

Research Article

Impact of Implementing Japanese 5S Practices on Total Productive Maintenance

Richa Sharma^{†*} and Jagtar Singh[†]

[†]Department of Mechanical Engineering, SLIET Longowal-148106, Distt. Sangrur, Punjab, India

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Abstract

5S is a systematic technique used by organizations comes from five Japanese words; Seiri (sort), Seiton (set in order), Seiso (shine), Seiketsu (standardize) and shitsuke (sustain). This system helps to organize a work place for efficiency and decrease wasting and optimize quality and productivity via monitoring an organized environment. 5S is the pre-step of Total Productive Maintenance (TPM), is a systematic approach providing the contribution of all personnel in the cleaning regime of the company. 5S execution is an essential prerequisite of implementation of Total Productive Maintenance (TPM). In this paper relations between 5S and pillars of TPM are explicated. The objective of this study is to identify the effectiveness of 5S practices on the TPM implemented organization performance. The result of this study confirms that all 5S principles affect TPM directly or indirectly. Consequently, 5S is an effective tool which strongly supports the objectives of TPM implemented organization to achieve continuous improvement and higher performance.

Keywords: 5S, Total Productive Maintenance (TPM), Overall Equipment Effectiveness (OEE), Six big losses, Housekeeping, Autonomous maintenance, Teamwork

1. Introduction

In 1940s and 1950s Japan put efforts to take advantage of theories and assumptions of Preventive Maintenance (PM) to optimize equipment maintenance systems. Being customized with Japanese culture which is embedded with elements of teamwork, cooperation, and responsibility, the new concept of total productive maintenance was introduced to the world in 1970s. This innovative approach which was proved to be more effective than its predecessors was rapidly globalized and consequently supported by industry owners. However, correct implementation of TPM calls for several preliminary actions such as implementing 5S as the most important principle which must be established before implementing TPM. This issue has been discussed in researches and opinions of local and foreign experts. The Maintenance Excellence Institute in its "Quality operations and maintenance guide" puts special emphasis on 5S. Thereby guidelines for maintenance excellence begin with defining, running and evaluating 5S activities (R.W. Peters, 2006). In a Polish case of implementing TPM in steel industry, 5S served as the foundation of TPM. Both TPM and 5S intend to increase performance of machineries and equipments by developing personnel's knowledge and skill as well as their sense

of responsibility. This may justify why 5S has been implemented in ArcelorMittal steel manufacturing company in Poland prior to TPM (B.Gajdzik, 2009). Another case in Australia introduces 5S and TPM as two key factors in Lean and World Class Manufacturing models and later combines them to introduce a new concept called TPM 3 (R.Kennedy and L.Mazza, 2009). A domestic case in Mobarakeh Steel Co. in Iran, guided by Japanese consultants, indicates precedence of implementation of 5S to TPM at the zero execution level (F.Sadeh, 2005). TPM is a system revealing itself as of the beginning of the application. The most important reason of this is the 5S applications. Through the proper application of 5S activities, a visible change occurs within the factory. Since it is executed in order to use the factory's area and equipments in a more efficient manner, it improves the efficiency of the company (Sevim, 2005). Through the first three principles, 5S approach prepares the environment conditions minimizing the work flow and through the last two principles, it targets the protection and development of the revealed improvement. According to this purpose, the foundations of the company policy oriented to avoiding the ineffective time are taken through the applications of 5S approach. 5S approach forms the basis of the other improvement activities conducted at the company and leaves positive impact on the motivation of the personnel (Saricoban, 2006). Furthermore, when 5S is applied; it has important impact on the work

*Corresponding author **Richa Sharma** is a PhD Scholar and **Dr. Jagtar Singh** is working as Professor

safety, quality, efficiency and decreasing the stops. The success of the system requires the recognition of all these operations by everyone and its continuous observation. Another important factor required for its successful application is that everyone has "teamwork soul".

This paper is organized in following sections: section two presents Literature review, section three describes the Objectives of the study, section four presents the concept of 5S and section five elaborates the key elements in successful implementation of 5S, section six and seven represents the Introduction to Total Productive Maintenance (TPM) and relation between 5S and Total Productive Maintenance (TPM), and conclusion is discussed in section eight.

2. Literature Review

In recent years, the practice of 5S is commonly used among the Japanese firms in order to enhance human capability and productivity. Since it was introduced by Takashi Osada in the early 1980s, it is believed that applying the 5S techniques could considerably raise the environmental performance in production line including housekeeping, health, safety and more. 5S is a useful method for founding an organization and spread out a design and can improve communication and help employees to develop their characteristics to decrease, downtime, lead time, inventory, defect, injury and associated costs (K.Tsuchiya, 1998). Result of the study indicates that 5S technique is an effective way to improve health and safety standards, environmental performance and housekeeping (Becker J.E, 2001). 5S is a method for development of companies, change and training. (Hirano, 1995) regards 5S as an industrial practice that distinguishes an organization from the others. According to the Japanese and organizations 5S have two components, a high level of management organizational system with complexity meaning and it translates to perfect performance and the other one is management provision tools position. Even though the 5S housekeeping program aids production but the 5S technique is one of the most known in industrial and business environment and there are few proofs about its adoption in organizations (Ab Rahman, M.N. et al, 2010) Other studies still accept 5S as a method of housekeeping (Becker J.E., 2001) however there are other ideas that believe 5S is a supportive way for Lean, TPM and TQM (Kumar, M., et al, 2006).

From the quality management point of view, order and cleanliness have been considered as a part for continuous improvement (Yusof & Aspinwall, 2001) and also a point to start continuous improvement and more advancement in organizations. 5S can link with total productive maintenance (TPM) (Ahuja and Khamba, 2008) and Japanese management approaches such as TPM, JIT and TQM (Gapp et al., 2008) Generally, the success of 5S implementation depends on organizational characteristics (Sousa & Voss, 2008) as this mentioned in many surveys (Bayo Moriones et al., 2008). Survey of one factory in Iran supports previous

findings in this field and indicates that 5S execution provides better condition for implementation of TPM (Moradi et al., 2011) As it is mentioned in several studies, the 5S method is recorded as a way for improving health and safety standard and performance in a holistic operation with high level of efficiency (Khamis, et al., 2009) and also helps improving data management system in factories (Ananthanarayanan, 2006). TPM is the proven manufacturing strategy that has been successfully employed globally for the last three decades, for achieving the organizational objectives of achieving core competence in the competitive environment (Ahuja et al., 2004). TPM is a highly influential technique that is in the core of "operations management" and deserves immediate attention by organizations across the globe (Voss, 2005). 5S is applied in most of the factories in manufacturing sections with priority compare to other sections with different ways which can be attributed to the maturity of the 5S programme (Warwood & Knowles, 2004). Mixing lean manufacturing initiatives through 5S with safety yield safety results that are well aligned with the rest of the organization (Becker, 2001). In their studies, (Ho and Fung, 1995) stated that 5S is one of the strongest tools for enhancing the success factor of TQM implementation. As supported by Khanna (2009), 5S is the driver for the successful of TQM implementation and other quality tool that 5S is an effective technique that can improve housekeeping, environmental performance, as well as safety standards in a systematic way. However, (Warwood and Knowles, 2004) stated that the implementation of 5S is tended to depend on the stage of the 5S programme. Most Japanese companies claimed that 5S benefit is not only for improving physical environment but also improving their thinking processes as well. A useful environmental tool for organization management is 5S, which comes from lean manufacturing process. The 5S practice simplifies the workplace and maintenance system's procedures, decrease waste and non-value added activities. It also improves quality, efficiency and safety. It is the most effective tool of control, which at least reduce or totally avoid different types of pollutions.

3. Objectives of the Study

There are many practices in the world to improve the quality of products/services and performance of organizations, but generally companies looking for the best practice to implement and utilize for achieving their organizational goals and objectives easier, sooner and with less expenses. This study aims to investigate the impact of 5S practices on performance of industrial organizations. Accordingly, the main objectives of the research are:

- To identify the effectiveness of 5S practices on the TPM implemented organization performance.
- To measure and compare of the organization's performance before and after implementing 5S practice.

- To develop the relations between Principles of 5S and Pillars of Total Productive Maintenance (TPM).

4. Concept of 5S

The 5S method begins each programme of improvement. It is the tool for helping the analysis of processes running on the workplace. The 5S is the methodology of creation and maintaining well organized, clean, high effective and high quality workplace. Its result is the effective organization of the workplace, reduction of work's environment, elimination of losses connected with failures and breaks, improvement of the quality and safety of work (T. Karkoszka and D. Szewieczek, 2007). The philosophy of the 5S has its roots in Japan. Name 5S is the acronym of five Japanese words of the following meanings as shown in Figure 1. (H.J. Harrington, 2000)

- Seri (sort),
- Seiton (set in order),
- Seiso (shine),
- Seiketsu (standardize),
- Shitsuke (sustain).



Figure 1 Principles of 5S

4.1 1 S - Seiri (Sorting, organization of the workplace, elimination of unnecessary materials).

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 (J. Peterson, 2001) 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.

4.2 2S- Seiton (Set in order, place for everything).

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.). 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 specialist 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.

4.3 3S- Seiso (Shine, cleaning, removing of wastes, dust etc.).

Regular cleaning permits to identify and to eliminate sources of disorder and to maintain the clean workplaces. During cleaning it is checked the cleanliness of machine, workplace and floor, tightness of equipment, cleanliness 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 (S.K. Ho, 1996):

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 cleanliness 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?

4.4 4S – Seiketsu (Standardize constant place for things, constant rules of organization, storage and keeping cleanliness).

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 (M. Dudek-Burlikowska, 2007)

4.5 5S- Shitsuke (Sustain, automatic realization of above-mentioned rules).

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 (M. Urbaniak, 2004).

5. Key Elements in Successful Implementation of 5S

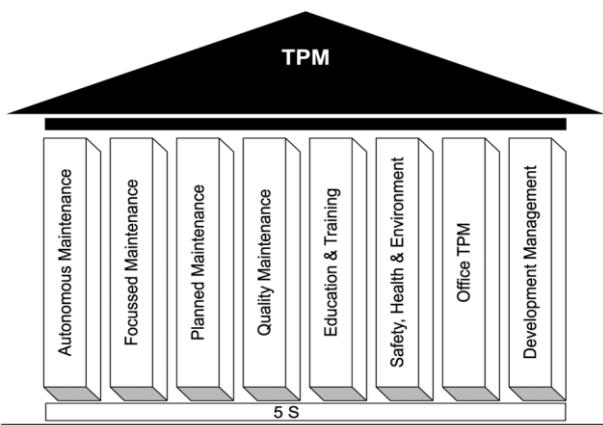
Active co-operation of personnel in 5S-related programs is the major factor in its successful implementation. In other words, staff responsibility and their commitments to run 5S is the secret behind this system's success. In order to encourage sense of commitment among an organization's staff, top managers have to reaffirm their dedication to 5S and continuous improvement ahead of the other personnel. Furthermore, to guarantee survival of this system, 5S coordinator and steering committee must be trained to correctly understand 5S and its importance, to regularly and systematically evaluate 5S implementation, and to optimize possible inefficiencies. Successful implementation of 5S in work environment will pave the way for executing activities which demand personnel cooperation. That is to say, personnel will have more courage to make positive changes in the organization.

6. Introduction to Total Productive Maintenance

Total Productive Maintenance (TPM) is a maintenance program which involves a newly defined concept for maintaining plants and equipment. It is a system of maintaining and improving the integrity of production and quality systems through the machines, equipment, processes, and employees that add business value to the organization. In order for TPM to be effective, the full support of the total workforce is required. This should result in accomplishing the goal of TPM: "Enhance the volume of the production, employee morale and job satisfaction." The key objective of an

effective TPM initiative is to bring critical maintenance skilled trades and production workers together (A.W. Labib, 1999) with its three ultimate goals: Zero breakdown, Zero defects and Zero accidents (P. Willmott, 1994), (M.Noon *et al* 2000). There are many different definitions for TPM and the reason behind this diversity in definition is found in the way of adoption this strategy, some industries focus on the group working more than equipment management, and other focus on equipment effectiveness, this diversity shows how important implementing TPM in company that it covers all factors may affect the production process (D.Hutchins, 1998).

TPM starts with 5S. The traditional approach to TPM was developed in the 1960s and consists of 5S as a foundation and eight supporting activities. Basically, Total Productive Maintenance (TPM) is classified into eight pillars, all of which are supported by 5S include Autonomous Maintenance, Focused Improvement, Planned Maintenance, Quality Maintenance, Education & Training, Office TPM Pillar, Safety Health & Environment and Development Management (Ireland & Dale, 2001; Shamsuddin *et al*, 2005) as shown in Figure 2. Table 1 represents activities of eight TPM pillars. It is a systematic process of housekeeping to achieve a serene environment in the work place involving the employees with a commitment to sincerely implement and practice housekeeping. Problems cannot be clearly seen when the work place is unorganized. Cleaning and organizing the workplace helps the team to uncover problems. Making problems visible is the first step of improvement. 5S is a foundation program before the implementation of TPM. (Ahuja & Khamba, 2008) have investigated the significant contributions of TPM implementation success factors like top management leadership and involvement, traditional maintenance practices and holistic TPM implementation initiatives towards affecting improvements in manufacturing performance in the Indian industry. .



Note: Approach suggested by the Japan Institute of Plant Maintenance

Figure 2 Pillars of Total Productive Maintenance

The core part of the TPM is the motivation, participation, and development of shop floor

personnel, pleasant workshop and sincerity of management towards overall improvement of organization.

Table 1 Activities for constructing the eight TPM pillars

TPM pillar	Activities for building the TPM pillar
Autonomous maintenance	<ul style="list-style-type: none"> Fostering operator skills Fostering operator ownership Performing seven autonomous maintenance activities: (i) initial cleaning, (ii) countermeasures for cause and effect of contamination sources, (iii) establishing cleaning and lubricating standards, (iv) general inspection, (v) autonomous inspection, (vi) organisation and tidiness, and (vii) full implementation of autonomous maintenance.
Focused improvement	<ul style="list-style-type: none"> Systematic identification and elimination of 16 losses Loss mitigation through structured why-why analysis and failure mode and effect analysis Achieving improved system efficiency Improving OEE of the systems
Planned maintenance	<ul style="list-style-type: none"> Planning efficient and effective preventive maintenance, predictive maintenance, and time-based maintenance systems throughout equipment life cycle Establishing 'preventive maintenance' check sheets Improving mean time between failure (MTBF) and mean time to repair (MTTR)
Quality maintenance	<ul style="list-style-type: none"> Achieving zero defects Tracking and addressing equipment problems and root causes Setting 4M (man, machine, material, and method) conditions
Education and training	<ul style="list-style-type: none"> Imparting technological, quality control, and interpersonal skills Multi-skilling of employees Aligning employees' mindset with organisational goals Periodic skill evaluation and updating
Safety, health, and environment	<ul style="list-style-type: none"> Ensuring safe working environment Providing appropriate work environment Eliminating incidents of injury and accidents Providing standard operating procedures
Office TPM	<ul style="list-style-type: none"> Improving synergy between various business functions Removing procedural hassles Focusing to address cost-related issues Applying 5S housekeeping procedures (5S stands for the Japanese terms <i>Seiri</i>, <i>Seiton</i>, <i>Seiso</i>, <i>Seiketsu</i>, and <i>Shitsuke</i>) in office and working areas
Development management	<ul style="list-style-type: none"> Deploying new equipment using minimum time Learning from existing systems to develop improved new systems Maintenance improvement initiatives

Generally 5S is the starting point of improvement activities. Many companies struggle to implement TPM due to insufficient knowledge and skills especially in understanding the linkages between 5S and 8 Pillar activities of TPM. A typical Total Productive Maintenance requires company-wide participation and full results can only be seen after 3 years and sometimes after 5 years. The main reason for this long duration is due to the basic involvement and training required for 5S and Autonomous Maintenance pillar, where operators participate in the restoring the equipment to its original capability and condition for improving the equipment.

7. Relations between 5s and Total Productive Maintenance

It is important to mention that 5S and TPM are both born in Japan and therefore have roots in Japanese culture. In Japanese industrial definitions, there are three main factor affecting work environment. Yaruki (morale & motivation), Yarude (fair competition) and Yaruba (proper work environment conditions). In order to eliminate the six big losses of a plant, it is necessary to improve personnel's morale and attitudes (Yaruki), to elevate skills towards creating grounds for fair competition (Yarude), and to create a safe and appropriate environment that supports relative activities regarding implementation of TPM (Yaruba). Obviously, creating a safe and appropriate environment necessitates consideration of principles of 5S. In many cases these considerations are not well understood and are therefore only shown in form of

symbolic actions (e.g. painting shop floor and machines' bodies), whereas major maintenance considerations (such as servicing internal parts of machines and revolving components) are missing (T. R. Pomorski, 2004). Hence, accurate and effective implementation of 5S could serve as a foundation for TPM implementation. More explicitly, the first two principles of 5S insist on clearing work environment of unwanted and unnecessary items as well as focusing on organizing necessary items. Crowded and chaotic layout of tools and parts in production sectors and warehouses increases times to access tools and parts and consequently MTTR2 indicator is as well increased. The third principle (sweeping) seeks cleanliness of work environment and equipment's. Sweeping is not only limited to showing parts but also must be applied to internal parts of equipments and behind guards and covers. Besides, it is easier to notice defects such as oil leakage in machines which are preserved cleanly.

Table 2 Relationships between Principles of 5S and TPM Pillars

Principles of 5S Pillars of TPM	Sorting	Simplifying	Sweeping	Standardizing	Self-discipline
Focused Improvement	clearing unnecessary item from work environment increases room for maintenance	Reduction of time to access to equipments & tools	Avoidance of fast depreciation Faster failures identification	Developing culture for documentation, acceptance and implementation of maintenance standards	Assistance to make commitment to continuous improvement in using equipments
Autonomous maintenance	Directing personnel to maintain necessary items	Assigning more time to maintenance as a result of increased productivity of employees	Basis of autonomous maintenance	Facilitation of autonomous maintenance through marking, tagging & using other standards	Developing culture for running autonomous maintenance
Planned Maintenance	Focus of planned maintenance on necessary items	Adapting to plans	Adapting to plans	Facilitation of accepting & running of maintenance standards	Making commitment to run plans
Training					
Maintenance prevention			Assistance to better identify causes of failure and establish ground for their elimination Maintaining equipments in appropriate operational conditions	Maintaining equipments in appropriate operational conditions	
Quality Maintenance		Reducing time to access to quality control equipments	Quality control facilitation Swift identification of unregulated items	Facilitation of accepting & running of quality standards	Making commitment to continuous quality improvement
Administrative TPM	clearing work environment and increase room for maintenance	Reduction of time to access to maintenance tools	Prevention of fast depreciation Faster identification of administrative equipments failures The first step in autonomous maintenance	Developing culture for documentation, acceptance and implementation of maintenance standards	Developing culture for running autonomous maintenance
Safety & environment	clearing work environment	Safety improvement considering specified location of tools	Safety improvement at clean work environment Protecting environment	Continuous use of personal protection equipment	Discipline in using safety equipments

Uncleanliness of machines may accelerate their depreciation, lower work efficiency, increase

percentage of scraps and in general, increase the need for maintenance which are all in fundamental contradiction with principles defined in TPM (R. Kennedy and L. Mazza, 2009a). The two principles of standardization and self-discipline have also indirect effect on establishing pillars of TPM. In other words, implementation and institutionalization of these two latter principles in organizations requires suitable mental and cultural grounds to enhance individuals' capability to accept responsibilities and consequently assist the firm in achieving basic goals of TPM.

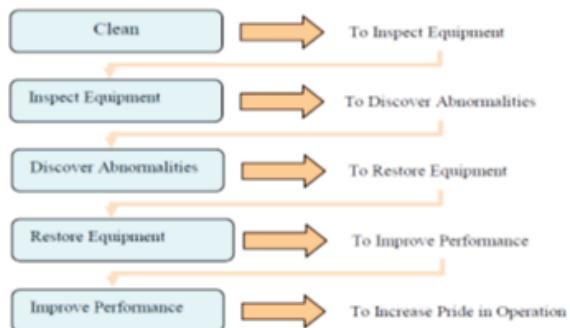


Figure 3 The role of 5S in Autonomous Pillar

Table 3 The relationship between the Principles of 5S and Reduction of Six Big Losses

Principles of 5S Six big losses	Sorting	Simplifying	Sweeping	Standardizing	Self - discipline
Failure and emergency shutdown	Clearing work environment and increased room for maintenance	Reduction of time to access to equipments & tools	Avoidance of fast depreciation Faster identification of failures	Developing culture for maintenance standardization	Developing culture for identification & implementation of preventive and autonomous maintenance
Line set-up & configuration	clearing work environment and increased room for set-ups	Reduction of time to access to maintenance tools	Faster reorganization of irregularities and faster measurement	Developing culture for maintenance standardization	Reduction of set-up time as result of Developing sense of cooperation and coordination
Idle time& short-time stop	Removing unnecessary items that are potential causes of short-term stops		Reduction of short-time stops resulted by pollution		
Speed reduction			maintaining equipments in proper operating conditions		
Wastes & rework		Reducing time to access to quality control equipments	maintaining equipments in proper operating conditions to produce quality products and reduce wastes Reduction of measurement errors as a result of cleanliness of measuring instruments	Assistance to standardize quality	Making commitment to quality improvement
Start-up losses			maintaining equipments in proper operating conditions		

Table 2 indicates relations between principles of 5S and pillars of TPM in a corresponding way. This must be elucidated that implementing 5S principles do not directly affect the training pillar of TPM but since 5S implementation is followed by training programs, it could serve as ground for increasing personnel's willingness to accept future training programs.

Table 3 depicts relations between principles of 5S and reduction of the six big losses which affect Overall Equipment Effectiveness (OEE). It shows effect of 5S implementation on first pillar of TPM precisely. Due to importance of autonomous maintenance in TPM, and principle of sweeping in 5S, relations between these two have been illustrated in table 2. This figure 3 depicts how in a cause-and-effect structure, cleaning of equipments could help us notice and identify abnormal conditions. Eliminating roots of these conditions, equipments and production process performance improvement will be enabled and personnel will strengthen their commitments to their work and the company.

Conclusion

The results of this research confirm that the 5S practice is seen as an effective technique that can improve housekeeping, environmental performance, health and safety standards in an integrated holistic way. However, 5S execution is an essential prerequisite of implementation of Total Productive Maintenance. The survey demonstrates that there are obstacles in the effective implementation of the 5S in TPM implemented industries. The most significant barriers identified are related to lack of communication and gap between the top management and shop floor employees and also the lack of training and consciousness of this activity amongst the staff. Poor communication will influence the poor results in managing the resources i.e. time, budget and materials with resultant lowered morale and motivation amongst employees. As supported by (Gapp *et al.* 2008) some critical decisions of 5S activity, especially which related to budget and time performance must have management approval and support. The result of this study concludes that all 5S principles affect TPM directly or indirectly. These effects have been studied for each pillar of TPM. 5S technique can provide better state to reduce six big losses and therefore improve OEE. Furthermore, it can promote collaboration culture in organization that attempt to elevate staff willingness for autonomous maintenance. The impact of implementing 5S technique on Total Productive Maintenance in terms of Productivity, Quality, Cost, Delivery, Safety and Morale (PQCDSM) known as TPM indicators are

- ❖ *Productivity (P)*
 - a) Improvement in Maintenance and increasing overall equipment efficiency.
 - b) Process improvement (increasing of effectiveness and efficiency).

- c) Reduction in equipment failure breakdown
- ❖ *Quality (Q)*
 - a) Reduction in process and product defects due to scraps and quality defects to be repaired.
 - b) Reduction in customer complaints.
 - c) Effective implementation of operator quality assurance.
- ❖ *Cost (C)*
 - a) Reduction in cost including in areas such as procurement, accounts, marketing, sales leading to high inventories.
 - b) Reduction in maintenance cost, logistics cost, inbound/outbound, Cost of communication, Demurrage costs.
 - c) Reduction in Overhead costs/Expenses on emergency dispatches or purchases.
- ❖ *Delivery (D)*
 - a) Reduction in logistics losses (Delay in loading and unloading)
 - b) Improvement in material handling/stores/logistics/commercial activities
 - c) Improvement of the internal communication process. (Delay in information and payment to suppliers).
- ❖ *Safety (S)*
 - a) Reduction in industry accidents/ pollution/ fires.
 - b) Creating a safe workplace and a surrounding area that is not damaged by our process or procedures.
 - c) To organize safety awareness program/ competition among employees like safety slogans, Quiz, drama, Posters etc.
- ❖ *Morale (M)*
 - a) Providing a stress free training programme to remove employee fatigue and making work enjoyable.
 - b) Increasing participation of employees in number of kaizens and One Point Lesson (OPL).
 - c) Creating a training environment for self learning based on felt needs.

As suggested by (J.Peterson,2001) training is the 5S's key of success. Without proper training, the employees haven't captured the 5S implementation properly and are not able to standardize the 5S activity. Hence, the full benefits of the 5S cannot be experienced in the business sector until all the obstacles associated with implementation of the technique are recognized, fully understood and addressed.

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