



Implementation of 5S Framework and Barriers modelling through Interpretive Structure Modelling in a Micro Small Medium Enterprise

Ram Babu Verma, Sanjay Kumar Jha

Abstract— The 5's technique is an assemblage of working tools of lean manufacturing that organize, order, clean, standardize and continuous any workplace. This article exemplifies a case study on the implementation of the Lean 5's Technology in a micro, small and medium enterprise (MSME), so as to make it more efficient, effective and productive.

Considering the working conditions, a 5's framework has been analyzed and implemented where a remarkable improvement was noticed in product quality, lead time as well as cost reduction. The personal study clearly exhibits that it is very essential for an organization to train its workers about 5's rules. In this article, an attempt has been made to identify various shortcomings and mitigate them. The proposed framework investigates the flaws in the manufacturing processes within the organization. Standard operating procedures have been developed and applied on the shop floor holistically and changes were recorded which validates the fact that 5S is a simple and powerful technique, used to eliminate the process wastes, errors and helps in the development of a formal workplace organization system for the company.

Furthermore, various barriers faced during the implementation of 5S rules were identified and a through the technique of Interpretive Structural Modelling (ISM) a visual model was developed which showcased the various interrelationships existing between the said barriers

Keywords: Lean Manufacturing, Implementation in MSMEs, 5's technique, process waste, Standard operating procedures, ISM.

I. INTRODUCTION

Lean-5S is a technique, provides an assistance to 'Micro Small and Medium Enterprises' in reducing their manufacturing costs and increases productivity through proper personnel management, better space utilization, improves process flows and reduces engineering time. The 5S is lean manufacturing technology that helps remove the "junk" from the job region and enhance an organization's working practices. 5S is not only a waste-eliminating method, but also built with five commandments[1]. Takashi Osada was the first to formalize the practice of 5S in 1980s using the Japanese terms Seiri, Seiton, Seiso, Seiketsu and Shitsuke to represent different phases in the process of workplace organization [2].

Manuscript published on 30 September 2019

* Correspondence Author

Ram Babu Verma*, Department of Production Engineering Birla Institute of Technology Mesra, Ranchi (Jharkhand), India

Dr. Sanjay Kumar Jha, Department of Production Engineering Birla Institute of Technology Mesra, Ranchi (Jharkhand), India

© The Authors. Published by Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP). This is an [open access](https://creativecommons.org/licenses/by-nc-nd/4.0/) article under the CC-BY-NC-ND license <http://creativecommons.org/licenses/by-nc-nd/4.0/>.

Retrieval Number: C6041098319/2019@BEIESP

DOI:10.35940/ijrte.C6041.098319

Journal Website: www.ijrte.org

The fundamental idea of 5S principles on a setting of complete quality and the 5S campaign describes how each workplace can benefit from its use [3]. The 5S philosophy focuses on efficient workplace organization, job environment simplification and waste reduction while enhancing quality and safety [4]. Lean execution includes a well-planned and systematic mixture of top-down and bottom-up strategy [5].

Potential benefits of 5S are to improve positive values in the organization culture [6]. The 5S method involves the entire organization at all levels for full participation and systematic execution and creates efficient quality procedures [7]. Top management must be truly committed to make lean happen. The success of 5s relies entirely on the complete participation of employees, their continuous monitoring and everybody should function in a team.

II. PROBLEM STATEMENT

Due to time consuming and inefficient process flow, MSME Tool Room involved in tool & die production business has trouble meeting customer requirements. The problem in the shop floor has its non-systematic way of working. As an outset most of die parts are being made in haphazard way on the machines, leads delay in manufacturing and delivering the tools & dies to the customers. It has been observed that the main reason of delay of work in machines is poor workplace condition, resulting the plant's efficiency low. To work in efficient way in the machine shop proper tools, devices, measuring instruments always needs to be available in Tool Cribs in proper place, so that allotted work can be done within the time. The condition of tool crib is found very poor. Most of the related items were found in mixed up condition and in improper place in different Tool Cribs.

For the second part of our analysis, various obstacles which were encountered during 5S adoption in the firm were identified through past literature study and via consultation of experts. These barriers were analyzed to construct an ISM model, which would subsequently provide the manager with a blueprint of how the barriers are interrelated and effecting the process of 5S implementation in an MSME.

III. LITERATURE REVIEW

5S remains fundamental to the organizations. Orderliness is still the basis for zero faults, cost reduction, safety and zero accidents [8]. From the quality management point of view, order and cleanliness have been considered as a part for continuous improvement (Yusuf & Aspinwall, 2001) [9].



Published By:

Blue Eyes Intelligence Engineering
& Sciences Publication

www.ijrte.org

Exploring Innovation

Implementation of 5S Framework and Barriers modelling through Interpretive Structure Modelling in a Micro Small Medium Enterprise

5S as an integral part of the workplace management and critical to the kaizen process. The lack of 5S results in inefficiency, waste, low morale, poor quality, high costs and a failure to meet delivery conditions [10].

Bryar & Walsh (2002) reported that an Australian management consultancy and training business saw some of the benefits listed and felt re-energized by the 5S result [11]. Withanachchi et al. used 5s to identify management areas in a public hospital in Sri Lanka that needed improvements [12]. 5S helps improving data management system in factories (Ananthanarayanan, 2006) [13]. 5S can link with total productive maintenance (TPM) (Abuja and Khamba, 2008) [14]. The potential benefits of 5S are improved levels of health, safety and environmental protection [15]. The impact of 5s on organizational cultures is, according to a case study, a better understanding of the needs of the customer and a better relationship and communication with them. [16].

The case study was carried out in a Scottish company (Herein referred as ABC) is a part of MNC based in Netherland. The company has currently two separate businesses houses of Lamps and Luminaries, running with approximately 350 employees. Due to complexity of Luminaries Products Company synchronized business operations in one unit. To achieve set goal lean 5S was implemented as a fundamental tool for the lean transformation. It has been observed that within a period of 3 months after 5s implementation organizational culture was significantly improved. It is clearly be seen that 5s program is performing well apart from sustain phase [17].

A case study of Vedanta Aluminium Co. Ltd has adopted the 5S technique in maintenance of crane used to transfer the molten metal. The purpose is to reduce bottlenecks of maintenance activities and to perform a systematic planned maintenance. The company has adopted the 5s principles for sorting and maintaining the essential tools and spare parts to repair the 5 Ton capacity Crane. The breakdown of crane will cause stoppage of entire facility production. Maintenance department has saved an average 7.5 Minutes time in each activity of earlier average of 15 minutes through 5S. The study revealed that department has saved 50 percent time as well as found work quality also much satisfactory [18].

Hubbard (1999) reported that the use of 5S in his manufacturing company lead to a recovery of 10% floor space, better use of space available and aid in cleanup[19].

Japanese management approaches such as TPM, JIT and TQM (Gapp *et al.*, 2008) [20]. The achievement of 5S application generally relies on the features of the organization (Sousa & Voss, 2008), as stated in many studies (Bayo Moriones et al., 2008) [21].

Khamis et al., 2009 demonstrated the application of 5S in Malaysia to two medium-sized enterprises A and B and surveyed that 5S practice is an effective technique that can improve housekeeping, environmental performance and health and safety standards in an integrated holistic manner. Effective execution of the 5S operation relies on the engagement of top-level leadership and full personnel participation. The 5S operations are provided priority based on the company's function and business. Finally, training is provided in the organization for the implementation of the 5S procedures [22].

Jose H. Ablanado-Rosas et al. (2010) developed the outcomes of an empirical research applied to some Mexican

organisations in order to understand their experience of execution, empirical interactions and continuing difficulties related to the 5S exercise. The 5S practice is used as the grounds for philosophies of sophisticated quality and continuous improvement and the organisation measures the advantages of implementing 5S such as improving quality. For manufacturing and service organisations, the 5S practice is valuable and universal to all organisations. The large challenge is how to integrate the 5S practice into the lives of everybody (employee). [23].

P. M. Rojrasra et al. (2012) explains the implementation in the Krishna Plastic Company, Udhyog Nagar, Amreli and Gujarat of the 5S methodology. 5S provides excellent potential for necessary improvements out of the multiple lean manufacturing methods available. The findings after the implementation of the 5S indicate that the effectiveness of the manufacturing scheme is enhanced from 67% to 88.8% in the successive week [24].

S. B. Khedkar and others. (2012) addressed the application of the 5S methodology In S. P. MIDC plastics industry, Nagpur. Research demonstrates important improvements in safety, productivity, effectiveness, morality and household management [25].

Gupta and Jain, 2014 in a small-scale manufacturing organization demonstrated the application of 5s and Kaizen. Implementation of 5s and Kaizen outcomes in enhanced process efficiency and efficiency, enhanced process visibility, enhanced employee morale and safety, decreased delays, time search and hazardous circumstances. Participation, engagement and help from top-level leadership are the most significant variables to create effective 5S and kaizen system. [26].

3.1 Barriers Identification

Barriers can be defined as obstacles while introducing a new concept or method in a preexisting system. Barriers can be categorized into internal and external barriers, but for our study chief focus would be on internal barriers. Top management commitment and reluctance of a workforce to adopt a new concept continue to be recurring issues [becker]. Also, financial constraints, lack of awareness and non-availability of resources are also a contributing factor towards hostility in 5S implementation [Grier]. After rigorous literature survey and after consultation with various industrial experts and academicians following 9 key barriers were identified.

1. Lack of commitment from top management.
2. Lack of clarity of purpose of 5S implementation
3. Firm culture
4. Low availability of resources
5. Poor cooperation among departments
6. High financial investment
7. Lack of training
8. Lack of incentives and rewards
9. Low awareness towards its benefits

3.2 Review Remarks

The above Literature review on above context of statement problem recommends that 5S implementation is necessary in the company. In production without 5S many wastes accumulate those covering up problems and becoming an accepted dysfunctional way of doing business.

Previous research has shown that 5-S is an important instrument for organizing workplaces to enhance the quality environment [36]. Thus, the literature review suggests following points to overcome with the problem:

1. 5S practice is to be taken in order to eliminate mistakes and smooth the manufacturing process flow to simplify the workplace and reduce waste and non-value-added operations.
2. To make continuous improvement 5S practices are the best way to find problem and improves the existing system.
3. The top management is made aware for adaptation of 5S, and its performance effectiveness has been shown.
4. Standardization of operational process sequences must be made.
5. 5S needs to be implemented in the company to get the clean workplace and to increase the higher productivity, quality, cost control and in time consistent delivery.

3.4. Objectives of the Study

A wide range of techniques are used to improve organizations' product quality, services, and performance. Generally, the companies are looking for the practices which are least expensive, simple and sooner can be implemented to achieve the set goals and targets. The study investigated the impact of 5S practices on performance of Company. Accordingly, the objectives of the research are set as:

1. To implement the 5S technique and to identify its effectiveness in the organization.
2. To measure and compare of the Pre and post study (before and after implementation) performance of the 5S.
3. To develop the framework of Lean-5S implementation and its maintainability system procedure.
4. Identification of various barriers involved in the implementation of 5S techniques.
5. Modelling of the barriers obtained to construct an ISM model which indicates the various relationship existing between the barriers.

3.5 Overview of ISM

ISM methodology is a technique to model complex, non-structured, implicit variables into a more articulated and lucid form which conveys both the effectiveness and the order existing amongst the variables. ISM method inputs various relationships existing between the barriers in the form of a Self-Structured Intersection Matrix (SSIM) and the output is a visible, explicit, easy to understand model.

The different steps engaged in building an ISM are:

- Construction of an SSIM matrix, indicating various relationships between different barriers in the form of symbols.
- An initial reachability matrix is constructed using results of the SSIM matrix, wherein relationships between barriers are indicated in form of binary numbers
- The initial matrix is reconstructed after removing any transitivity relations to obtain a final reachability matrix
- The final reachability matrix is partitioned into various levels
- Finally using the results from the final reachability matrix, an ISM model is constructed which depicts the various relationships between the barriers in a structured form.

IV. RESEARCH METHODOLOGY

The systematic practical and theoretical analysis method has been applied to a field of study. In order to achieve the set objectives of the research work the scientific ways are used for the data collection, analysis and conclusion. The research is quantitative and applied in nature. It aims to enhance the competitiveness of the MSME sector organizations. To meet the set objectives 5S has been applied and its pre and post study is conducted. Before implementation of 5S a very comprehensive study of literature review has been done. In this regard required information have been collected from the various journals, books and magazines.

- **Primary Data:** The research work is applied and experimental in nature therefore, a series of experiments of 5S implementation are carried out to meet the objectives of the research work.

- **Tools and Techniques applied:**

A questioner has been prepared to list out the process wastes. Time study has been done, statistical tools and Microsoft excel sheets are used for interpretation of data.

V. ACTIVITIES DONE UNDER 5-S RULE

Each 5S rule has been implemented and a significant change reflects in figures-B. 5S increases tools storage space, redefined the access. Items location readjusted and preserved the standard practices. Implementation of 5-S improved industrial management together with improvement of the physical environment. In Case study one Tool Crib has been displayed, similarly 5S has been applied in all the machines Tool Cribs of the shop floor. Following 5S activities have been done:

1S (Sorting):

- Items were sorted out on the basis of necessary and unnecessary. (Ref. fig.7)
- Unnecessary items have been sorted out on different tool cribs.
- Pocket has been made for each item in thermo coal sheets as per lay out design. (Ref. fig. 9)
- Item code was engraved in all the necessary items. (Ref. fig. 8)
- Agronomic design has been made as per maximum to minimum usage. (Ref. fig. 2)

2S (Set in order):

- Tool Crib layout has been made for each rack.
- Appropriate size Tool Cribs is selected and placed near each machine.
- Lighter in weight items (Ref. fig. 2 Rack No.1&2) are kept on top and heavier items (Ref. fig. 2 Rack No.7) were kept in down racks.
- Item name with quantity Tags have been fixed in the respective pockets. Similar kinds of items are grouped like measuring instruments (Ref. fig. 4), hand tools (Ref. fig. 6), Cutting tools (Ref. fig. 5), Clamps (Ref. fig.9) etc.

3S (Shine):

Implementation of 5S Framework and Barriers modelling through Interpretive Structure Modelling in a Micro Small Medium Enterprise

- All machines, accessories and racks have been cleaned. (Ref. almost all fig.)
- Shop floor has been washed and Gang ways are made.
- Tool crib has been repaired, cleaned and respective codes were written. (Ref. fig.1)
- Old items have been cleaned and repaired. (Ref. fig. 10)

4S (Standardize):

- Considering the obligatory rules of the company Process activity rules have been made.
- Followed store procedure to issue and do the codification of the items. (Ref. fig. 3)
- Items were grouped and code is written with paint on the outside of the racks. (Ref. fig.1)
- Replacement Procedure was made for frequent wearable and damageable items.
- Established the standard operating procedure (SOP).

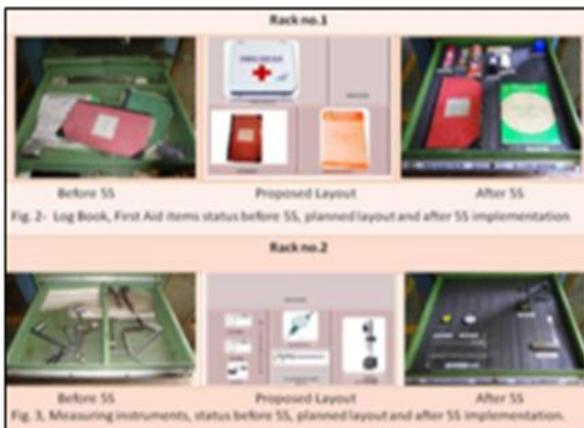
5S (sustain):

- 5S Team is made and trained to maintain the 5S activities.
- Each rack Photograph of arranged items has been taken for future reference.
- To maintain the tool cribs on daily basis a Tool Verification Report has been developed.
- 5S operating system has been made and audit scheduled is made.
- All the members present in the organization can give their opinion /innovative ideas to make it better.



Fig.1:Layout Design of Tool Crib as per 5S

Fig 2-9: Photograph of Tool Crib and layout as planned after categorization of tools



VI. CASE STUDY

The research was carried out in a Tool and Die manufacturing Company. The Company manufactures different kind of Tools and dies, precision machining components for Micro Small Medium Enterprises. Before the 5S implementation shop floor condition was in very bad shape tools, instruments devices were mixed and lying haphazardly in any Tool Crib. In above situation 5S was the suitable tool to implement in machine shop. Tool Cribs layout design has been made according to requirement of the items for each machine. The items were kept in systematic way in Tool Cribs. The 5S operating procedure has been made. Before and after 5S implementation Pictures are shown in figures 2-9.

**VII.MONITORING AND CONTROL SYSTEM
FRAMEWORK FOR 5S**

There will be four stages of monitoring and control system framework:

Stage - I: The item kept in the workplace, its inventories and cabinet layout design have to be monitored on day to day basis by the authorized lean-5s committee

member/Inspector/concern employee. The verification report made on a standard format shown in table 1:

**TOOL VERIFICATION REPORT
(Schedule: Fortnight - I/II)**

Month:
Tool Crib No.

Section:
Machine:

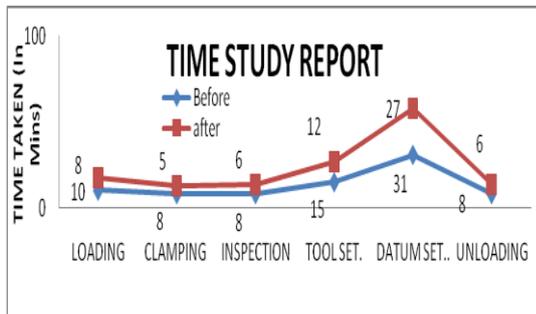
Table 1- Tool verification report

R A C K N O	ITEM NAME	Q T Y	WEEK1							WEEK2							Remark (Missing/ Breakage)			
			Date																	
1	First aid box	1																		
	Log book	1																		
	Drawings	1																		
2	Lever type dial	2																		
	Plunger type dial	2																		
	Edge finder	2																		
	Vernier (0-300)	1																		
	Vernier (0-150)	1																		
	Dial stand	1																		
	Try square	1																		
3	Side & face cutter	1																		
	Convex cutter	1																		
	Double angle cut.	1																		
	Single angle cut.	1																		
	Slitting saw	1																		
	Slot drill	1																		
	End mill	2																		
	Carbide cutters	4																		
	Edge finder	1																		
4	Soft hammer	1																		
	Steel hammer	1																		
	Allen keys	4																		
	Spanner-open end	8																		
	C-spanner	3																		
	Chuck key	3																		
5	Screw driver	1																		
	Star Allen key	2																		
	Ring spanner	1																		
5	Handle	1																		

3	Measuring	8	6
4	Tool setting	15	12
5	Datum setting	31	27
6	Unloading	8	6
Total Time taken in per Job machining (in Min.)		80	64

Table 4- Time study observation sheet summary

Time Study data Graphical Analysis (Graph 1):



(Before and After 5S Activity Vs Time taken)

Data Analysis and Costing Report (after Implementation of the 5S)

S. N .	Activity details and data interpretation	Results
1	Time saved per job after 5S: 80 Min. - 64 Min.	16 Min.
2	Jobs are made in 2 shift basis-16 Hrs.(before Lean-5S): 960/80	12 Nos.
3	Jobs are made in 2 shift basis-16 Hrs. (After Lean-5S) : 960/64	15 Nos.
4	Increase in production:	25 %
5	Total Time saved in 2 Shifts: 15 Pc. x 16 Min. (15X16)	240 Min.
6	Yearly working days (365 days - (52 Sundays + 17 Holidays))	296 days
7	Yearly Time saving (in Min.): 296 days x 240 Min/day	71040 Min.
8	Yearly Time saving (in Hrs.): 71040/60	1184 Hrs.
9	Considered Machining Hour rate of Milling machine	Rs. 200/-
10	Yearly saving after Lean-5S Implementation Rs.200 x 1184 Hrs	Rs. 2,36,800/-
11	Yearly saving from all 10 Nos. m/cs. of the Section Rs.236800x10	Rs.23,68,00 0/-

Table 5: Data Analysis and Costing Report (after Implementation of the 5S)

IX. CONSTRUCTION OF ISM

9.1 Structural Self Intersection Matrix

After identifying and enlisting the various barriers an SSIM matrix is constructed. For this purpose, a panel consisting of academicians and industrial experts was formed and their opinions regarding the various interrelationship existing between the barriers was listed in the form of a SSIM sheet. The symbols indicated represent:

- V entry at (p,q) indicates that p influences q.
- A entry at (p,q) indicates that p is influenced by q.
- X entry at (p,q) indicates that p and q mutually influence each other.
- O entry at (p,q) indicates that no relation exist amongst p and q.

Barriers		9	8	7	6
		5	4	3	2
1	Lack of commitment from top management.	A	V	V	A
2	Lack of clarity of purpose of 5S	V	X	A	A
3	Firm culture	V	O	V	
4	Low availability of resources	V	O	A	O
5	Poor cooperation among departments	V	O	V	V
6	High financial investment	O	X	V	
7	Lack of training	V	V		
8	Lack of incentives and rewards	V			
9	Low awareness towards its benefits				

Table 6 indicates the SSIM matrix obtained.

9.2 Development of Initial and Final Reachability Matrix

The transformation to initial reachability matrix is done by converting the SSIM matrix into binary digits (1s and 0s) wherein 1 at (p,q) position indicates that p leads to q and 0 indicates p does not lead to q. Using the above stated rule, the initial reachability matrix is obtained as shown in table 7.

The matrix obtained is further checked for any transitivity existing whatsoever. After removing the transitivity, final reachability matrix is obtained as depicted in table 8. Here 1* denotes the reformed elements of matrix after removing the transitivity.

Barriers	1	2	3	4	5	6	7	8	9
1	1	0	0	1	1	0	1	1	0
2	1	1	1	0	1	0	0	0	0
3	1	0	1	0	1	0	0	0	1
4	1	0	0	1	0	1	1	1	0
5	0	0	0	0	1	0	0	0	1
6	1	0	0	0	0	1	1	1	0
7	0	1	1	0	1	0	1	1	1
8	0	0	0	0	0	1	0	1	1
9	1	1	0	0	0	0	0	0	1

Table 7 Initial Reachability Matrix

Barriers	1	2	3	4	5	6	7	8	9
1	1	1*	1*	1	1	1*	1	1	1*
2	1	1	1	1*	1	0	1*	1*	1*
3	1	1*	1	1*	1	0	1*	1*	1
4	1	1*	0	1	1*	1	1	1	1*
5	1*	1*	0	0	1	0	0	0	1
6	1	1*	1*	1*	1*	1	1	1	1*
7	1*	1	1	0	1	1*	1	1	1
8	1*	1*	0	0	0	1	1*	1	1
9	1	1	1*	1*	1*	0	1*	1*	1

Table 8 Final Reachability Matrix

9.3 Level Partitioning of Final Reachability Matrix

After obtaining the final reachability matrix, the next objective is partitioning of levels. Each level in the final ISM model would depict wherein the different barriers lie hierarchy wise in terms of their potency. For this the reachability set and antecedent set are determined for each barrier. After several iterative processes, the different barriers are grouped into 3 levels as shown in table 9.

Barriers	Reachability Set	Antecedent Set	Intersection Set	Level
5	1,2,5,9	1,2,3,4,5,6,7,9	1,2,5,9	1
1	1,2,5,9	1,2,3,4,5,6,7,9	1,2,5,9	1
2	1,2,5,9	1,2,3,4,5,6,7,9	1,2,5,9	1
9	1,2,5,9	1,2,3,4,5,6,7,9	1,2,5,9	1
8	6,7,8	3,4,6,7,8	6,7,8	2
6	6,7,8	3,4,6,7,8	6,7,8	2
7	6,7,8	3,4,6,7,8	6,7,8	2
3	3,4	3,4	3,4	3
4	3,4	3,4	3,4	3

Table 9 Level Partitioning

9.4 Construction of ISM model

Using inputs from final reachability matrix and level partitioning matrix, the next step is to construct a visual representation of the whole structure. Each barrier is indicated in the form of a block and arrows are implying directions. The ISM is divided into levels which were earlier obtained from level partitioning. As evident from the ISM, Top management commitment and Low awareness turn out to be the key barriers in 5S implementation. These barriers would further guide other key barriers such as high financial investment, lack of incentives etc. Firm Culture and Low availability of resources are the least important barriers for our consideration because they do not lead to other barriers. The final ISM is shown in fig 10.

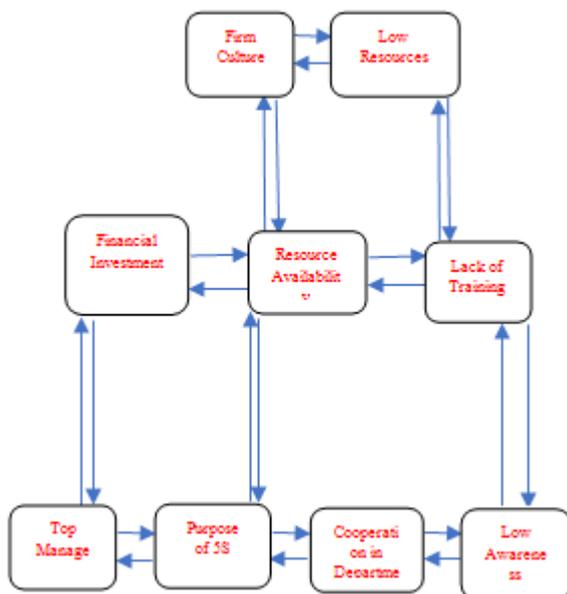


Fig 10: ISM Model for barriers

X. RESULTS AND DISCUSSIONS

Following are the outcomes of the research:

1. Result shows the saving of Rs. 2, 36, 800/- from one machine (Table 4 at point no.10) by implementing the Lean-5S. This is very positive result the step of workplace management.
2. The 5S is applied in all the 10 machines of the section and yielded savings of Rs.23, 68, 000/- (Table 4 at point no.11). The above result of shows a major contribution annually. The 5S has done miracles in terms of saving without doing any production work. Thus it can be implemented and maintained holistically by the company.
3. Increased daily production of 15 Pc. in place of 12 Pc. (Table 3 at point no. 4) Thus, Productivity is increased 25 percent annually (Ref. Table 4 at point No.4).
4. The entire shop floor became more apparent, leading to a highly efficient workflow.
5. Workers are more satisfied with the environment as well their performance.
6. 5S boosted employees morale as junk items and materials which were creating hazards are identified and removed.
7. The end product quality improved full attention is paid during production.
8. Top Management Commitment and Low awareness are the most influential barriers for 5S implementation.
9. Firm Culture and Low availability of resources emerged as the least vital barriers.

XI. CONCLUSION

The research work has provided a basis for 5S implementation in MSME organizations. This 5S framework is helpful to the company in improving its work practices. The 5S framework has helped to develop a Total Improvement Program, employee involvement and continuous improvement. It also states that results of 5S can be driven through 4M “Man, Method, Material and Machinery”. The framework also helped to identify the key areas needs to be improved by through 5S [i]. Housekeeping and workplace organization are directly linked to achieve discipline in manufacturing. World Class Manufacturing cannot be achieved without the discipline and culture of 5S in workplace [4]. The 5S minimized the time-consuming acts of identifying and gathering tools and materials required for processing the work and increase the profitability. Moreover, the barrier identification and modelling using ISM provides a roadmap as to how the various barriers are interlinked and how they are influencing the implementation of 5S practices in a MSME. The result of ISM is totally generic and can be used by any manufacturing firm with slightest modifications. Following are the outcomes: 5S practices have been studied and followed by the world’s most reputed tool and die manufacturing companies. 5S synchronized the workplace activities and minimized the wastage time. 5S helped in developing the value chain system of manufacturing in the company.

The process-efficiency has been improved by developing an unmatched process that has the capability of manufacturing. 5S improved the process and lead time and this leads to an improvement in product quality, cost and delivery. The Competitiveness of the company has been increased and it started offering integrated solutions to the clients in his entire core and allied business activities.

XII. FUTURE SCOPE AND LIMITATIONS OF THE STUDY

The implemented 5S system of the company can be modified and altered, in future, if any idea or suggestion found beneficial for the organization. In the event of a change in the existing system, any employee or the respective section in charge will request to the Lean Coordinator and Coordinator will do the feasibility study of the new idea. It may be implemented if an idea is found suitable. Material Indent can be raised for the purchase of new items after getting the approval from the competent authority. The 5S implementation results increased the efficiency, safety, quality and reduced the industry pollution.

The case study presented in this paper is useful to the researchers, professionals concerned with this subject to understand the implementation procedure and significance of 5S.

Further MICMAC analysis for the various barriers identified can be conducted so as to categorize each barrier based upon its driving and dependence power.

This study was concerned with the implementation of the 5s technology within an organization to eliminate the workplace related problems. The study is inclusively intended to help MSME organizations to enhance their profitability by using the 5S methodology. This study may not be completely applicable to any other nature of company.

REFERENCES

1. Abdulmalek, F. A., Rajgopal, J., & Needy, K. L. (2006) A classification scheme for the process industry to guide the implementation of lean. *Engineering Management Journal*, 18, 15–25.
2. Gapp R, Fisher R, Kobayashi K. (2008) Implementing 5S within a Japanese context: an integrated management system. *Management Decision* : 46: 565-579.
3. Osada, T. *The 5S's: Five Keys to a Total Quality Environment*, Asian Productivity Organization, Tokyo, 1991.
4. Karkut, D.S., Cackicier, N., Erdinler, E.S., Ulay, G. and Dogan, A.M. (2009), 5s activities and its application at a sample company *African Journal of Biotechnology*, Vol.8 (8), pp 1720-1728.
5. Singh, Akhilesh N., *Quality World Magazine* – vol.7, iss. 09, Sept-2010, pg.4.
6. Van Patten, J 2006, ' A second look at 5S, *Quality progress*, vol. 39, no. 10, pp. 55-59.
7. Ho, S. K. M. The 5-S auditing. *Managerial Auditing Journal*, 14 (6) (1999) 294-302.
8. Ho, S.K. and Cicmil, S. (1996), Japanese 5-S practice, *The TQM Magazine*, Vol. 8(1), pp. 45-53.
9. Pranckevicius, D., Diaz, D.M. and Gitlow, H. (2008), "A lean six sigma case study: an application of the 5s techniques", *Journal of Advances in Management. Research*, Vol. 5, No. 1, pp. 63-79.
10. Sui-PPheng, L., & Danielle Khoo, S. (2001). Team performance management: enhancement through Japanese 5-S principles. *Team Performance Management: An International Journal*, 7(7/8), pp.105-111.
11. Khanna V.K., (2009), 5S and TQM status in Indian organizations, *The TQM Journal*, Vol. 21 Iss: 5, pp. 486 – 501.
12. Patra, N.K. and Tripathy, J.K. (2005), Implementing the office total productive maintenance (office TPM) program: a library case study, *Library Review*, Vol. 54 Iss: 7, pp. 415 – 424.
13. Jiju Antony and Kumar Maneesh, The impact of 5s on organizational culture: A case study, lean six sigma: Research and Practice, pg.75.
14. Brown GD, O'Rourke D, Lean Manufacturing comes to China: A case study of its impact on Workplace Health and Safety, *International Journal of Occupational and Environmental Health*, 13 (3) (2007) 249-257.
15. Hemmant, R, 2007, The 5-Ss to keeping lean on course, circuits Assembly, Aug-2007.
16. Hirano, H. *Five Pillars of the Visual Workplace: The Source book for 5S Implementation*, Productivity Press, Portland, Oregon, 1995.
17. Yusof, S. R. M., & Aspinwall, E. (2001). Case studies on the implementation of TQM in the UK automotive SMEs. *International Journal of Quality & Reliability Management*, 18(7), 722-744.
18. Imai, M. *Gemba Kiazen: A common Sense, Low cost Approach to Management*, McGraw-Hill, London, 1997.
19. Bryar, P., & Walsh, M 2002, Facilitating change – Implementing 5S: an Australian case study, *Managerial Auditing Journal*, vol.17, no. 6, PP. 329-332.
20. Withanachchi, N., Handa, Y., karandagoda, KKW., Pathiroge, PP., Termakoon, NCK., Pullaperuma, DSP 2007, TQM emphasizing 5-s principles: *International Journal of public Sector management* vol. 20, no. 3, pp – 168-177.
21. Ananthanarayanan, K. R. M. (2006, December). Application of 5S management system in NDE laboratory. In National seminar on non-destructive evaluation.
22. I.P.S. Ahuja, J.S. Khamba, (2008) An evaluation of TPM initiatives in Indian industry for enhanced manufacturing performance, *International Journal of Quality & Reliability Management*, Vol. 25 Iss: 2, pp.147 – 172.
23. Pojasek 1999, O'hEocha 2000, Warwood & Knowles 2004, Van Pattern 2006, Kumar et al. 2007, Withanachchi et al. 2007.
24. O'hEocha 2000, Ho et al. 1995, Kumar 2007, Withanachchi et al. 2007, Gapp et al. 2008.
25. Jiju Antony and Kumar Maneesh, *Lean Six Sigma: Research and practices*, Chapter 5.1, Impact of 5s on organizational culture: a case study Pg.74.
26. Sinha, Rockenjit, Case Study - 5S in Maintenance: An example from industry, Vedanta Company Ltd., *Quality World magazine*, vol. 08, issue-02, February 2011, page 28.
27. Hubbard, R1994, Case study on the 5S programme: the five pillar of the visual workplace, *Hospital Material Management Quarterly*, May 1999, vol. 20, no. 4, pg. 24.
28. Rod Gapp, Ron Fisher, Kaoru Kobayashi, (2008) Implementing 5S within a Japanese context: an integrated management system, *Management Decision*, Vol. 46 issue: 4, pp.565 – 579.
29. Alberto Bayo-Moriones, Alejandro Bello-Pintado, Javier Merino-Diaz de Cerio, (2010) 5S use in manufacturing plants: contextual factors and impact on operating performance, *International Journal of Quality & Reliability Management*, Vol. 27 Iss: 2, pp.217 – 230.
30. Khamis, N., Abraham, M. N., Jamaludin, K. R., Ismail, A. R., Ghani, J. A., & Zulkifli, R. (2009). Development of 5S practice checklist for manufacturing industry. In *Proceedings of the World Congress on Engineering*, Vol. 1, No. 3, pp. 1-5.
31. Jose H. Ablanado-Rosas, Bahram Alidaee, Juan Carlos Moreno and Javier Urbina "Quality improvement supported by the 5S, an empirical case study of Mexican organizations", *International Journal of Production Research*, 2010, Vol. 48 (23), PP.7063–7087.
32. Rojrasra, P. M., & Qureshi, M. N. (2013). Performance improvement through 5S in small scale industry: a case study. *International Journal of Modern Engineering Research*, 3(3), pp1654-1660.
33. Khedkar, S.B., Thakre, R. D., Mahantare, Y. V., Gondne, Ravi. Study of Implementing 5S Techniques in Plastic Moulding, *International Journal of Modern Engineering Research*, 2012, Vol.2 (5), pp. 3653-3656.
34. Gupta, S. and Jain, S.K., The 5S and kaizen concept for overall improvement of the organization: a case study, *International Journal of Lean Enterprise Research*, Vol. 1, No.1(2014).
35. Liker, Jeffrey., *The Toyota Way: 14 Management Principles*, Tata McGraw-Hill Edition, 2004, pg.150.
36. Ho, S.K.M. 5-S practice: a new tool for industrial management, *Industrial Management and Data systems*, Vol.98, No.2, pp.55-62, 1998.

Implementation of 5S Framework and Barriers modelling through Interpretive Structure Modelling in a Micro Small Medium Enterprise

37. Monden, Yasuhiro. The Toyota Management System: Guidelines for Practicing 5S-Hiroyuki Hirano (1998) and Tamoo Suggiyama(1985). Engineering and Management Press, USA, 1998. pp.205-213.
38. Monden, Yasuhiro. The Toyota Management System: Guidelines for Practicing 5S-Hiroyuki Hirano (1998) and Tamoo Suggiyama (1985). Engineering and Management Press, USA, 1998. pp. 202-204.
39. Nimnath, W., Wimal, K. and Yujiro, H. A performance improvement programme at a public hospital in Sri Lanka: an introduction, Journal of Health Organization and Management, 2004, Vol.18, No.5, pp.361-369.
40. Kwang, K.L., Pervaiz, K.A. and Mohamed, Z., Techniques – Managing waste and looking beyond: the IMI approach, The TQM Magazine, 1999, Vol.11, No.5, pp. 304-310.
41. Larry, R. and Madelyn, M. Implementing World Class Manufacturing: A Bridge to Your Manufacturing Survival, WCM Associates, Fort Wayne, Indiana, 1999.
42. J. Michalska, D. Szewieczek, The 5S methodology as a tool for improving the organization, Journal of Achievements in Materials and Manufacturing Engineering, October -2007, Vol. 24(2), pp.211-214.

AUTHORS PROFILE



Ram Babu Verma is PhD Scholar in the department of Production Engineering, Birla Institute of Technology Mesra, Ranchi.



Dr. Sanjay Kumar Jha is Associate Professor & Head of the department of Production Engineering, Birla Institute of Technology Mesra, Ranchi.