not a randomly formed philosophy, but a system of thought that is influenced by the great influence of Shintoism, Buddhism and Confucianism in Japanese culture [43], [44].

5S or kaizen is a method used to diminish the slack hidden in the plants. 5S Technique consists of five fundamental elements or arms which act as a foundation of a good production system. 5S concept is intended to organize, clean,

standardized and maintain the discipline at workplace in pursuit of sustainable improvements in the productivity, efficiency cost optimization and reduction of waste in an organization. Argues that 5S is a Japanese way of organizing the workspace, in a clean, efficient and safe way, in order to achieve a productive work environment. 5S has become a way of doing business, not only to convince customers but also to create effective quality processes as a prerequisite for good products and services. This technique has been practiced in Japan for a long time. Most Japanese 5S practitioners consider 5S useful not only to improve their physical environment but also to improve their thinking processes. Apparently, the 5S can help in all walks of life. Many everyday problems can be solved by adopting this practice. 5S is not only a housekeeping system; it is an integrated approach to improving productivity. 5S is a whole culture that increases production, improves quality, reduces cost, leads on-time delivery, improves safety and improves morale. The primary goal of 5S is to create a clean and orderly environment where there is a place for everything and everything is in place. Moreover, many companies begin to shift lean with the 5S because it reveals some of the most obvious examples of waste. It also helps to establish the framework and discipline required for the successful implementation of other continuous improvement initiatives. Figure 1.5 represents the various elements of 5S represented as arms of 5S [45], [46].

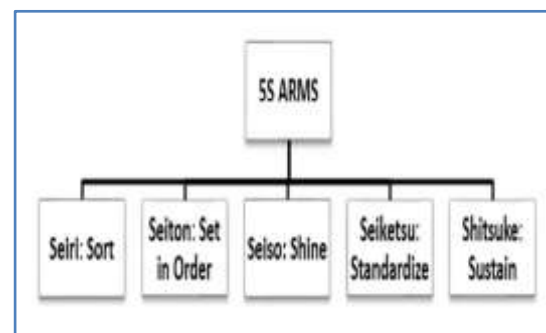


Figure 1.5 Arms of 5S [45]

After the assessment and evaluation of the safety and environmental standards followed by the industrial unit, a risk assessment was carried out in the screening room. This risk assessment was elaborated on the ground through direct observation in order to monitor the operators' daily work habits and verify their interaction with the environment that surrounds them. In order to evaluate if 5S methodology has an impact or not at the level of

safety, the 5S were implemented in site with high risks since there is a very close contact between forklifts and pedestrians. The use of powered industrial vehicles can contribute to improve productivity and efficiency but at the same time they represent major threat. In an initial phase a risk assessment was done in order to obtain a quantification of the safety in the working site. The Risk Assessment Values were obtained by multiplying the scores for the Severity and Probability values together. After this step was concluded it was time to start the 5S implementation and to perform other risk assessments in order to compare the results with the initial situation. This evaluation was performed on the shop floor through a direct observation by the evaluator. Although there are some hazards that exist in the screening area (such as manual handling, ergonomics, etc.), these are not going to be considered since this risk assessment was done only in the screening zone, that is, in the physical space of the screening site. The action of 5S implementation took approximately 25 days to complete. During the initial phase, data were collected, in addition to the risk assessment previously presented. Then, a pre-analysis form was prepared for the first three —S. The initial state of the screening area was also recorded through photographs in order to make a comparison of before and after the implementation of the 5S [47], [48].

### SEIRI-Sort

5S Seiri or sort is the first step in 5S, it refers to the sorting of the clutter from the other items within the work area that are actually needed. Seiri is about sorting out between necessary and unnecessary materials in the workplace and discard of unnecessary things. The idea of Seiri is to keep only the necessary items in workplace in an appropriate area. According to Kobayashi and friends, Seiri creates a system that works effectively and that system presents excellency for enterprises. The first element of 5S is 'Seiri' is about sorting or keeping the necessary things or items at their appropriate places. To introduce the principle of organization called Sieri, there is need of combined effort of organization and self-discipline. Seiri holistically discourages the age old hoarder's mentality of employees at Downloaded by University of Colorado Boulder at 23:40 17 January 2017 at some of the workplace, whereby large quantities of items or goods were retained at workplace irrespective of their immediate utilization at workplace. Seiri calls for effective utilization of workplace space and also promotes

that the goods or items should be segregated strictly in accordance to the relevance and frequency of utilization at workplace in order to create efficient workplace. Seiri is helpful element for estimating the material or goods requirements at present and future, which is necessary and stored at their respective workplace. Seiri facilitates avoiding the stack of irrelevant things at workplace thereby eliminating hindrance in the flow of work. The benefits of 5S first element include: saving of space, searching time is quite short, safe and clean workplace; detection of damage is easy [42], [44], [49].

### SEITON- Set in Order

The second step was to define a space for all objects and to delimit specific zones in order to maximize the existing space. Several copies of the plan of the zone were printed with containers designed to scale so that it was possible to simulate a better layout and to define specific zones. After receiving all the suggestions it was elected the one that the engineers deemed as the best solution. The site was divided in half so that each sorting company had its own space. Through this provision it was possible to create an area entitled "safety zone" and due to the barriers the forklift it ceased to have access. This area is intended to be used by operators during the break times for protection every time the forklift needs to access to the sorting zone for the container handling. For the setting of the barriers, a specification was drawn up. After validation of the request, the works began. The screening space was also sealed by placing a chain on the gate. Adhesive tape was also placed on the floor so as to delimit the intended spaces for loading the forklifts. Seiton can be defined as "organizing necessary items in excellent in order to pick them up easily for later use". Seiton focuses on where and how much material and equipment should be placed. The essence of seiton is to arrange tools in a sequence of process that relates to the work. A decision must make about the usage rate of materials. Frequently used materials should be placed in easiest access points and rarely used materials should be placed further away. Heights of shelves should be considered, too. Frequently used items can be better at shoulder level, rarely used ones can be better at feet or ceiling level. The reasons behind this are finding equipments easily and much faster, saving time and providing a comfortable location. The main purpose of stability is to find the practical deposit of each necessary tool and these repositories must be properly marked. Each element, which is necessary at work, will be organized in a way that can be easily found



when needed. Setting in order ensures that it's easy for everyone to find, use, and place the item away. The aim of all these actions is to eliminate futile research, improve work safety and make the work environment better [44], [46], [47].

### **SEISO-Shine**

This step can be performed in parallel with the organization and storage phase. It aims ensuring that workplaces and machines are cleaned regularly and are in optimal operating conditions, as anomalies are usually detected more quickly and easily in cleaner workplaces. Shine step includes three primary activities which include getting the workplace clean, maintaining its appearance, and using preventative measures to keep it clean. Shine the workplace by eliminating dirt, dust, fluids, and other debris. Each team member should be equipped with adequate cleaning supplies that have been tested to make sure the solution will not harm any equipment or work areas. Teams can clean things such as equipment, tools, work surfaces, desks, storage areas, floors, lighting, and anything else that affects overall cleanliness. A team may also paint or coat work surfaces, equipment, floors, and walls. Treat cleaning as an inspection process. Use it to identify even tiny abnormal and pre-failure conditions. Working in a clean environment enables workers to notice malfunctions in equipment such as leaks, vibrations, breakages, and misalignments. The Shine process should not be left for a special janitorial crew. In order to make sure everyone participates and works together, each team should establish a regular schedule for routine cleaning as well as deep cleaning. Once the work area, tools, and equipment are clean, they need to be kept that way. Continued housekeeping is one way to keep the work area clean, but the better method is to prevent things from getting dirty in the first place. Find ways to keep the workplace clean by eliminating sources of contamination. Root cause analysis, mistake-proofing, and the use of preventative measures are important to keep the workplace clean and orderly. Equipment that is kept clean performs more efficiently, has less unscheduled downtime, and reduces costs to the company. Many organizations find that safety and productivity improve as regular maintenance and housekeeping become the norm [43], [50], [51].

### **SEIKETSU-Standardize**

After performing the previous steps it is possible to say that the company has reached an optimal state, given that workplaces are clean, organized and good looking. However, when achieving this step it also faces the most

complicated aspect of 5S: trying to keep workplaces in excellent conditions in the long term. To accomplish this, companies must standardize rules defined in the previous steps, which should be done together with employees as they are the most knowledgeable of their workplaces, equipment and most frequent problems/anomalies. This step should ensure that all rules are followed so that organization, storage and regular cleaning become a habit, preventing the return of previous bad habits. Worked out and implemented standards in the workshop. Management should give direction to the workers, which are clear and easily understandable so that workplace clean and would be in order. All the workers of the workshop should be participated in this activity; the workers group knows particularly their own exercise and process of elaboration, usage gives them possibility of understanding the quality and each prospect of the operation. The objective is to easy access of the required standards for constant and ocular places should be assured. It is conclude that standards not only being implemented in usual operational process e.g. maintenance, movement, production, sorting but also in organizational process like customer service, book keeping, HRM etc [51], [52].

### **SHITSUKE-Sustain**

The principle is to establish the maintenance of a clean environment as an ongoing process for ever. This increases the consciousness if the workers and decreases the number of non-confirming products and defective products. This process also increases the internal communication and human relations in the organization. It is also essential to understand the need and importance of the inspections for 5S. The inspections are executed with the help of Check list prepared on the basis of the radar charts of 5S. This also helps in estimating the work place. The inspection of the realization of 5S standards is executed once in a month by the team. Train employees disciplined for practicing 5S system continuously so that the habits and culture within the organization. The task here is undertaken by the leader directors. The directors should explain the importance of 5S to the personnel through various trainings and the knowledge of the personnel about 5S should be kept updated through the 5S boards to be formed at the workplace. To maintaining the standards and keeping the facility in safe and efficient order day after day, year after year. It is also important to understand the need of executing the routine inspections of usage the 5S rule. This inspection is executed by helping of so called Check List and created on its basis the radar

graph of the 5S, which serves to estimation of the workplace. The inspection of realization of the 5S rule is executed once a month by chosen team implementing the 5S rule – the control team [53], [54].

## VII. ADVANTAGES OF IMPLEMENTING 5S TECHNIQUE

The successful implementation and execution of the 5S principles are applied in various organizations results several advantages as mentioned following [53], [55], [56].

1. 5S concept is very simple and easily understood by everyone because this only requires knowledge of the conventional discipline and high commitment. This practice can be implemented at all levels.
2. 5S will foster teamwork, discipline and will increase the sense of responsibility and compassion for company.
3. 5S will create clean, productive work environments and secure the delivery system towards a world-class.
4. On-going commitment from management and involvement are the cornerstone of all citizens for the successful implementation of 5S practices.
5. 5S is an on-going need to maintain excellent service delivery performance.
6. Assessment of Internal Audit will normally move the organization to continually repair the quality and effectiveness of services delivered to customers. Activities are planned and on-going audit to help people to be prepared to face the real 5S audits by the MPC to obtain and maintain certification of 5S.

Today, many organisations have implemented the 5S system with astonishing results as there is no other approach for improvement that is simpler or more powerful that can be implemented at very low cost. Some of the salient benefits are:

- Workplace becomes cleaner and better organised.
- Shop floor and office operation becomes safer.
- Visible results enhance the generation of more and better ideas.
- Lead-time reduced.
- Changeover time reduced by streamlining operations.
- Breakdowns and minor stops eliminated on production lines.
- Defects reduced by mistake proofing.
- Clear methods and standards are established.
- In-process inventory is reduced.
- Space usage is improved.
- Customer complaints are reduced.

- Better workplace management.
- Increased Workplace Safety.
- Effective area utilization.
- Ambient atmosphere for working.
- Good ambience and cleanliness.
- Location and proper marking of items.
- Reduction in searching time for items.
- File management and labelling.

## VIII. CONCLUSION

The study these papers demonstrates the efficient implementation of 5S technique leads to subsequent improvement in productivity of the manufacturing company. The 5S improves environmental performance and thus relate primarily in reduction of wastes in manufacturing. It promotes neatness in storage of raw material and finished products. The 5S implementation leads to the improvement of the organization in many ways for instance. The 5S is an effective management method to enhance environmental conditions and workplace management standards. 5S sort stage will help to reduce the wastage, after sorting space is increased for utilization, by set in order items location is fixed and they can easily assessed which save searching time, also other steps are implemented which improve overall working condition of institute. Results of 5S are seen in very short span of time, which makes employees self-discipline during working.

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**International Journal of Advances in  
Engineering and Management**  
**ISSN: 2395-5252**



# IJAEM

**Volume: 02**

**Issue: 01**

**DOI: 10.35629/5252**

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