

Reducing Manufacturing Barriers by Introducing A 5S Hybrid Management System in SA Industries

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Abstract

The 5S method is a housekeeping method first practised by TOYOTA to increase productivity and efficiency in the manufacturing systems. The tool instils discipline and cleanliness among staff at their workstations to maximize efficiency and reduce the 8 wastes. The study aims at establishing how efficient the suppliers of TSAM and other industries in South Africa are implementing 5S by focussing on the barriers that can be removed by implementing 5S and the other 2 new Ss on other lean tools. A hybrid 5S tool superimposes the Poka Yoke, Kanban, Cleaner production, Green technologies to remove barriers thereby improving productivity in manufacturing.

Keywords

Productivity, Lean, waste, red tag, cleaner production

1.0 Introduction

The first Lean Manufacturing tool to be applied in existing Lean or Non-Lean Manufacturing (NLM) industries is the housekeeping 5S tool. 5S paves the path of the continuous improvement culture using Lean principles. 5S implementation defines the first rules to eliminate waste and maintain an efficient, safe, and clean work environment. Taiichi Ohno and Shigeo Shingo introduced this popular housekeeping strategy in the Toyota Production system (TPS).

The tool cannot exist on its own unless linked to another productivity improvement strategy tool. Today the 5S is has been developed to 5S + 2S where the safety of the workplace and security of all stakeholders is included.

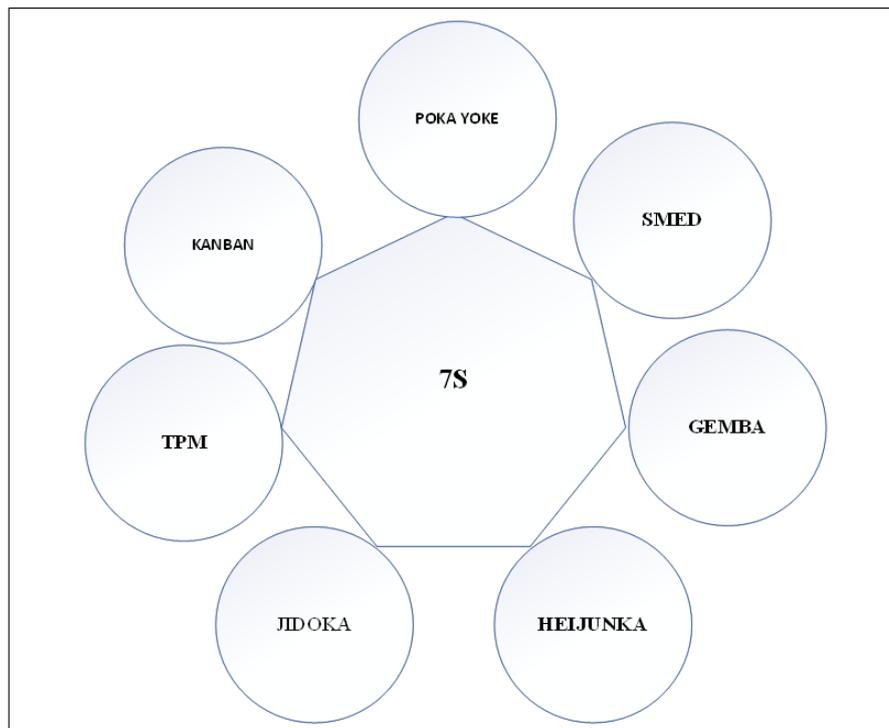


Figure 1. 7S housekeeping tool in manufacturing

Fig 1 shows the 7S housekeeping tool in manufacturing and its influence on the other Lean manufacturing strategies. The success of these Lean principles is possible when all or some of the Ss are implemented. For instance, the SMED cannot be successful when the first 3Ss are not applied. The same is true for Kanban, TPM, Poka Yoke, Jidoka, and Heijunka.

If a Manufacturing work floor is in a mess, the different processes slow down, unless 7S is used to systematically organize the workplace by keeping the spaces clean and clear of clutter. It is a team effort with continuous feedback and reinforcement that makes 7S a success. If an employee understands that management cares and is willing to observe their working conditions, then the worker is likely to improve. A trend in most NLM workplaces tend to dictate that being observed makes a subordinate work faster to impress and show their ability. This may increase production but not productivity.

1.1 Objectives

The paper seeks to reveal the success of implementing 5S by suppliers of Toyota and other manufacturing companies in South Africa. Statical data and pictorial evidence would be acquired as evidence of success in implementing 5S. The development of the system from 5S to 7S is also considered to provide safety and security during the pandemic.

2.0 Literature survey

The study will use the literature survey together with case studies of companies that I visited in in South Africa during Work Integrated Learning (WIL) monitoring for Mechanical engineering students. Kumar and Kumar, (2012) (Kumar, 2012) described 5S as a Kaizen tool that help supply the local or foreign customer with the correct product whenever it's needed in the correct volumes or numbers. It makes the workplace cleaner and better organized whilst reducing the lead times. 5S reduces changeover times and eliminate breakdowns. Further linking it to Poka Yoke (mistake proofing) eliminates defects and set up methods and standards that reduce inventory whilst improving space usage and customer needs.

Another improvement jump is obtained when you link 5S to Kanban system and the FIFO, LIFO strategy. Nine steps for implementing the 5S principle were outlined Kumar. Fig 2 shows how companies can introduce and implement the 5S principle. A steering committee must be put in place to arrange and organize the training program before implementing 5S. Skipping this stage may face some resistance from workers because the program and training is not well organised. In SA some companies introduce 5S but if you come and check after say 6 months nothing will be in place for 5S.

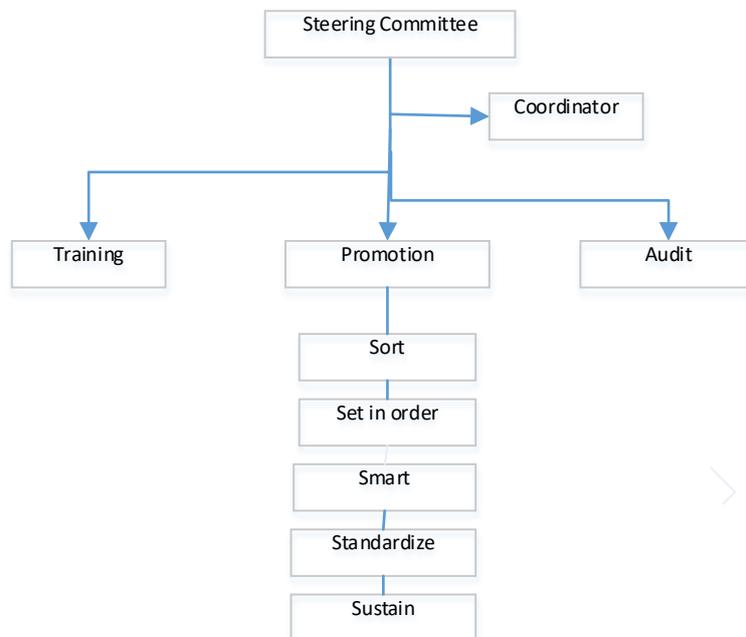


Figure 2. Formation of 5S Council

The normal implementation of 5S is done in two phases. The initial phase that encompasses the first 3Ss and refinement for the last 2Ss. The initial stage organizes the work by eliminating and finding home for all what is

not required then clear the space for remaining materials. All items that are used for a longer period say 12 months find a new home or holding area. Items that are no longer needed can be disposed by transferring them where they are useful. Components that are no longer used by the company are disposed on auction for use elsewhere or as scrap for recycling.

When sorting is complete create a convenient floor layout and location for each item depending on frequency of use, ease, and safety of accessing each item then label the location by numbering or naming or colour coding. A setting in order replenishing process and procedures involves returning the items to their places of storage or their new homes. Some go to scrap or offcuts section whilst others are in the waiting zone.

The 5S has a daily systematic cleaning (smart) to inspect the work area to increase visibility. This exposes any performance that is not acceptable, and it will be corrected. Visual marking, lights and alarms are common controls in almost every industry.

In refinement, the Standards, which will be used as a rule of thumb in the check sheet for the audit, are set. Audit levels are established and documented in the plant. For instance, a Toolbox talk every beginning of a shift is an audit standard for safety and report back on challenges and achievements.

Sustaining the standards is everyone's work therefore all staff should participate in all the 5S stages, and their constructive views incorporated in the system. A system where workers perform checks that are more frequent is established. Team leaders will come in after some time to do the checks as opposed to leaders who come to verify what has already been checked. Senior managers only come when there are issues to refine the standards. (Jamian, 2014), integrated the 5S principle with some management system practices improving productivity, quality delivery of services and safety. The study concluded that 5S creates a total quality environment where processes and operations were well controlled in handling fresh fruits to produce high quality goods and services. In a manufacturing environment, the input materials, consumables, tools used, the equipment and the skills if well-arranged and controlled by the 5S method will improve productivity.

The study by Faulkner and Badurdeen (2014) also established that 5S could reduce environmental impacts of a manufacturing industry by integrating lean and green technologies such as Cleaner production that converts waste into raw materials to evade environmental pollution.

(Rojasra, 2017)(2013) conducted a study on implementation of 5S methodology in the Krishna Plastic Company in India. The study revealed that after the implementation of 5S in the production system improved efficiency from 67% to 88.8% in a time span of ten weeks. They concluded that high productivity is enhanced by removing small faults through the aid of cleaning, providing the execution of visual control, providing the performance of protective activities, granting the responsibility of the machine to the operator and instilling discipline in company.

Present Trends in manufacturing strive to attain eco-efficient remanufacturing systems, green technology, cleaner production (Vimal, 2015). Manufacturing industries should envisage that they produce finished products for the first client and raw materials for downstream industries. For instance, in the production of pig iron the iron slag is the raw material for cement whilst the ash is used for in the construction industries. Green technologies are used today in LM to comply with environmental statutes whilst generating raw materials for downstream industries. The materials and equipment, which is removed from the plant by 5S, are raw materials of a downstream industry.

(Singh, 2015), developed steps for implementing 5S programme and stressed that management has to be educated on 5S in order for them to provide full commitment to training of staff and support of the promotional campaign. A system of updating must be devised, implemented and records filed. In a storeroom, a 5S Kanban can be used to record tools and materials in the store, when they are taken out, what quantities are taken out and remains and so on so that replenishment and replacements can be ordered in time. The study showed that 5S implementation in Bengkel ABC created 30.2cm^2 more space to improve the layout, space for stock and space for material handling. In stores for many manufacturing companies, space is running short but when 5S is applied, you even create extra space.

(Singh, 2015) highlighted that the some of the benefits of 5S are reduction of searching time, safety hazards, walking time and distance, unnecessary motions, mistakes, downtime and accidents. On the other hand an improved cleanliness makes visible the defects, material flow, and available space. The productivity, quality, delivery time, safety and morale of workers will improve. 5S approach is a long-term programme that requires

standard long-term policies to meet organisational objectives. Its success dependent entirely on frequent updating the education of all employees. The full participation of top management strengthens its implementation and motivates staff. Teamwork and improved communication lessen the barriers.

(Singh, 2015) stressed that management has to be educated on 5S in order for them to provide full commitment to training of staff and support of the promotional campaign. A system of updating has to be developed and implemented. In a storeroom, a 5S Kanban can be used to record tools and materials in the store. Data on what item is taken out, what quantities remains so that replenishment and replacements are ordered in time. He also identified executive issues, management issues, implementation issues, technical issues and cultural issues as common barriers that hinder Lean manufacturing. The biggest barrier in implementing 5S programme at workplace are lack of interests from top management. If top management does not support the implementation, the program will not take off.

(Ishijima, 2016), showed that the 5S approach can reduce waiting time at a workplace. Findings from hospitals in Northern Tanzania indicated that 5S reducing the patient waiting time because all the records will be easy to access. The study provided evidence on the importance of 5S in improving productivity and competitiveness in organizations in that the staff member Can see, Can take out, Can return” to the right place. The quantities of items and tools can be availed in numbers and colour codes. This reduces the waiting time looking for some tools or records. In manufacturing 5S is used to remove unused and broken tools from the shelves. Grouping and labelling useful tools and materials makes it easy and quicker to retrieve tools and materials.

(Rai, 2016), applied 5S in multiple types of industries including a bio-mass processing unit for diagnosing the production process, streamlining the workflow, removing/reducing process waste and cleaning the production environment. This enhanced production efficiency while maintaining a pleasant working environment.

(Singh, 2018), carried a study that revealed that the introduction and implementation of 5S increased quality, efficiency and productivity of many manufacturing organizations. The operational performance improved greatly by reducing the eight waste and supplying the customer a product of real satisfaction in time. The manufacturing lead-time reduced and the number of defects in the products fell.

(Cichocka, 2019) concluded that 5S is the first step in improving productivity in service (hospitals, schools, garages) and manufacturing (motor industry, plastic, oil refinery, food) industries. 5S avails space and materials and improves the queuing and material handling at any point in the industries. It organizes the workplace against any forms of accidents whether minor or major. Its success however depends on strong teamwork, sense of belonging to the company, leadership commitment, good psychological and interpersonal relationships between management and employees. If these factors are not satisfied, the 5S system will be a failure.

(Rhaffor, 2019), hinted that 5S is a health and safety management system that improves performance of the organizations by increasing efficiency, effectiveness, productivity, safety and health of the workers. Relationship between staff and management in the manufacturing industry where 5S is practiced improves.

(Bharambe, 2020), in the review paper recommended that the implementation of 5S methodologies is the road to success. Its implementation however encounters resistance from workers if management and staff do not receive training. Good record keeping and timely feedback is essential for the success of 5S.

3. Methodology

The study used the Case study method and interviews to obtain both quantitative data qualitative information from two food industries and a car seat manufacturing company. The food industry companies have adopted the 5S principles in the storeroom and food processor floors. The car seat manufacturing company supplies TSAM with car seats for all the models made in SA. Industrial visits were conducted at different companies where production line staff were interviewed to get information. Due to corvid 19 restrictions work study was done for only three hours and the data obtained was on departmental noticeboards in table, charts, and graph form. Initially the study wanted to use questionnaires on google forms format, but only a few incomplete responses were received compelling me to use interviews and mini work studies.

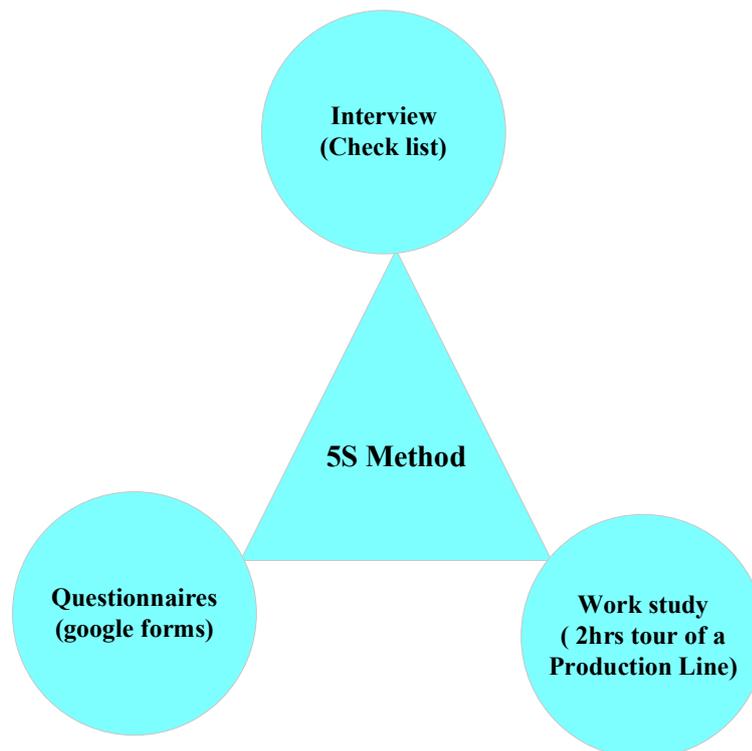


Fig 3 Methods of collecting data from Industry

Fig 3 is showing the methods used to collect data from industry. Questionnaires had very few respondents hence real time interviews, and work study was preferred in the end. Some data was also collected from noticeboards.

4. Data Collection

The data used was collected from interviews, noticeboard charts and graphs and observation during factory tours.

4.1 Case study 1

A plant visit at one food industry in South Africa (Rhodes Foods) showed that the introduction of 5S space created $3.8 m^2$ extra space in the stores 2017. The company has five production lines, which uses the same stores for maintenance and production. In the stores and warehouse inventory is bar coded, dated, color-coded, or named and packed in pallets. Before 5S staff in the production line believed that their job is focus only in production, the workplace inventory arrangement and cleaning of equipment was not their tasks until the introduction of the 5S principle. 5S was a success because it got support from top management who provided training to the personnel and started teamwork and promotional activities.

Fig 4 shows a storeroom for maintenance equipment before and after applying the 5S principle. The 5S removed all broken tools and empty containers which were occupying space. Tool hanging racks were made on the walls vertical instead of horizontal table racks that occupy much floor space.



Fig 4. Maintenance storeroom before and after 5S

Fig 5 shows the processing floor at a food industry before and after 5S. The 2nd and 3rd S was applied to arrange the equipment used and clean the production line so that all materials and tools used are visible and obtained from the nearest point.



Fig 5 food processing room before and after 5S

4.2 Case study 2

Toyota Boshoku makes and supplies TSAM with seats for the cars assembled by TSAM in Prospecction Durban. The company was running out of space and decided to apply 5S Kaizen. The unused containers were used to keep obsolete machines and equipment. The application of the 5SKaizen removed all obsolete equipment and disposed them on auction to create space for usable materials and equipment. In the plant, the equipment, which is outdated, was placed at the central red tag area and created space for storage of car seats materials such as the seat frames awaiting upholstery. The rule of thumb in the Red Tag area is if you don't use it "relocate, recycle, replace, dispose" to allow easy flow of materials, reduce waste and improve productivity.

In the production line, 5S worked with Jidoka, Kanban, Poka Yoke and the Ishikawa principles. The performance and efficiency of machines improved greatly with 5S. The sewing machines would stop whenever you feed the wrong seat material is fed and through the Andon lights, the operators could visibly see the problem and correct it immediately. The correction before a mistake is error proof and called Poka Yoke.

In the work study carried in Case study 2 photographic data of the container storeroom before and after the application of 5S was obtained in installation of car seats frames. Storage shelves were designed made and installed in the containers with the support of senior managers who released funds.

Fig 6 shows the container at Toyota Boshoku before applying 5S, after Red tagging and removing all unwanted materials and equipment. The second picture shows the cleaned container before fitting hanging racks. The last shows the container with hanging racks on which is hung the seat frames for bakkies. If a worker is to get a particular frame, he/she does not waste time looking for the frame, but can see what he is looking for at first site without wasting time or making mistakes because the items are arranged in a fool proof manner.

Visible floor markings control traffic at intersections and whilst Andon lights enhances communication on the state of volumes available at any given moment and depend on commitment from managers. The container stores created good storage space after applying 5S. In principle, 5S removes all unwanted inventory and places it at the right place. The rule of thumb in 5S is "If you don't use it throw it away". Accidents and shortage of space gives many managers a headache until they apply the 5S principle. Fig 5 shows space created by 5S and renovated to shelves where seats frames are hanged. In the office of the line manager who was, implementing 5S the table showed a good arrangement after introducing 5S.



Fig 6. Containers with old machines Container before and after 5S

Fig 7 shows a manager’s desk before and implementing 5S. Line managers and academics should lead by example when skilling their subordinates and students respectively on 5S principles.

5. Results

The results visually show the floor changes made and improvement of the storage facility. The graphic pictures on notice boards before and after applying 5S. Statistical data is used to plot a graph on the improvements attained.



Fig 7. Manager desk before and after 5S

5.1 Pictorial

Figures 4, 5, 6 and 7 shows the pictorial arrangements before and after applying 5S. Figures 4 and 5 initially show a maintenance storeroom and food processing plant respectively before the first 3Ss is applied and the same storeroom after implementing 5S. Space was been created in the tune of 3.8 m^2 when all unwanted inventory was red tagged. This also eased the searching for items and reduced the searching time by more than 50%. In Fig 6 all unwanted items were discarded in the container and red tagged before installing shelves. This improved the arrangement and created more space for hanging the frames and filling documents. In Fig 7 cabinets were fitted in the office and all equipment placed in the right place.

Table.1 Red tagging guide adopted by many SA companies

Category	Examples	Reasons	Action
Supplier	Materials steel bars,	Not required	Obsolete /auction
WIP	Tools, jigs, wrenches,	Extra	Surplus/ Red tag
Consumables	Oils/Greases	Unknown Owner	Central red Tag
Equipment	Jigs	Scrap	Obsolete/production

5.2 Graphical results

Fig 8 shows the progress in the application of 5S in the Single Minute Exchange of Die (SMED) in manufacturing at Toyota Boshoku. The improvement was in steps from Kaizen 1 to 3. Before applying the 5S Kaizen the die exchange was taking 40min to complete, but the time reduced gradually from 40 to 35minutes when 5S Kaizen 1 was implemented. Ishikawa, 5Whys and PDCA were included in the 5SKaizen 2 and the time to change the dies reduced from 35 to 20 minutes. At 5s Kaisen 3, Poka yoke was introduced, and the time fell to 12 minutes just a fraction before reaching the target. A further application may reduce it close to 10 minutes or even to 10 minutes.

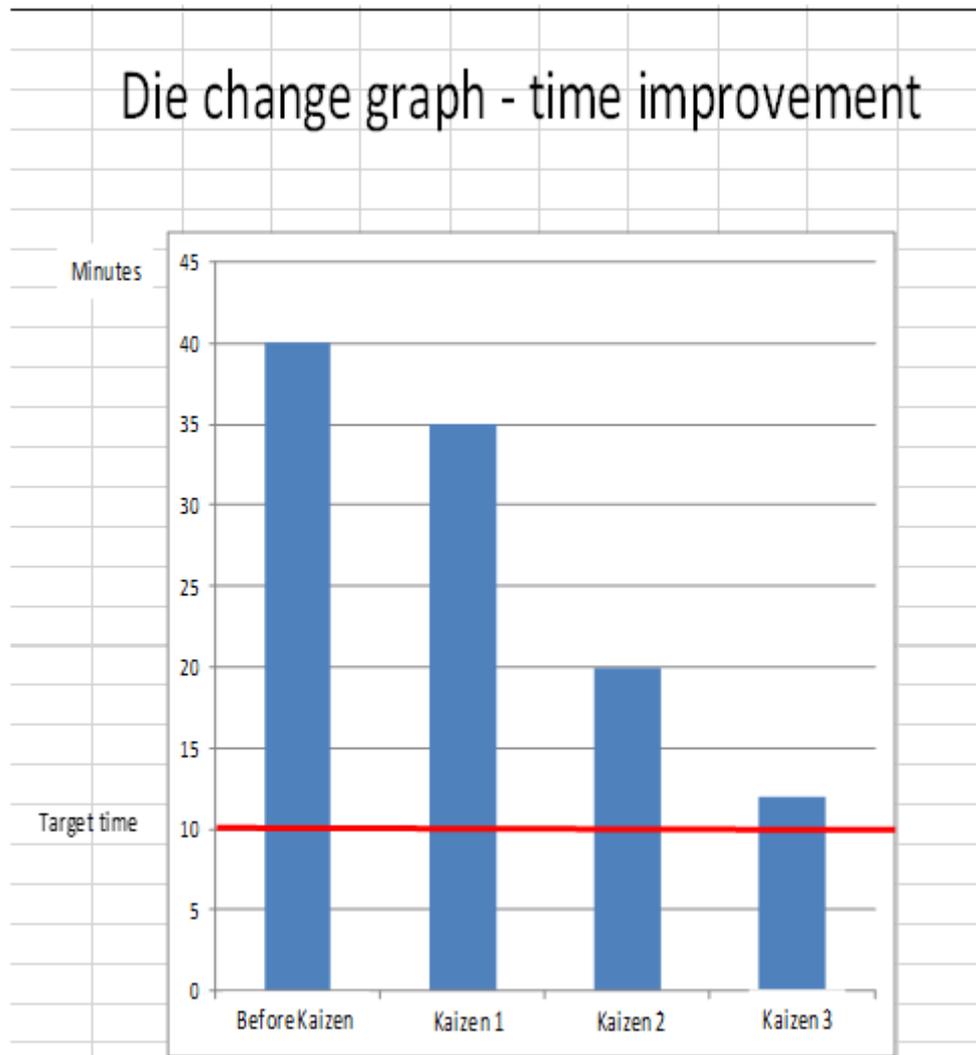


Fig 8. Benefits of 5S in Single Minute Exchange of Dies

5.3 Proposed improvements

To improve productivity and reduce waste non-Lean manufacturing Industries are obliged to first select and target zones (stores and warehouses) determine costs, needs, risks, and safety required. The system should have labels, safety signs, marked floors for AGVs, red tags, 5S tags, bins, holders and training material. The visual aids that show a clean and organized workstation help the staff to keep a pattern of good housekeeping. The second step is to provide proper training at the shop floor using tools that make employees feel more engaged in the system. Although classroom type sessions, videos on 5S events and reading material are all effective ways to provide the initial training. Many people are visual learners by trait thus showing what the ideal workplace should look like is more effective than telling. It is compulsory to train all Line managers to for them to acknowledge the fundamentals of the 5S system in order to help fix any situations that arise in the shop floor and provide positive and constructive feedback if certain expectations are not met.

Thirdly, employees buy into the 5S system when the manager's office clean. Gemba Managers who walk and violate 5S protocols deliver crushing blows to the success of 5S. Managers should not violate or be afraid to point out a violation anytime they are on the floor with employees. A 5S champion at a company should have the cleanest and most organized work areas in the organization.

The next step is to set up daily lookouts for 5S violations and conducting weekly or monthly audits. Each zone manager can conduct annual or bi-annual audits to help shed light on specific areas of concern and define expectations for continued improvement. Immediate feedback of findings is a good recipe for continuous improvement.

Finally, yet importantly staff or teams that outperforming others get rewards to reinforce good practice in the shop floor. TSAM and its suppliers place on notice boards the successes, which are beyond the level of laid out standards. The charts show the success rate before and after as in Fig 7. It is important morally to reward the highest score and avoid pointing out the lowest scores. Before and after pictures are helpful to show others what going beyond looks like. When reviewing or conducting audits and looking for ways to improve your system, look back to identify possible areas for improvement. An error in LM is the starting point in productivity improvement.

In LM, the Hawthorne Effect empowers and give workers ownership of the business, as well helping to build disciplined teams through 5S. The principle improves worker-to-worker and worker-to-manager relationships. The pride of Teams and managers grow when they see that what they do makes a difference. The inputs from employees are imbedded into workplace decisions to motivate the teams and make them strive to achieve the common goal of making the business more profitable.

5.4 Validation

The graph Fig 8 shows the outcome of implementing 5S at company that supplies TSAM. Other suppliers have graphs with similar trends. The 5S champions are all trained by TSAM before they go to their companies to implement the skill.

6. Conclusion

The study revealed that to boost productivity from your employees one needs to pay more attention to their needs and concerns. When employees feel more appreciated, they improve their performance. Companies that invest in their workers' happiness and well-being by providing employee support, and improved workplace conditions has bigger return on investment. 5S provides a working environment that is self-ordering, self-explaining, self-regulating, and self-improving. 5S saves space and speed up the process of getting and feeding materials, dies, fixtures and jigs, thus speeding the manufacturing process. 5S reduces and eliminates the 8 wastes in manufacturing and create more time.

Today we have many industries that practice 5S and go further to recycle waste and manufacture new products from old tyres, plastics, metals, and wood chips. The environment at which these exist requires the application of 6S principles to save time in locating specific materials. The sixth S is safety which improve the order, cleanliness and create a safe working environment. The other S the 7th that is job security, which prevails without any resistance under the present pandemic. Every employee requires safety and security to be in the manufacturing floor otherwise working from home is the option. Under the pandemic 5S is a visual management system that has improved organization efficiency in manufacturing floor. Employee morale and company image is determined by the sixth and seventh S. The system is an ongoing process designed for continuous improvement for organization's long-term success.

The Non lean companies that are adopting 5S always find it difficult when they do not use the model and fail to set up champions for each S. The success of 5S to companies that are adopting the principle depend on the culture of the people, training provided, its implementation and above all the sustenance. 5S must be clearly defined by senior management among workers. To sustain 5S, set a habit to maintain and improve 5S so that every employee is involved in developing good working habits. The methods used are driven by executive managers and cascaded down to the staff. Visual checks, audits controls and displays on noticeboards, on company TVs in the cafeteria and online simulation refreshes the staff and act as a daily reminder. Recognition of the team's good performance stimulates the need to understand its benefits by other teams. When all teams understand and appreciate the benefits, all teams will thrive to excel be self-directing

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