

Detail Investigation, Analysis and Implementation for Improving Quality/ Productivity in Rolling Mill Unit

Nitesh Mundhada, Aditya Wankhade, Bhavesh Bohra

Abstract-The lean project is aimed at diagnosing the production process, streamlining the workflow, removing/reducing process waste, cleaning the production environment, improving plant layout, and organizing workstations. 5S lean technology is utilized for achieving project objectives. The work was a combination of both culture changes and tangible/physical changes on the shop floor.

Index Terms 5S Technique, Continuous Improvement, Kaizen, Lean Technology, Work Methods, Work Standards

I. INTRODUCTION

In a highly competitive global marketplace of decreasing profit margins, waste reduction has become an essential element in companies' effort to thrive and in some cases to just survive. Waste (*muda* in Japanese) has a broad meaning that ranges from the unnecessary or excessive use of materials, space, and production resources to any incurred costs that add no value to the product such as overproduction, inventory, setup, transportation, delay, and rework. It is any effort or cost beyond delivering the right product to the right customer at the right time and at the right price. The hidden cost of such wastes significantly contributes to increased production cost, reduced profit margin, and loss of competitiveness. Reducing process waste is the primary mission of lean manufacturing which was started by the Japanese industry, mainly Toyota, in the 1950s [4]. Toyota production system and lean manufacturing in general are focused on pinpointing waste sources and using tools of proven effectiveness to eliminate or reduce waste. Lean defines the major types of waste as: overproduction, over processing, defects, inventory, transportation, motion, underutilization, and delay.

Examples of these wastes in a production facility include:

Overproduction: Producing more than demanded or a large quantity of a product before it is needed.

Waiting time: Machines or workers stop production and wait for materials or others. Industrial firm as well as for the economical progress of the country.

Transportation: The NVA movements of parts, materials, labor, or others.

Over processing (NVA processing): Using highly skilled Operator or machine to operate a job that others with less qualification can perform.

Inventory: All sorts of product or material accumulation that increases lead-time. It is classified into four types, raw material, and work in process, crib, and finished goods.

Defects: Bad quality level which results from reworking, repairing, re-inspection, and scrapping Products or materials..

Motion: Excess operation movements that often result in tiring workers and lowering their performance.

Underutilized resources: Labor, machines, spaces, etc.

Ideally, lean principles are focused on achieving zero levels in the different types of waste. Practically, lean Manufacturing is an operational strategy oriented toward achieving the shortest possible cycle time by eliminating waste. The benefits generally are lower costs, higher quality, and shorter lead times. The ideal characteristics of lean processes include:

- Single-piece production
- Just-In-Time (JIT) pull production
- Short cycle times
- Quick changeover
- Continuous flow
- Zero defects
- Multi-skilled workers
- Low inventory

II. LEAN TECHNOLOGY

5S is a lean method and a system of process improvement that is adopted to reduce waste, clean workplace, and improve labor productivity. To this end, 5S maintains an orderly workplace and utilizes visual cues to achieve more consistent operational results. As an infrastructure for a culture of continuous improvement, 5S is typically the first lean method which organizations implement to facilitate the application of other lean techniques that improve/optimize process structure and parameters. The 5S components include Sort (*Seiri*), Set in Order (*Seiton*), Shine (*Seiso*), Standardize (*Seiketsu*), and Sustain (*Shitsuke*). Together, they provide a methodology for organizing, cleaning, developing, and sustaining a productive work environment.[1]

III. THE 5S LEAN TECHNIQUE INCLUDES

1. Sort: Removing wastes and clearing the work area
2. Set in Order: Designating and labeling locations of work tools
3. Shine: Cleaning and improving the appearance of the workplace
4. Standardize: Documenting the work method, using standard tools, and populating the best practices
5. Sustain: Maintaining improvement, controlling work methods, and integrating the 5S's into the culture.

1 S – Sorting Through the suitable sorting it can be identified the materials, tools, equipment and necessary information for realization the tasks. Sorting eliminates the waste material (raw materials and materials), nonconforming products, and damaged tools. It helps to maintain the clean workplace and improves the efficiency of searching and receiving things, shortens the time of running the operation. The 1S rule's proceedings:

A) On the first stage one should answer to so-called Control Questions: -

Are unnecessary things causing the mess in the workplace?
Are unnecessary remainders of materials thrown anywhere in the workplace?

Do tools or remainders of materials to production lie on the floor (in the workplace)?

Are all necessary things sorted, classified, described and possess the own place?

Are all measuring tools properly classified and kept?

On the basis of the answer to the above questions it is possible the estimation of the workplace in terms of the 1S rule so littering the workplace. If on any question answer is yes, it should execute sorting of things, which are in the workplace.

B) On the second stage one should execute the review of all things which are in the workplace and group them according to the definite system. According to carried out sorting it should execute the elimination from the workplace the things, which were found unnecessary.

C) To permanent usage the 1S rule is so-called the Programme of the Red Label. It means giving the red label to things, which operator will recognize as useless within his workplace. This label will make possible not only the elimination of the given thing, but through its own formula will make possible the liquidation of the reasons of appearing on the workplace this given thing.

2 S – Set in order Especially important is visualization of the workplace (eg. painting the floor helps to identify the places of storage of each material or transport ways, drawing out the shapes of tools makes possible the quick putting aside them on the constant places, colored labels permit to identify the material, spare parts or documents etc.). Implementing the 2S rule: It should execute the segregation of things and mark the places of their storing. Used things should always be divided on these, which should be: - in close access (1st degree sphere), - accessible (2nd degree sphere), - in the range of hand (3rd degree sphere).

To the estimation of the workplace in terms of the 2S rule, that is setting in order things, serve the following Control Questions: -

Is position (location) of the main passages and places of storing clearly marked?

Are tools segregated on these to regular uses and on specialistic tools?

Are all transport palettes storage on the proper heights?

Is anything kept in the area of devices against the fire?

Has the floor any irregularity, cracks or causes other difficulties for the operator's movement?

Things used occasionally and seldom should be on the workplace but outside the direct using sphere. Their

distance and location from the place of work should depend on the frequency of using these materials or tools. Places of storage should be marked in the manner making possible their quick identification. It can be used colored lines, signs or tool boards. Once defined places and methods of storage should be invariable.

3 S – Shine Regular cleaning permits to identify and to eliminate sources of disorder and to maintain the clean workplaces. During cleaning it is checked the cleanness of machine, workplace and floor, tightness of equipment, cleanness of lines, pipes, sources of light, current data, legibility and comprehensibility of delivered information etc. Indispensable is also taking care of and maintenance the personal tidiness of the operator.

Implementing the 3S rule: The first step of realization the 3S rule is renovation the workplace. It is assumed that the first cleaning forces the exact checking of usage two of the previous rules. The usage of the 3S rule relies on everyday keeping in faultless cleanness the workplace. It is executed by the operator of the given workplace. To the estimation of the workplace in terms of the 3S rule, that is cleaning the workplace, serve the following Control Questions: -

Are the oil's stains, dust or remains of metal found around the position, machine, on the floor?

Is machine clean?

Are lines, pipes etc. clean, will they demand repairing?

Are pipe outlets of oils not clogged by some dirt?

Are sources of light clean?

4 S – Standardize Worked out and implemented standards in the form of procedures and instructions permit to keep the order on the workplaces. Standards should be very communicative, clear and easy to understand. Regarding this during preparation and improving, it should be involved all participants of the process on the given workplace, it means direct workers. The group knows the best specificity of its own activities, and process of elaboration and after that, usage gives them possibility of understanding the essence and each aspect of the operation. In the aim of assuring all the easy access, obligatory standards should be found in constant and visible places. It is assumed that standards should not be implemented only in the typical operational processes e.g. production, movement maintenance, storing, but also in the administrative processes, for example: book-keeping, customer service, human resources management, or secretariat service

5 S – Sustain Implementing the idea of the 5S will demand from workers the compact self-discipline connected with implementing and obeying the rules of regularity in cleaning and sorting. It leads to increasing the consciousness of staff, and decreasing the number of non-conforming products and processes, improvements in the internal communication, and through this to improvement in the human relations. 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.

In the daily work of a company, 5S maintains organization and transparency which are essential to a smooth and efficient flow of activities. Successful application of this lean method also improves the work conditions and encourages workers to improve their productivity and reduce waste, unplanned downtime, and in-process inventory. A typical 5S implementation would result in significant reductions in materials and space needed for existing operations. It also would result in the organization of tools and materials into labeled and color coded storage locations such as bins and kits. Such conditions provide the foundation that imperative to a successful implementation of other lean methods such as TPM, cellular manufacturing, and just-in time production. 5S also prepares the floor and optimizes the process structure to facilitate Six Sigma projects. The 5S's lead to improved processes in terms of many aspects including:

- Transparent process flow
- Clean workplace
- Reduced set-up times
- Reduced cycle times
- Increased floor space
- Lower safety incident/accident rate
- Less wasted labor time
- Better equipment reliability

The advantages from implementing the 5S rules 1S:process improvement by costs' reduction, stock decreasing, better usage of the working area, prevention of losing tools, 2S:process improvement (increasing of effectiveness and efficiency), shortening of the time of seeking necessary things, safety improvement, 3S:increasing of machines' efficiency, maintenance the cleanness of devices, maintenance and improvement of the machines efficiency, maintenance the clean workplace, easy to check, quick informing about damages (potential sources of damages),improvement of the work environment, elimination of the accidents' reasons, 4S:safety increasing and reduction of the industry pollution, working out the procedures defining the course of processes, 5S:increasing of the awareness and morale, decreasing of mistakes quantity resulting from the inattention, proceedings according to decisions, improvement of the internal communication processes, improvement of the interhuman relations [5].

IV. 5S EVENT CASE STUDY

The Challenge:-

Process of everybody involvement and cooperative effort with human being is not infallible.

SIPOC DIGRAM:-

| Suppliers | Inputs | Process | Outputs | Customers |
|--------------|--|--|--|-------------------------|
| Organization | All the resources that required to make final product with constant linear resources | Eliminate unwanted items either by disposing them or by relocating them. | Organization should work well and efficiently with all the available features. | Dealer and the customer |

Fig 1.The answer: Conduct a Lean 5S Event

Targets:

The process owner and sponsors asked Team to 5S the OR There were many things to consider in accepting this challenge, such as:

Process and staff morale, search and travel times and how to effectively communicate the changes. Therefore, the workshop targets were established as follows:

- Create an organized, usable Work Room.
- Reduce supply inventories.
- Adhere to compliance rules.
- Remove equipment from hallways.

Areas of Focus:

While the primary area of focus was the Shop floor Work Room in the Perioperative Services Department, other areas were also impacted by the work. For example, the Scrub Room, Equipment Storage Rooms, Equipment Storage Alcoves, and the Operating Room Core were also involved to a degree. It was important to have stakeholders from all areas involved in the process.

Workshop Actions:

The Team exerted so much energy and dedication during the workshop and it was reflected in the amount of work they accomplished. Here are the highlights:

- Created a workstation for the Anesthesia Technicians in the Work Room
- Color coded the storage bins
- Placed high use items immediately inside the room for rapid retrieval.
- Remodeled the Scrub Room to allow point-of-use storage of equipment that was previously stored in the current Anesthesia Work Room.
- Stored delicate scopes in an alcove created from an unused pass-through
- Eliminated damaged rolling cart system
- Created visual system for supply restocking (“tell at a glance” based on right-sized containers, signage, and grouping like supplies)
- Created space to bring equipment out of the hallways
- Developed an audit monitoring plan (includes measuring par levels, staff satisfaction and restocking times)
- Developed a sustaining plan
- Developed a communication plan

V. RESULTS

Although the Process consumed amount of time but the Team did amazing things with the additional square footage. For example, It's reduce the RPN (risk Priority

Number) to great extent by applying 5's. It also increases the safety and moral of the worker, by providing them good and hygienic workplace area. It also reduces the time consumption and WIP and give the smooth and good workstation.

| Potential Failure Mode | Potential Effect(s) of Failure | Sev | Potential Cause(s)/ Mechanism(s) of Failure | O C C | Current Process Controls | D E T | RPN | Recommended Action(s) | Responsibility & Target Completion Date | Actions Taken | SE V | O C C | D E T | RPN |
|---|--------------------------------|--|---|-------|--------------------------|-------|-----|----------------------------------|---|---------------|------|-------|-------|-----|
| Everybody is not involved with cooperative effort | Dissatisfied customer | 7 | Unstable assigning process | | | | | | 25/02/2013 | Yes | 4 | | | |
| | wastage of time | | Non-availability of equipment at proper place | 8 | No | 4 | 224 | | | Yes | 3 | 4 | 1 | 12 |
| | increase in process | | poor handling operation | 5 | No | 4 | 140 | | | Yes | 3 | 3 | 1 | 9 |
| | WIP increase | | Poor Knowledge of the process activity | 8 | No | 4 | 224 | use lean tool like 5's and other | | Yes | 4 | 3 | 1 | 12 |
| Delay in overall operation and final bundling | | Due to poor overall configuration and inadequate process | 4 | No | 4 | 112 | | | Yes | 4 | 3 | 2 | 24 | |
| Increase the labour handed activity | | Addition of Non value | 8 | No | 4 | 224 | | | Yes | 4 | 4 | 2 | 32 | |

Fig 2 :-FMEA before and After Applying 5's.



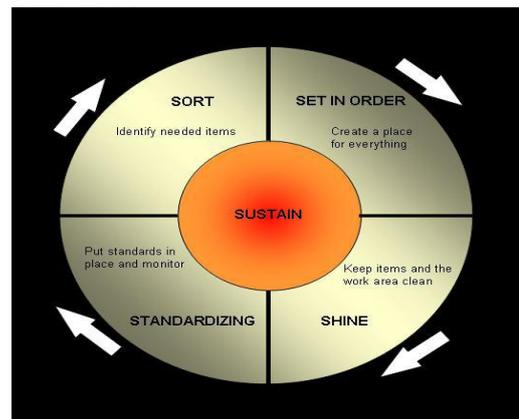
Before 5'S



After 5'S

VI. DISCUSSION

The ultimate objective of manufacturing industries today is to increase productivity through system simplification, organizational potential and incremental improvements by using modern techniques like 5's. Most of the manufacturing industries are currently encountering a necessity to respond to rapidly changing customer needs, desires and tastes.



For industries, to remain competitive and retain market share in this global market, continuous improvement of manufacturing system processes has become necessary. Competition and continuously increasing standards of customer satisfaction has proven to be the endless driver of organizations performance improvement. It not only ensures that manufacturing processes become leaner and fitter, but eliminate waste where value is added. 5's by

now is a widely discussed and applied manufacturing philosophy, in a variety of industries across the globe.

VII. CONCLUSION

From the paper, it can be concluded that there is a reasonably vast literature available on Kaizen philosophy, which gives a broad view of past practices and researches carried across the globe. But as 5's is a widely accepted philosophy in manufacturing industries, more research work is required in this field. It also possible that 5's philosophy can also be applied to different areas like business, service, Commerce, etc. So a great scope of research is available for new researchers in this field. Success stories reveal that it requires team efforts involving every employee in the organization to fully implement the system.

REFERENCES

- [1] J. Michalska, D. Szewieczek, The improvement of the quality management by the activity-based costing, *Journal of Achievements in Materials and Manufacturing Engineering* 21/1(2007) 91-94.
- [2] M. Urbaniak, *Quality management – theory and practice*, Difin, Warsaw, 2004 (in Polish).
- [3] S.K. Ho, *TQM an Integrated Approaching – Implementing Total Quality through Japanese 5S and ISO 9000*, Kogan Page, London, 1996.
- [4] T. Karkoszka, D. Szewieczek, Risk of the processes in the aspect of quality, natural environment and occupational safety, *Journal of Achievements in Materials and Manufacturing Engineering* 20 (2007) 539-542.
- [5] J. Peterson, R. Smith, *The 5S Pocket Guide*, Quality Resources, New York, 2001.
- [6] H.J. Harrington, *Business Process Improvement: The Breakthrough Strategy for Total Quality, Productivity, and Competitiveness*, Mc Graw-Hill Inc., New York, 2000.
- [7] M. Dudek-Burlikowska, Quality research methods as a factor of improvement of preproduction sphere, *Journal of Achievements in Materials and Manufacturing Engineering* 18 (2006) 435-438.
- [8] J. Cucki, *Basis of Total Quality Management*, AE, Poznań, 2001 (in Polish).
- [9] J. Michalska, The usage of the quality-cost analysis in a production process, *Journal of Achievements in Materials and Manufacturing Engineering* 16 (2006) 190-198.
- [10] J.J. Dahlgaard, K. Kristensen, G.K. Kanji, *Basis of Quality Management*, PWN, Warsaw, 2000 (in Polish).