

# The impact of 5S Kaizen in the implementation of Lean manufacturing in South Africa(SA).

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## Abstract

The study revealed that 5SKaizen is the backbone of Lean Manufacturing, any productivity improvement strategy will depend upon a full understanding of 5S to reduce the 8 wastes. The successful implementing of 5S depend on the commitment of management and staff. Set KPIs should be targeted in training of staff so that the company culture gradually changes from NLM to LM. 5S has to be clearly interlinked to all LM strategies. The Manufacturing organisation should also interlink all its supplies so that the materials and equipment of the correct specifications are supplied timely. The first 3 Ss are critical and management should develop and establish 1S, 2S and 3S champions Sort, set in order and shine responsibilities. It is pertinent to give feedback for any achievements in 5S.

**Key words** Delays, defects, dissatisfied, declining profits, and demoralized.

## 1. Background

The 5S tool is a house-keeping tool that is used to organise inventory in the shop floor. It is the basis or first step in Lean Manufacturing (LM). 5S is a “good housekeeping” process aimed at improving the work place by controlling the work floor environment. The Implementing of 5S is not a simple process especially when it is being applied on existing systems, cultures and people of different attitudes and experiences. For a company that is at the starting stage it is simple to set up the factory and allocating space to each departments, employ and train workers on how to apply 5S. A new factory with new with newly employed employees quickly adapt to 5S than an old factory with members who have saved for years.

Factories whose productivity is below the expected can be rescued by 5S if the employees change their house keeping culture. The existing or old culture has to improve to reduce the eight waste and cost of space for the equipment and tools by introducing a systematic pattern based on 5S principles. The employees also need to go through a paradigm shift from the traditional way of keeping tools and equipment to the effective 5S. Employees adopt new ideas if the approach and method used favours them as a way of motivation so life skills knowledge is critical as well.

When 5S is applied to existing factories that are thriving for excellence some challenges may be encountered because each factory has factors affecting it such as organization culture, factory layout, experienced employees, policies and procedures for any improvements. A 5S champion or specialist is required for instance to improve the factory layout and save space. In such cases if floor area of say  $2m^2$  that would be a big saving in the cost of floor area. A culture of arranging the tools and equipment using FIFO or LIFO would save the cost of time delays in locating and retrieving materials and tools. The culture of improving cleanliness on the work place by Red tagging also reduces cost and generate income through Green technologies. Company policies and procedures on training, reporting and decision-making is also crucial.

The literature studied across the whole world has revealed some of the challenges encountered by companies that succeeded in implementing 5S and those that did not succeed. Critical success factors are important to ensure the successful implementation of LM whilst preventing the risk of failing to control organization’s resources, costs, time and employee’s effort. The challenge and question to be answered is: Are all these factors going to change without resistance by both staff and equipment?

## 2. Literature Survey

(Grove, 2010), recommended that management is obliged to communicate the vision of the new initiative and its importance to the employees at every organizational level. This is enhanced and reinforced by providing training on lean tools and techniques at the work place to show the immediate benefits derived. The 5S pillar of productivity create opportunities to simplify standard and tasks. Successful implementation of 5S will free up space and resources within the organisation and generate income which will be redirected towards provision of better services to the customer.

(Suárez-Barraza, 2012) carried a case study in Mexico and singled out senior managers as the first hindrance to 5S implementation. He cited senior managers who do not demonstrate a sound, visible leadership role and practice of 5S lean implementation as the main hindrance. Managers should demonstrate the desired behaviour to shop floor workers by putting posters, flyers and running television sessions in common rooms. If this is not revealed some employees, may not adopt the use of the tool and resort to old ways of doing the assigned tasks.

(Kundu, 2012) carried a study on public service enterprise, defining values and setting goals is critical in implementing 5S. Employees who have long service organization culture tend to resist change and are not comfortable with the new performance measurement system. Changing a culture which has been in place for years is very difficult and any attempt has to be done carefully in a way that the old staff members benefit in terms of control and responsibility so that they buy in the 5S tool. The Goals and values of the organization should be communicated to all staff and their importance and made known. Where a balance of power, resources are managed properly to maximum capacity.

(Reynolds, 2012) merged the 5S pillar of productivity with the 5Ps of Organization transformation. The first P indicate the process has to be *People* centred with necessary resources availed. The individual with a strong *Passion* to driver the 5S implementation become the champions of each of the first 3 Ss. All 5S practitioners should understand the *Purpose* of implementing the 5S pillar and participate in the *Planning* required r using PDCA cycle. Finally, all staff to have *Perseverance* in standardizing and sustaining the 5S pillar.

The studies by (Landeghem, 2011), (Houti, 2019) and (Dat MINH, 2018) identified the f critical success factor for any LM tool as:

- i. Top management involvement and commitment.
- ii. Middle management commitment
- iii. Employees commitment
- iv. Standard for evaluation and KPI
- v. LM training and consulting
- vi. Culture change
- vii. Effective communication 8. Rewarding/Recognition
- viii. Understand tools & techniques
- ix. Linking to suppliers/vendors
- x. Linking to customers
- xi. Flexibility and prioritization

In his study (Kumar, 2014) expressed the need to address cultural issues in terms of service sector performance. He highlighted the need to generate a performance measurement criteria using already set expected standards, KPIs and what flexibility or prioritization action is taken in areas of a deficiencies. The formulation and setting of standards should involve the participation of the shop floor workers, line and senior managers. A deficiency of motivation by rewarding and recognition will hinder progress in the implementation. It has been found effective to reward good behaviour as a form of recognition. The need to train long service employees is important in order to empower them with supervisory skills and new problem solving techniques. This would counter the effects of lack of planning and top management commitment, lack of contingency human aspects and strategic perspective, and lack of technological infrastructure. The training and use of advanced technology would reduce the

manufacturing lead time. The resistance to change and social influence aspect also is a challenge tha need to be addressed.

(Kiatcharoenpol.T, T, P, & C, 2014) applied the resource based view that is based on firstly a collections of *resources* that are valuable to the firm but *rare* to come by. Mobile resources in and out of the factory that are not adorable by customers and competitors. Resources which are not substitutable and are core to the business and service resources such as security systems to control theft. The effective and efficient utilization of resources

enhances the capability of the organization. Resources are a bundle of potential services, whilst capabilities are intangible skills and knowledge exercised through company operating procedures and policies.

(Mostafa, 2015) reiterated the same challenges exposed by Kundu and transposed the 5S pillar in the maintenance of the plant equipment to meet the value required by the customer. Successful results are realised when the challenges such training and change technology are eliminated. It has been found effective in many places to introduce the 5S pillar when new equipment and technology is introduced.

(Ahmed Hama Kareem, 2015) in his PhD thesis sighted the level of trust and mutual cooperation between management and appropriate employees as critical. The organizations that provide financial and moral support to employees obtain the desired results.

Some staff believe that their job is not to organize or clean the work area and equipment but to focus only in production. Such attitudes will only be driven out of staff by training to instil a sense of belonging and team spirit among the staff. It is therefore imperative to train the staff on Kaizen principles so that their attitudes changes. Training in 5S built a stronger work ethic within the work man and engineer.

Today the 6S principle is in use for most factory operations and it is critical that the champions always check:

- i. If the item is needed and in that quantity.
- ii. If needed how frequently do, we use it?
- iii. Should we locate it at this place and who is responsible?
- iv. Do we have any other unneeded items, tools, materials scattering on the floor?

The allocation of responsibilities in 5S makes it successful. If staff are not allocated responsibilities the tool may fail.

(Zailani, 2015) cited Barraza who discovered that two main barriers that hinder the effectiveness of the kaizen activities in Spain and Mexico are poor cooperation among employees and management and also the defiance of employees towards the changes in the working system are the employee resistance to change and no appropriate execution and monitoring of the kaizen.

(Kumar Attri, 2016) and (Moradlou, 2017) identified seven common barriers in the implementing of lean 5S namely resources, financial, knowledge, management, conflicts, employee culture and past experience. If resources such Labour, capital communication resources are not availed the training of staff will not yield desired results and the implementing of the 5S tool will not succeed. Provision of correct training and information to employees is necessary for successful implementation. Training builds the capacity and skills of the employees to work independently and assist them to find the root cause of the problems encountered time after time. 5S supports the identification of the 8 waste and eliminate them bit by bit to reduce costs. To give it a priority LM should be budgeted for first so that the cost training is in the plan.

Management is urged to put in place a long term vision of 5S for the tool to yield desirable results. The financial support for on the job training to provide knowledge and skills to apply 5S tool. Consultation only is not enough but real work can be done starting with the hot spot in the factory.

Management are obliged to understand and resolve conflicts with improvement techniques such as 5S, TPM, JIT and OEE to mention a few. It has been realised that many resource conflicts at the workplace are resolved by 5S.

Some Employee have a strong resistance to change because of fear of failure, lower confidence and lesser capability to collaborate. This in 5S has to be flushed out slowly taking into consideration the past experience. Past experience and projects impact the adoption of 5S by employees. If in the previous attempt it flopped, then this time around employees will not have confidence in it as well.

(Lodgaard, 2016) (Kleszcz, 2018) showed listed factors that needs to be addressed before one decide and start implementing the strategy. The factors are aligned to the John Shook (2015) model to answer the questions:

- i. What are the leadership behaviour and management systems that are required to support this new way of working?
- ii. What basic thinking, mind-set or assumptions comprise the existing culture, and drive this transformation?
- iii. What is the work that needs to be done?
- iv. How can we start the work, and what situation problem do we need to address?
- v. What employee involvement is required and how can we motivate our people?
- vi. What are the external factors that impact the work?

To answer the questions of lean transformation *John Shook (2015)* developed a framework that can be used to overcome the LM implementation barriers.



Figure 1. Research Framework by John Hook (2015)

The success of lean is dependent on the external management of supplier and clients, the manufacturing process technologies used, change management culture, the situation at hand and strategies used to motivate staff.

(Hama Kareem, 2017) 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. The availability of resources to install storage shelves in the storeroom depend on financial support from management. If senior managers are not releasing funding this hinders the implementation of the system. The manager subordinate relationship (autonomy), ethical training programs, and ethical instructions and commands are influential in 5S. The physiological factors include the motivational, morale, job security, workload, awareness and responsibility. The diagnosis of organizational, administrative, operational, technological and financial obstacles and challenges of 5S alone does not cause the success of 5S but the capacities of human resources (employees) as well.

Visual aids clearly identify the red tag areas, routes and directions to access items. Andon lights enhances communication on the state of the manufacturing process at any given moment to employees and managers by informing workers the quantities of available and wanted items. The Andon system can be in the manufacturing floor where any staff can see or in the line manager’s offices. In the case of thermal power stations and mines where there is dust and heat, alarms are the plant and Andon lights are in the control room. Inventory is visibly bar coded, dated, color-coded and named for ease of access and identification. Inventory that is stacked too far to reach with unused inventory blockading allows trash to accumulate.

(Mali S Bhongade, 2017) viewed the 5S framework as an overlap into just-in-time (JIT) production systems where the product has to be delivered to the customer in time. The company faced delay problem in dispatching resources because of customer relations. Bhongade concluded that 5S methodology improved safety, productivity, efficiency and housekeeping. Poor communication led to delays in receiving materials, restoring breakdowns, and delivery of the wrong items or quantities. Significant improvements in safety, productivity, efficiency and housekeeping are noticed when 5S was implemented in plastic industries. Process became well planned and sequenced due to scheduling of tasks. The efficiency increased from 67 to 88% in the moulding factory most waste was eliminated, work place area increased and lead-time reduced. The study showed that implementation of 5S saved 8 days of the machine manufacturing process in a year.

(Gobachew, 2019) conducted a case study in 5S in a plastic manufacturing company and obtained an improvement in efficiency of 30%. He concluded that the application of 5S reduces searching time and time to take materials or equipment from one point to the other. By Red tagging only useful materials and equipment are near the work centre.

(Houti, 2019) hinted that the success depends on management, resources and organization. Houti study concluded that factors that are controlled by management influenced the resources and their organization. The success is determined by support from management and their ability to avail resources. Motivation from management is a big stimulant to good 5S practice.

### **3. Methodology**

The first method used was to do a Literature Survey to obtain both quantitative and qualitative information on the challenges that have been faced by many institutions the world over at different Manufacturing companies. Books, Journals and articles from renowned Mechanical, Industrial, Productivity improvement Engineering journal have been selected for use in the study from 2010 to date.

The second method is conducting a Work study at companies in South Africa. The companies include the suppliers of Toyota that already have 5S as guided by TSAM and those which neither collaborate with TSAM nor its suppliers who thriving to establish 5S. We have companies that have succeeded and also that are struggling. The work study considered the material searching duration, setting up of machine & tools, alignment of tool & work piece and the arrangement of the work centre.

### **4. Data Collection**

The data in the study was collected by interviews, work-study and obtaining specific quality materials from the companies that supplies TSAM in South Africa. Interviews were quite efficient because they provided feedback instantly. Work-study and observations was used to supplement the questions for interviews and verify the statistics given on notice boards. Many suppliers have multiple products for TSAM and other motor industries but the study only considered four products, which were still undergoing improvement whose defects rate was above 10%. Defects rate between 0-10percent will be considered in the next study. Note that from 2019, Mother Nature changed the productivity in all manufacturing resources inputs and output. The Manpower, Materials, Machines and Methods were affected in one way or the other. This has an adverse impact on the efficiency of the manufacturing industry. Some industries have scaled down production, retrenched experienced workers, and replaced them with young trainees from Universities and colleges.

### **5. Results and Discussions**

The literature survey revealed some critical factors that impede effective implementation of the 5S tool. Considerable care has to be taken in overcoming the barriers when adopting Lean in case an organization adopts factors that are not suitable for the desired performance. Initially the suppliers of TSAM did not fully comprehend how 5S is inter-linked to other LM tools. They faced many obstacles and chances of failure in implementing LM systems unless they send the staff to train and develop skills at TSAM. All suppliers of TSAM use this approach.

A survey at the suppliers showed that the holistic benefits of the 5S are enjoyed when all the barriers associated with implementation of the technique are removed. However, the removal of these barriers is not done at one go, but step by step or one at a time. The first step is to assess and evaluate its applicability to inspire determination and build confidence. The management support is critical to sustain the success and remain persistent and pervasive in the application of 5S in manufacturing. At this stage senior management, visibly demonstrate commitment to the 5S program outcomes and ascertain the smooth running of the 5S tool.

In many instances workers wondered why clean the work entre when it will just get dirty again and others strongly believed that dirty is evidence of work done. They strongly believe that cleaning it up would do little good since it would be dirty soon and the benefits of efficiency and quality is overshadowed by this logic. In the manufacturing line, workers think their job is strictly to add value by manufacturing products, not organize or clean things. This attitude disappeared gradually until extinction as workers learn the importance of the Sorting and Setting in Order the materials and tools, and cleaning the work centers to actually maximizing output. The 5S tool reduces mistakes from staff and its suppliers. Defects and damage of products is minimised resulting in an increase in the overall safety. Sustainable Standards are set and maintained.

The time for orientation and training, searching the inventory and unnecessary human motion and transportation of goods from place to place have associated costs. Such costs are reduced and eventually eliminated by implementing the 5S principle. The workspace utilization, employee safety and morale is improved and boosted by 5S resulting in the reduction of defects in the products. The improvement in quality improves the morale and boost confidence of the customers. 5S improves the workplace conditions in terms of smartness and care on machines resulting in extended life of equipment. Cycle times are reduced by eliminating unnecessary delays due to clutter. The 5S approach improves company morale and team efficiency by eradicating staff frustrations and providing a smooth working environment.

## 5.1 Numerical results

**Table 1 Working Efficiency Improvements after Implementing 5S**

	Process	Duration after 5S	Duration before 5S
1	Total Time spent safety incidents	36	48
2	Time spent to obtain material from bay	30	42
3	Time spent searching Material	36	48
4	Time spent arranging tools	30	42
5	Time spent setting up machine	48	54

Table 2 shows the process times before and after implementing 5S and the time saved for each of the four machines considered in the study.

**Table 2. Process times before and after implementing 5S per 8hr shift**

Process	Expected	Actual	5S	Saved sec
Power Saw Cutting	4	5,5	4,5	30
Lathe turning for one part	120	129	118	120
Milling	60	70	56	240
Gas Welding	120	122	117	180

Table 3 show the average ratings of the 5S benefits in a in interview schedule of production technicians at suppliers of TSAM. I used this to find out which factors contribute more in improving productivity when 5S is implemented.

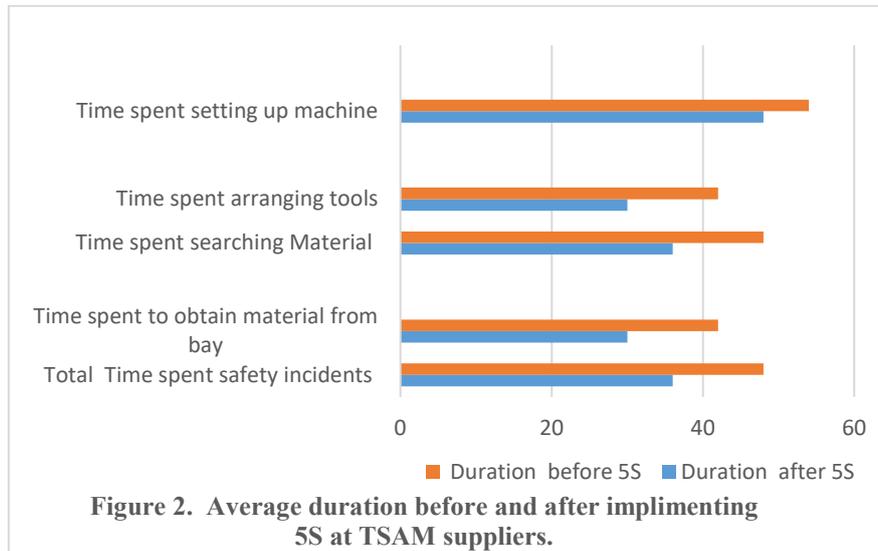
**Table 3. Pareto Analysis of the benefits of implementing 5S**

Factors	Rating	% Rating	Cumulative
Reduction Lead time	5	22%	22%
Reduction in Rework	5	22%	43%
Reduction of Defects	4	17%	61%
Reduction of Incidents	3	13%	74%
Training & Awareness	3	13%	87%
Improved Discipline	2	9%	96%
Reduced Pollution	1	4%	100%
Sum Total	23		

## 5.2 Graphical Results

The success of 5S has a big impact on the success of other LM tools since 5S is the foundation that supports the other pillars of LM. In all the other tools, 5S is critical in sorting and placing items at the right place. 5S overlaps into design and automation (Poka yoke) whose success depends on good housekeeping. Through the Jidoka principle, the machines only allow process motions to take place when all items are in the right place. This is possible when the 5S approach is applied. It was revealed that 5S has an improvement effect on the success of Total Productive Maintenance (TPM), Jidoka, and the Overall Equipment Efficiency (OEE).

The work-study has shown that most companies have successfully set up the Departmental Red Tag areas for materials and equipment, which are not in use. This improves the flow of materials and tools when required and saves in some cases more than 2hrs per 8-hour shift. The retag also improves the safety of workers, equipment and machines.



The numerical results from table 2 were used to plot the graph in figure 3. The introduction of 5S also reduced the actual machining time. This is attributed to less time wastage in the setting up, making minor machine adjustments and changeover of tools.

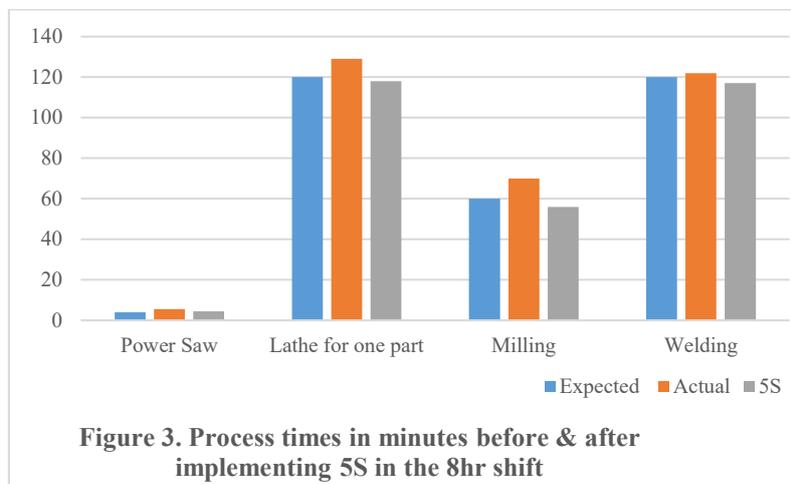


Figure 4. shows that the reduction of defects, lead times and rework is critical in improving the productivity of a manufacturing process as compared to other factors

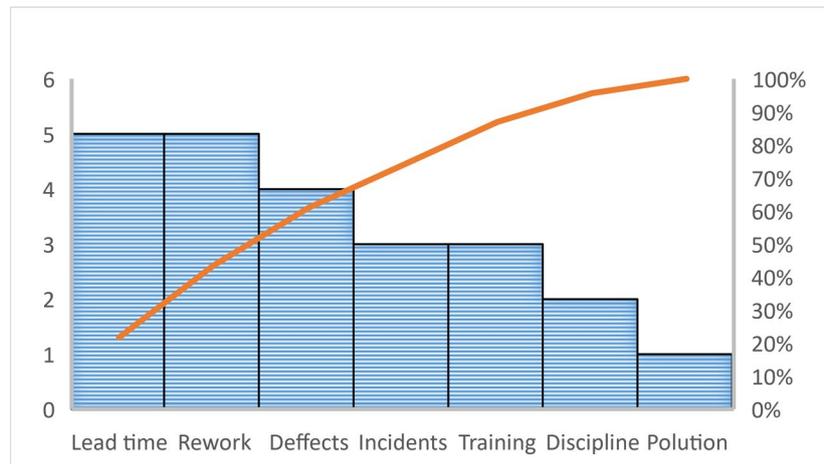


Figure 4. Benefits derived from the implementing of 5S

The study showed that total employee involvement is the first step for the success of 5S. Employee buy-in makes the employees to be open, willing, and committed to making contributions to make the endeavour a success since it eliminates the resistance to change by employees. Workers need to be involved in nearly all stages of implementing 5S and in all tasks in the shop floor. They should participate in the decision-making process regarding the red tagging of unneeded items. They should be part of the process of noting both the pitfalls and peaks of each work process. A company simply cannot be successful in implementing 5S without involving employees who are on the work floor each day.

The second step is to provide regular maintenance of equipment and review of the standards set in compliancy with quality ISO 9000 requirements. ISO 9000 and ISO 2000 for Total quality are integrated from the onset to reduce defects.

Thirdly, management should avail resources suitable for the implementation of 5S, otherwise it will be difficult for workers to buy in the tool. So adequate resources should be set up on the shop floor first. The proper application of 5S skills need motivation of each employee in the area where he is the champion.

Fourthly, the 1S, 2S and 3S champions should be developed and given responsibility for the *Sort, set in order and shine*. Champions combine training at the shop floor, motivation by visual rewards and application in the processes in order to yield good results. They frequently check for thrash at the work centres, orderly arrangement of all resources, and visually clean workspace. The setting in order champion is involved in the planning and compilation of job cards to be able to identify and place resources in the correct sequence of usage. The smart champion checks and reminds other workers to remove any dirt at the workstation or walk ways as per procedures set.

The last is feedback; staff need to be updated of the outcomes in the newsletter graphs and charts. Recording and displaying the success periodically motivate staff to implement the tool. At the shop floors of TSAM and its suppliers, I have visited so far show 5S graphs, charts, flow charts, tables of the outcomes of the implementing of 5S. 5S improves the quality, productivity and efficiency of the organization; it also has positive effect on overall performance. Some resist because the feedback and manufacturing results will be showing that the company is successful so some staff do not realise the importance of applying 5S when you are successful.

Employees are not be expected to understand and comply with the methodologies of 5S without proper training. Both employees and management need to be educated on the value of 5S as a "tool" to use not a philosophy. The transformation will make the employees to believe in the processes involved and start to promote greater levels of efficiency, quality, and staff flexibility

### 5.3 Visual Results

The pictures show a Red tag area in the R&D department of an organisation that does not collaborate with TSAM. The workbenches are in the R&D department for product development and process improvement. The parts shown in the picture either have defects and failures that occur much earlier than expected; hence, they are under study to establish the cause of failure. The arrangement in these pictures do not show application of 5S and time maybe wasted in locating ant part in the room because the parts are not arranged according to type and purpose or FIFO and LIFO. The application of 5S saves much space the workshop.

A central R&D section studies the cause of defects in the manufacturing plant using the Root Cause analysis (Ishikawa) and 5WHY mitigation. Investment in technology for Jidoka and Poka Yoke will detect the errors before it starts and stop the process so that no defects will be made. The 5S principle is not properly done as depicted by the Fig 5. The work bench looks like a scrap yard instead of a smart R&D work table.



**Figure 5. Red Tag area in R&D of a Non Lean Company**

Figure 6 shows a more organized table where defective parts are properly sorted and cleaned. Visual inspection and use of dye penetrants can reveal some material loss and cracks. This improves the defect mitigation process and results obtained are more reliable.



**Figure 6. Red Tag area in R&D of a TSAM supplier**

Depending on the type of industry and management cooperation, the R&D sections operate in the same principle for TSAM supplier but very different with Non Lean manufacturers despite having a common objective.

Situational analysis, perseverance, knowledge, belief, acceptability, commitment and support of top management are important qualitative factors to overcome the barriers. The availability, procedures and management of

resources and plant layouts greatly devour the barriers. If 5S is not taken up seriously, then 5Ds (delays, defects, dissatisfied customers, declining profits, and demoralized employee) happens.

## 6. Conclusions

Considerable care must be taken in overcoming the barriers in adopting Lean in case an organization adopts factors that are not suitable, it may impede the achievement of the desired performance. A survey on its applicability is the first step, then determination and confidence building like Toyota's sustained success due to its persistent and pervasive application of the lean principles to their manufacturing and management systems.

Organizations that do not fully understand the synergy between 5S and other LM tools face many obstacles when implementing 5S resulting in high chances of failure. The long-term prosperity and sustainability of the 5S method for an organization first requires an analysis of the strengths and weaknesses of the approach and correct methods to properly utilize the 5S concept. A success in 5S changes the production to achieve zero changeovers, defects, wastes, delays, injuries, breakdowns, complaints and red ink. The Overall Equipment Effectiveness (OEE) improves when a full 5S program is implemented together with Total Productive Maintenance (TPM) and empowering of shop floor workers to make decisions.

The holistic benefits of the 5S are enjoyed in LM when all the barriers associated with implementation of the technique are removed. The availability and management of resources, provision of clear procedures and plant layouts greatly devour the barriers. Delegating responsibilities and the power of decision making to staff guarantee a strong impact on successful completion of each task. It reinforces on employee motivation and validation of the investments required. The lack of expertise affects several fields like computer science and information flow. Leadership is not the sole important component for ensuring success when changing organisational culture.

## References

- (Kundu, 2. (2014). A Qualitative Study on the Barriers of Lean Manufacturing Implementation: An Indian Context (Delhi Ncr Region).
- Dat MINH, N. (2018). Critical Success Factors Of Lean Implementation In Vietnam Manufacturing Enterprises.
- Gobachew, A. M. (2019). Implementation of 5s methodology for performance improvement in a medium scale industry : A case study.
- Grove, A. L. (2010). Lean implementation in primary care health visiting services in National Health Service UK.
- Houti, M. (2019). Critical success factors for lean implementation "projection on SMEs". Proceedings of the International Conference on Industrial Engineering and Operations Management.
- Kleszcz, D. (2018). Barriers and opportunities in implementation of Lean Manufacturing tools in the ceramic industry.
- Kumar Attri, R. (2016). Identification of barriers in implementation of World Class Manufacturing (WCM) Practices: A Literature analysis.
- Kumar, A. (2014). A Qualitative Study on the Barriers of Lean Manufacturing Implementation: An Indian Context (Delhi Ncr Region).
- Kundu, G. (2012). Challenges And Success Factors For Implementation Of Lean Manufacturing In European SMES.
- Lodgaard, E. (2016). Barriers to Lean Implementation: Perceptions of Top Managers, Middle Managers and Workers.
- Mali S Bhongade, S. A. (2017). Implementation Of 5s In Manufacturing Firm To Reduce Delivery Time Of A Product.
- Moradlou, H. (2017). Identification of the Barriers in Implementation of Lean Principles in Iranian SMEs: Case Study Approach Identification of the Barriers in Implementation of Lean Principles in Iranian SMEs: Case Study Approach Interdisciplinary.
- Mostafa, S. (2015). Lean thinking for a maintenance process.
- Reynolds, S. F. (2012). The 5 Ps of Organizational Transformation.
- Suárez-Barraza, M. F. (2012). An exploratory study of 5S: a multiple case study of multinational organizations in Mexico.