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Analysis of 5S Implementation Lapses in PFC Lines: A case study from SEIPL plant

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Abstract

The 5S methodology consists of the 5 S's – Sort(Seiri), Set-in-order(Seiton), Shine(Seiso), Standardize(Seiketsu) and Sustain(Shisuke). This 5S methodology is widely adopted in lean manufacturing to enhance workplace organization, efficiency, and safety. But the complete impact of 5S is not achieved because of the lapses in implementing 5S. In this paper, a detailed study of the PFC (Power Factor Correction) lines of the Schneider Electric plant has been conducted to determine and examine the phases where 5S practice were not successfully implemented. By the systematic observation, root cause analysis, and operator comments, critical lapses were classified and resolved with action-oriented recommendations. This research enhances the maintenance of 5S standards via a duplicable framework to conduct periodic audits and ongoing improvements.

Keywords: PFC, 5S, Lean

1. Introduction

5S is a fundamental building block of lean manufacturing and total productive maintenance (TPM), with the purpose of increasing efficiency by getting the workplace in order and having visual order. Schneider Electric, which is the world leader in energy management and automation, has put 5S into place across its manufacturing lines, such as Power Factor Correction (PFC) units. Institutionalization efforts notwithstanding, maintaining 5S on a continuous basis continues to be challenging.

But while I was working on the PFC lines of the SEIPL plant, I noticed that there were lapses occurring in the PFC lines in the implementation of 5S. There are 4 main lines in the Power Factor Correction sector.

- Support Assembly
- Cell assembly 1
- Cell assembly 2
- Final Assembly

Final assembly in turn consists of 3 separate lines – Infinity, Koti and Box.
Since these three lines are very small, for my research I have considered all three lines as one line (Final Assembly)

2. Objectives

- To conduct a detailed 5S audit of PFC production lines.
- To identify and classify 5S lapses across different areas of the line.
- To understand the root causes of recurring issues
- To suggest practical recommendations for improving 5S adherence.

3. Methodology

3.1 Area of study

The study was conducted at the Schneider Electric plants PFC assembly and test lines where capacitors and power correction systems are produced.

3.2 Data collection

- Direct Observation: Considerable amounts of time were spent on each line to analyse the 5S lapses occurring. Operator behaviors were studied and taken into account.
- Photographic Evidence: Photos and videos of how operators worked and the exact time and processes where the lapses occurred were noted down.
- 5S audit checklist: Brief standard interviews with operators, supervisors, and maintenance personnel.

3.3 Tools used

- 5 whys
- Fishbone diagram
- Pareto chart Analysis

4. Findings

Lapses were found in all 5S categories and the analysis was done line wise.

1.Support Assembly

1)Sort

a) Parts that are not needed are kept on the racks in the first station(Lid assembly).

parts not needed in the first station:-

Terminal plates(1,2,35mm)

Terminal bases

Brass rivets

b)Unecessary parts kept in sleev assembly - 13 unused parts
Wanted parts are as follows :-

PL3029 PL3030 PL3031	116 Reference	PL3029 PL3034 PL3035	136 Reference

2)Set-in-order

a)Terminal base and terminal plates are kept far away resulting in unecessary movements in lid riveting station.

b)The same problem is again presented in the lid riveting clampite station.

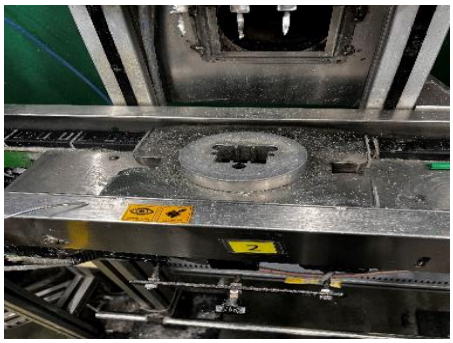
c)No proper place for storing bins. They are kept on the belt leading to unsafe and hazardous conditions

d) The parts that are being use in the sleev assembly must be kept in order to reduce time in finding the parts.

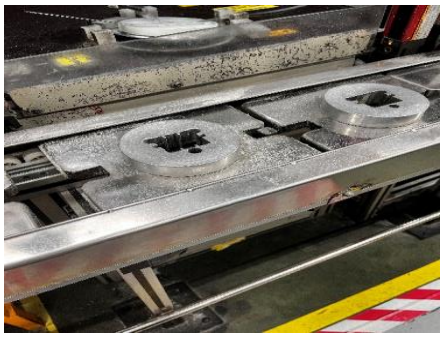
3)Shine

a) Disconnector bridge assembly station isn't kept clean.

b) Soldering stations are filled with solder wire residue



c)HV testing station is very dusty and is not kept clean.



2.Cell Assembly 1 and 2

1)Sort

a) Racks with unnecessary bins were found on the line(cell assembly 2). Theses bins must be sorted in terms of need and usage.

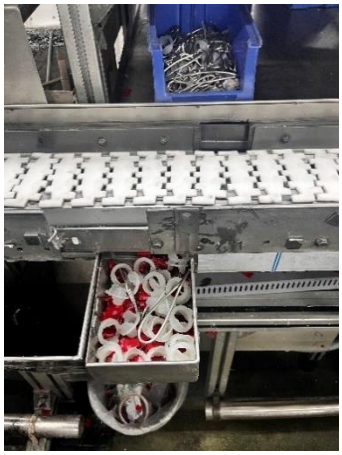
b) Bins with unecessary parts kept in ca assembly station in cell assembly 1. These parts should be removed from the line to optimise space.


2)Set-in-order

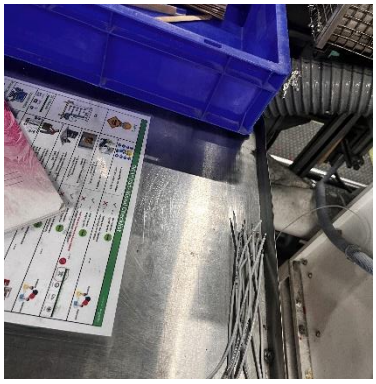
a)Bins are kept on the belt leading to unsafe conditions especially near soldering stations in cell assembly 1 and 2.
Racks should be provided for better storage, ergonomics and better movement through the line.



b)Trays were found with mixed components on the line. This makes it difficult to find the right parts easily.

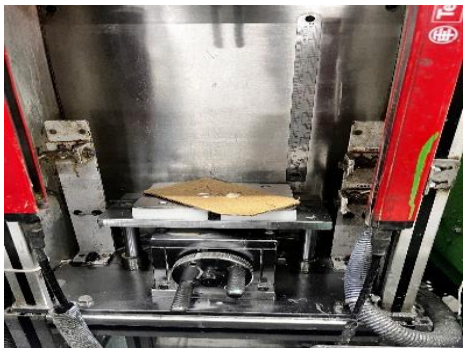

c)Wires kept at random at different places I cell assembly 1 and 2.



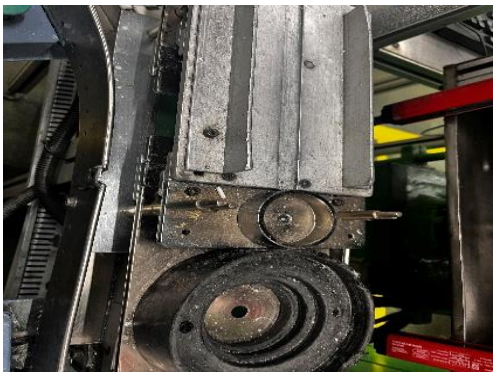
3)Shine

a) Soldering stations are filled with solder wire residue and is not kept clean.

b) Resin residue is found in the holding machines and should be kept clean.



c)Fixtures should be kept clean and stations must be cleaned regularly.



3. Final Assembly

1)Sort

a) Many bins are kept in the final assembly infinity line. Parts that are needed should be identified and the rest must be removed

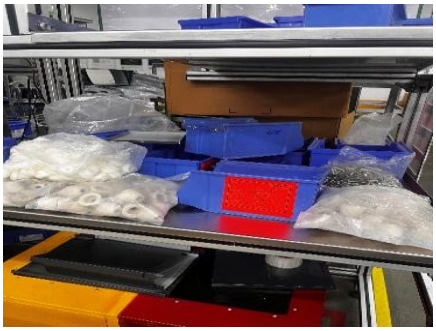
b)Many unwanted bins are stacked on the racks causing clutter.

2)Set-in-order

a) After sorting bins in the infinity lines, it should be set in order for better movement and ergonomics.

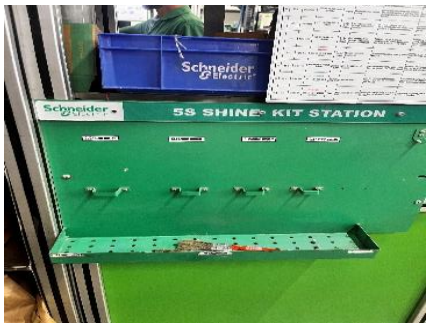



b) Components are not set in order in the final assembly box line.



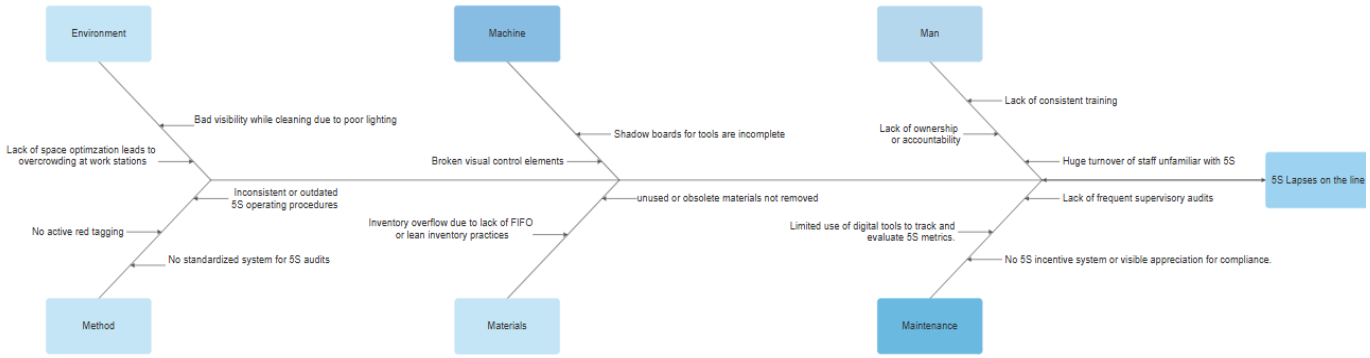

3)Shine

a) 5S shine kit is missing from the final assembly box line.



5. Root Cause Analysis

Root cause analysis was performed to find the root causes of 5S lapses.



6. Pareto Chart Analysis

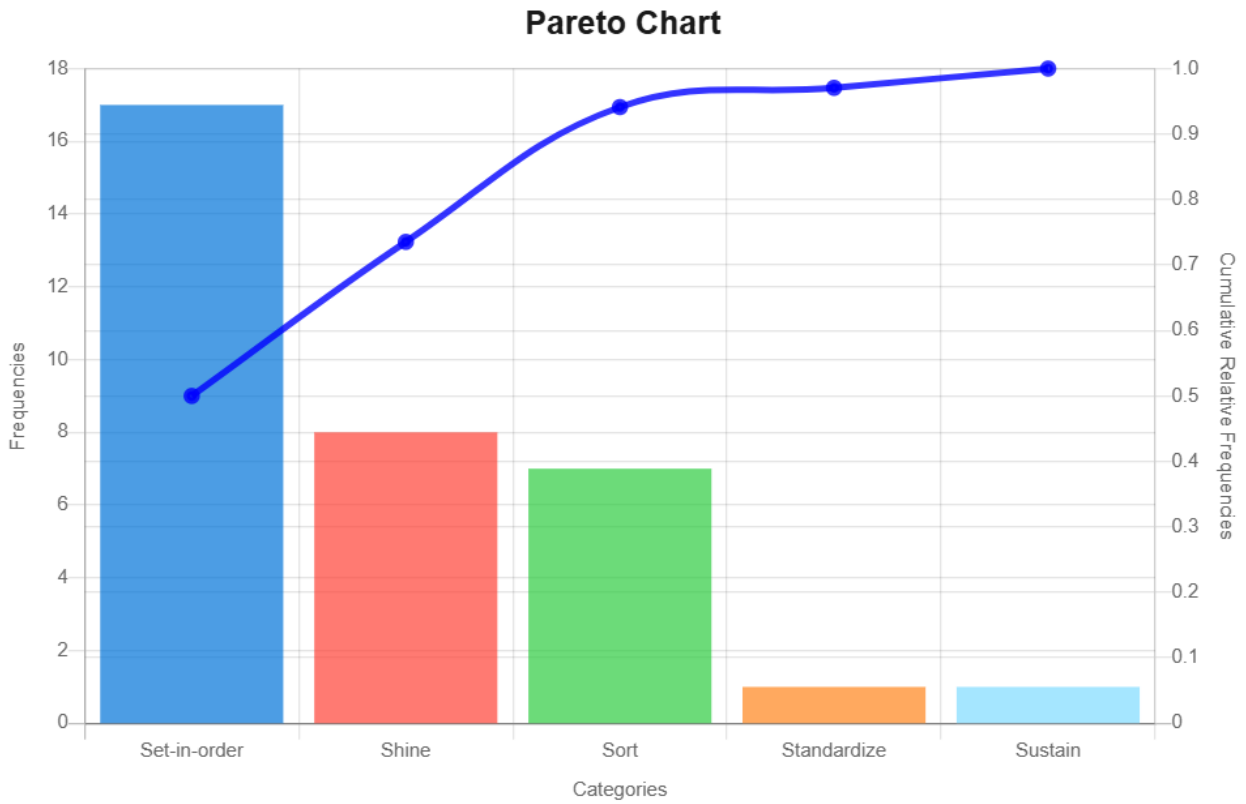
The following categories and associated frequencies are provided:

Categories	Frequencies
Sort	7
Set-in-order	17
Shine	8
Standardize	1
Sustain	1

Now, the following table shows the categories in descending order (with respect to the frequencies), along with the cumulative relative frequencies

Categories	Frequencies	Cumulative Relative Frequencies (%)
Set-in-order	17	50
Shine	8	73.53
Sort	7	94.12
Standardize	1	97.06
Sustain	1	100
Total =	34	

Therefore, the following Pareto Chart is obtained based on the table above:



7. 5 Whys Analysis

In order to supplement the fishbone (root cause) analysis and to further identify the origins of the principal 5S failures on the PFC lines, the Five Whys method was used on the most frequent problems.

Problem 1: Tools not returned to designated locations

Why 1: Why are tools not returned to their assigned locations?
Because operators leave them wherever it's convenient during peak times.

Why 2: Why do operators put tools in random places?
Because the shadow boards are out-of-date or not well maintained.

Why 3: Why are the shadow boards out-of-date or not well maintained?
Because they were not revised when tool sets shifted or grew.

Why 4: Why weren't the shadow boards revised with new tools?
Because there is no clear responsibility or SOP for revising visual controls.

Why 5: Why is there no clear responsibility?
Due to the lack of clear 5S ownership within the team.

- Root Cause: Lack of process and ownership of maintaining visual management tools like shadow boards.

Problem 2: Excess material in the way
Why 1: Why is excess material in the workspace?
Since operators do not take away unused tools or components.

Why 2: Why don't they take them away?
Due to the fact that the red-tagging procedure is not being implemented.

Why 3: Why isn't the red-tagging system adhered to?
Because operators do not know or do not regard it as mandatory.

Why 4: Why do operators not know or do not care about the red-tagging process?
Because there hasn't been regular training or monitoring.

Why 5: Why has not training or monitoring been done?
Because there is no repeated 5S reinforcement or interval audit follow-up.

- Root Cause: Inadequate constant training and implementation of red-tagging procedures under the 5S Sort pillar.

Problem 3: Cleaning activities are omitted in critical areas
Why 1: Why are cleaning activities omitted in testing and inspection areas?
Because operators think someone else will do them.

Why 2: Why do they think it's someone else's task?
Because cleaning responsibilities are not clearly assigned or announced.

Why 3: Why are responsibilities not explicitly assigned?
Because there is no standard cleaning checklist or duty schedule.

Why 4: Why is there no standard checklist?
Because team leads have not enforced or practiced the habit.

Why 5: Why haven't team leads enforced cleaning standards?
Because there is no accountability system or follow-up on 5S adherence.

- Root Cause: Absence of organized cleaning habits and accountability under the Shine and Sustain pillars.

Problem 4: SOPs and visual controls are out of date or unavailable
Why 1: Why are SOPs and visual supports out of date or unavailable in workstations?
Because it is not made a practice to update regularly as changes happen.

Why 2: Why isn't updating practiced?

Because there is no mechanism for periodic review of 5S documents.

Why 3: Why isn't a periodic review mechanism available?
Because updating the 5S standards is not included in the production review schedule.

Why 4: Why is it not included in the review cycle?
Because management does not place a priority on 5S documentation updates as part of production metrics.

Why 5: Why is it not being prioritized?
Because 5S is considered a soft program and not a performance measure.

- Root Cause: Misalignment between maintenance of 5S and key operational KPIs, leading to overlooking documentation.

This 5 Whys decomposition is detailed and shows that 5S shortcomings are predominantly caused by a lack of ownership, standardization, and reinforcement, not by individual operator errors. These underlying reasons guided the countermeasures outlined in Section 6.

8. Recommendations

To correct these issues, the following recommendations were made. Although some of these already exist a more thorough version will be implemented.

- 5S training – Quarterly compulsory refreshers for all the line operators.
- Visual Management revamp – Visual charts for Am checklist and part numberings were done to make it easier for the operators to identify parts and equipment.
- Daily 5-minute 5S huddles – This can be integrated with the daily sim meetings.
- Digital checklists – Integrating checklists with the current ERP systems for easier auditing.
- Leadership Involvement – Designated 5S champions to check during every shift and report to supervisors weekly.

9. Results and Impact

Following the initial improvements, the following are the expected outcome:

- Reduction of clutter by >50%.
- Operator-reported inefficiencies dropped by at least 20%.
- Audit scores improved by an average of 30% within a month.
- Increased awareness and participation in maintaining 5S practices.

10. Conclusion

This research emphasizes the need for ongoing monitoring and worker participation in maintaining 5S practices. Though initial rollout is successful, drift over time occurs and must be corrected through routine audits and retraining. The methodology employed herein for the detection and correction of 5S gaps can be extended to other production lines throughout Schneider Electric and comparable

manufacturing settings. Using tools like % whys, pareto charts and root cause analysis can be very helpful in finding out the root causes and correcting them abd prevention of potential mistakes.

11. Future Scope

Through digitization various developments can be made in 5S maintenance, such as:

- Integration with IoT sensors to track cleanliness and tool usage.
- AI-powered S compliance detection using CCTV and image analysis.
- Crossline benchmarking of 5S practice across different Schneider Electric plants.

12. Authors' Biography

Hridya Soumia Krishna graduated from Christ (Deemed to be) University in 2025 with Btech in Mechanical Engineering. With a keen interest in industrial efficiency, lean manufacturing and smart innovations, she now works at Schneider Electric as a GET and has undertaken multiple research and improvement initiatives.

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