

Digital 5S: a case study of an Automotive wiring industry

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Abstract. The 5S methodology is a Lean tool that helps to organize and improve the workplace by eliminating waste and improving efficiency. The five S's stand for Sort, Set in Order, Shine, Standardize, and Sustain. Digitization refers to the use of digital technology to transform manual processes into automated ones, which can help to improve the speed and accuracy of operations. The paper focused on implementing the 5S methodology in an industrial setting using digital tools to improve efficiency and productivity while also fostering a culture of continuous improvement. The results of the study are likely to provide insights into the effectiveness of using the 5S methodology and digitization to achieve Lean goals in an industrial context.

1 Introduction

In a highly competitive environment, companies must make great efforts to improve their efficiency [1]. Lean management is a methodology that focuses on optimizing processes and reducing waste in order to maximize value for customers [2]. 5S is a critical component of Lean transformation [3], as it provides a solid foundation for implementing Lean principles and facilitates a culture of continuous improvement [4]. In addition, combining 5S with digital tool helps to real-time data collection and take action quickly. In this paper, a case study is conducted in a multinational company automotive cable harnesses, where a digital 5S is applied. The idea of digitalizing the 5S tool was born to satisfy a need of the studied company. In fact, a great variability was detected when tracking the results of 5S projects already implemented in the shop floor. In reality, best results are usually achieved just before each 5S audit, which means that the respect of 5S rules and standards is particularly accentuated when a visit or an audit is going to take place. To deal with this problem, ensure permanent compliance with the standards, and reduce this variability, it is important to establish a clear and consistent audit process.

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2 Literature review

While there have been numerous studies exploring Lean assessment and ergonomic risk analysis in the workplace, only a limited number of them have incorporated ergonomic assessment with Lean principles. For example, a 2007 study [5] presented a discussion on how the Kaizen continuous improvement approach was used to improve the ergonomics of standard workstations in a company. It described the elements of the Kaizen system and how it was applied to address ergonomic problems. Lean manufacturing can also have a positive impact on working conditions. In a 2009 study [6], it was demonstrated that lean principles can be used to improve working conditions. However, the introduction of new work organization systems like Lean Manufacturing and Total Quality Management can also impact workplace ergonomics, but only a few studies have examined this aspect [7]. Additionally, the human dimension in the implementation of Lean systems has not been explored much [8], specifically in terms of cognitive capacities and limits. It is worth noting that ergonomics plays a crucial role in improving comfort and productivity, and various success factors have been discussed in the literature [9]. The "6S" method is one of the Lean tools that focuses on work safety, and it is based on the "5S" method.

3 Problem description

When tracking the results of 5S audits conducted in shop floors, a notable variation has been observed in the achieved outcomes. It is interesting to note that the best results are often seen just before scheduled 5S audits (figure 1). This indicates that adherence to 5S rules and standards is significantly emphasized when an audit or visit is scheduled. To tackle this issue, it is crucial to establish a well-defined and consistent audit process that ensures permanent compliance with the standards and reduces the observed variability. Such a process will help to maintain a high level of compliance with 5S standards consistently, thus maximizing the benefits of the methodology.

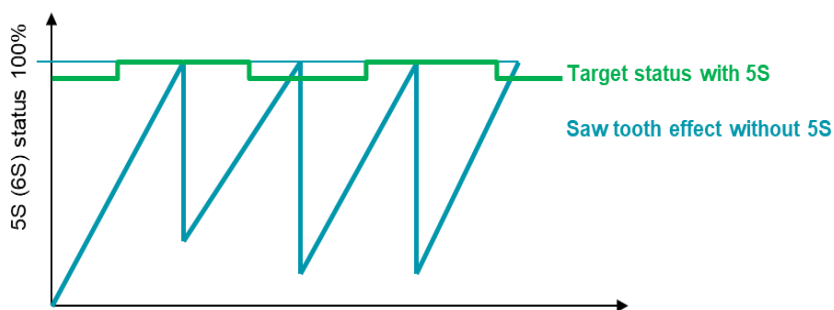


Fig. 1. Results of 5S audits

4 Proposed Solution

4.1 Audit level methodology

A new audit strategy based on 3 levels of auditing has been established and 5S experts are dedicated to all shop floor areas. The « 5S-experts » perform **the regular audits** weekly (planned). Monthly, the « Continuous Improvement Department » perform **an unregular audit** (random schedule) to check the efficiency, the correctness and the visibility of the 5S

results of the regular audits, at the shop floor. The « 5S board » is the area where all the completed audit documentation and action lists are displayed. It is accessible for all, to view and assess the 5S progress. It will be also used by all departments, to check if they are responsible for any 5S improvement actions, on the action list. Unexpected , « Regional Auditor» perform **Intermediate Audit** (involving one responsible from the area) to review corrective actions or to audit the relevant area in between the regular audits (Tab1).

Table 1. Different Audit Level

Audit level	Character	Frequency	Auditor
1	Regular Audit	Weekly in every Shift (planned)	5S Expert Plant Self-audit
2	Unregular Audit	Monthly (random schedule)	CI-department (Results will be tracked and monitored)
3	Intermediate Audit	Unexpected	Regional Auditor

To maintain and uphold the 5S methodology, it is recommended to conduct regular audits. These audits should be carried out weekly and include both self-audits and management audits. The audit document comprises six sheets that must all be completed. An audit schedule will be established, allowing all staff members to be aware of their audit completion deadlines. To complete the audit, individuals will need to respond to the questions outlined in the audit document (figure 2). Before carrying out an audit, training will be provided to all staff members to ensure they understand how to conduct an audit and complete the necessary documentation.

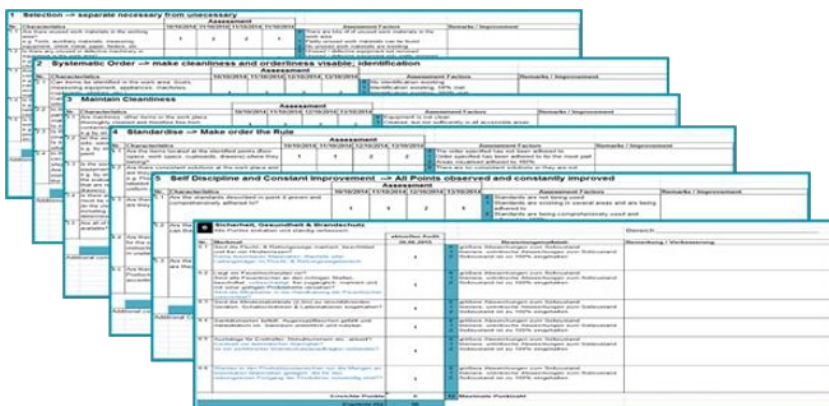


Fig. 2. 5S audits document

4.2 Digital Audit

To reduce the variability of regular audits the results, a dynamic application was created by PowerAPP "digital 5S". The digital 5S tool allows the access to all audit documents and action lists numerically. Digital 5S tool is available to all, to monitor the 5S progress. It will be also used by all departments to check if they are responsible of 5S improvement measures on the action list. Thanks to digital 5S, an organized, clean and stable work environment is assured that promotes efficiency, safety and quality. By organising the workplace, reducing waste and improving the material and information flow, companies can improve productivity, reduce costs and improve quality. The use of digital tools can make 5S implementation a mindset, as well as easier to monitor and maintain, to enhance tracking. On this screen, the evaluator grades the 5S verification, each question is evaluated by selecting the corresponding answer (according to the criteria), showing a final score in the 5S Score box (figure 3).

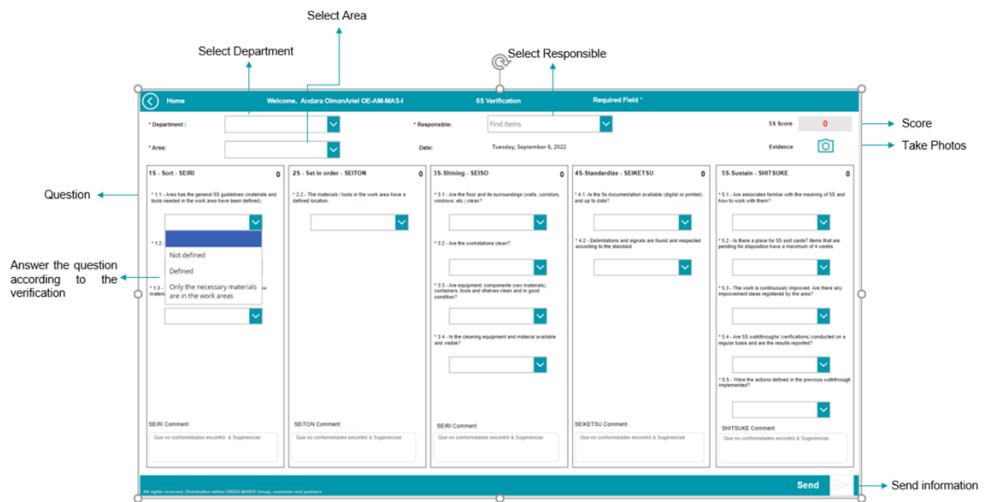


Fig. 3. Dynamic application " 5S Verification"

Within this application, 4 options are available: In this window, evaluations are performed on each area. The evaluator can view and filter outstanding and completed assessments with corrective action status. Also from this application we display the average reached by the zones via a report in PowerBI. And finally a help window for the user. (figure 4).

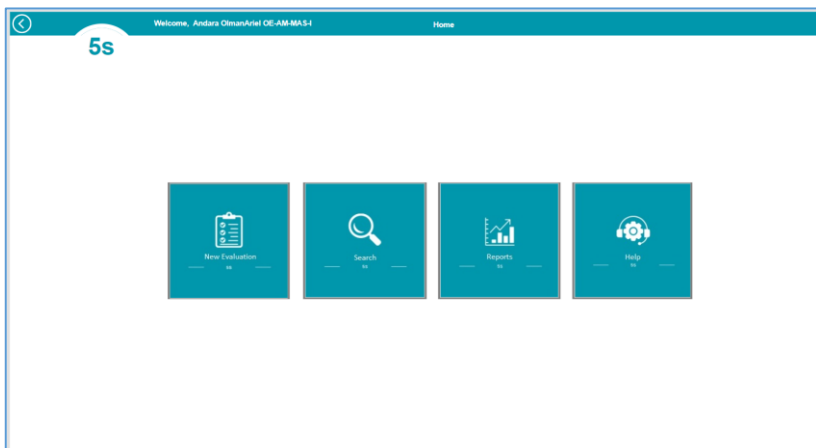


Fig. 4. 5S Digital App

This application has a camera feature integrated into the 5S check screen, which is critical for the effective use of this app (figure 5). The camera allows users to take photos of the work area, which can be used as evidence and stored in the SharePoint database. To conduct a thorough assessment of the work area, it is important to observe the current situation and take "BEFORE" photos using the camera feature. This allows users to document the state of the area before any changes or improvements are made, which can be useful in identifying areas for improvement and evaluating the effectiveness of any changes made.

By taking "BEFORE" photos using the camera feature in the app, users can ensure that they have a clear record of the work area's initial state. These photos can be compared to "AFTER" photos taken after improvements are made to determine the effectiveness of the changes.

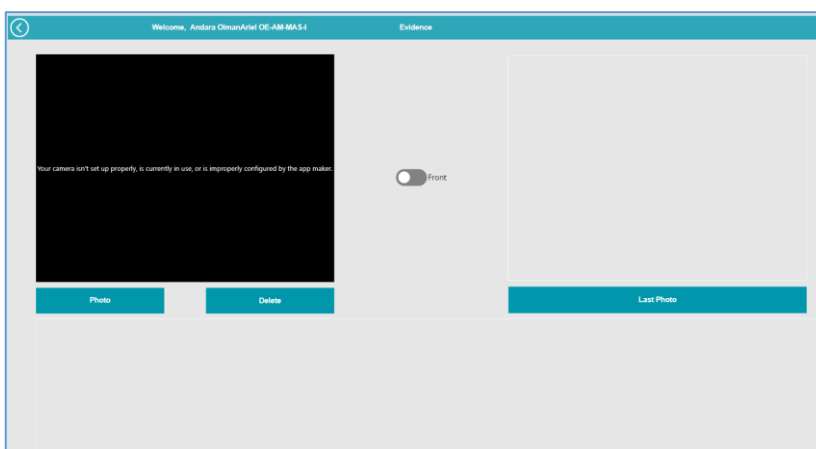


Fig. 5. 5S app "Camera Interface"

The final report screen in this app provides a comprehensive overview of the assessment results for each area, including the score and date of the assessment (Figure 6). The assessment results are displayed as either "acceptable" or "not accepted," indicating whether or not the area meets the required standards.

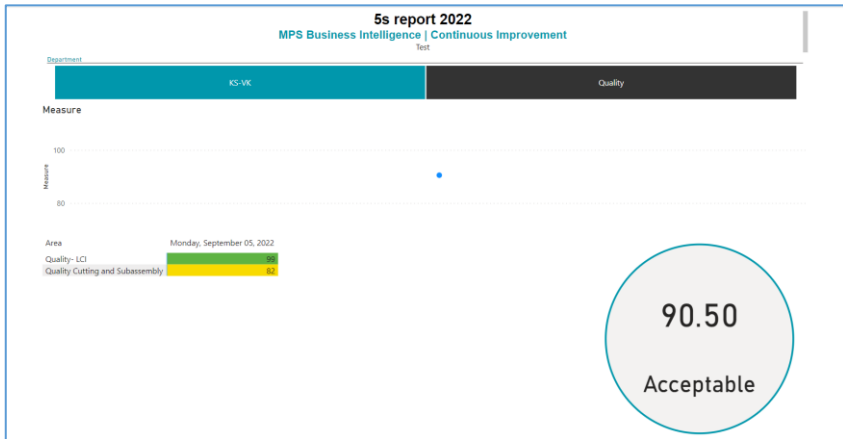


Fig. 6. 5S app “Report Screen”

5 Safety

Incorporating safety measures into the 5S process can be achieved by consistently prioritizing safety at each of the 5S phases (Figure 7). This involves utilizing red tags to identify and remove items that pose a safety hazard, organizing items with safety in mind, and including safety concerns on cleaning checklists. Safety can also be reinforced through visual management signage and regular inspections dedicated to identifying potential safety issues.

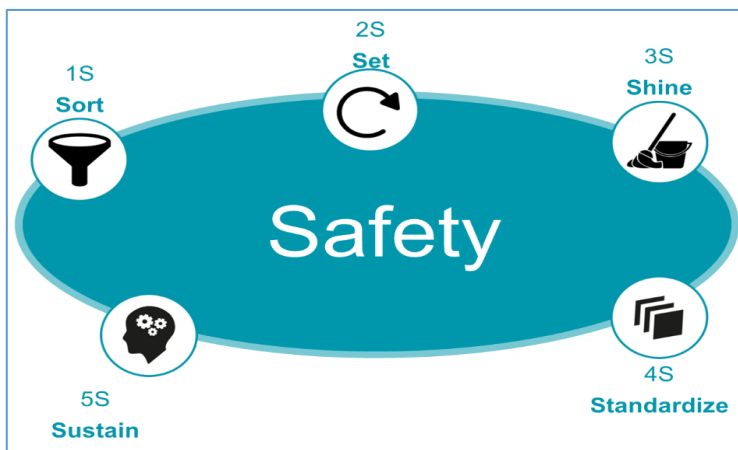


Fig. 7. 5S app “Report Screen”

6 Standardize Work

To embark on a lean transformation journey, it is crucial to start with the first step, which is standardization through the 5S approach (Figure 8). The 5S method is a workplace organization technique that involves five steps: sort, set in order, shine, standardize, and sustain. By following these steps, an organization can systematically organize their workplace to create a clean, safe, and efficient environment. This step involves setting clear and specific procedures and guidelines for how the workplace should be organized and maintained. Standardization helps to eliminate confusion and inefficiencies, ensuring everyone is on the same page and working towards the same goal. which involves continuously monitoring and improving the workplace to ensure it remains clean, safe, and efficient. Overall, standardization based on the 5S approach is the foundation of lean transformation. By implementing the 5S method, an organization can create a workplace that is organized, efficient, and safe, setting the stage for a successful lean transformation journey.

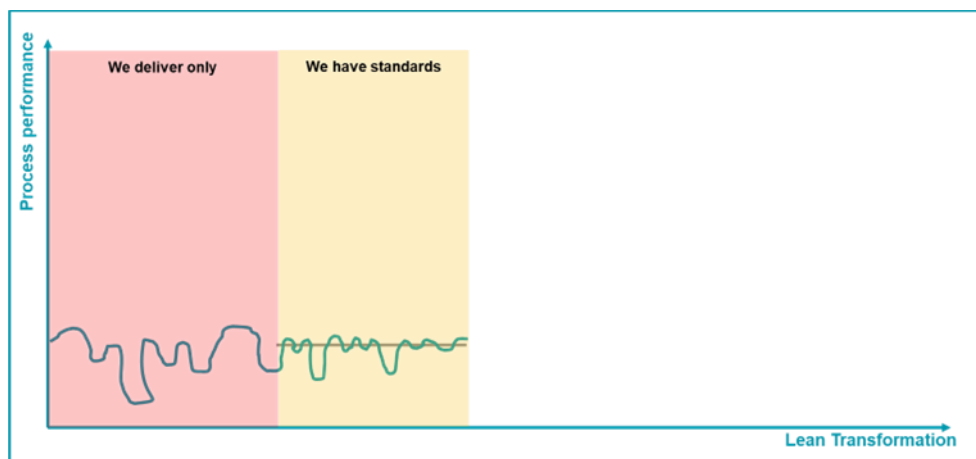


Fig. 8. Lean Transformation

7 Conclusion and perspectives

Our study focused on tackling the issue of inconsistent 5S audit results in the automotive industry. We have identified that integrating Industry 4.0 tools, particularly digitalization, can streamline the monitoring of shopfloor management and ensure that the progress of corrective actions is transparent to all. This will result in efficient organization of the workplace, reduction in waste, and improvement in material and information flow, leading to standardized and value-adding workflows. Additionally, access to all audit documents and action lists will enable departments to check their responsibility for 5S improvement measures. Digital tools can simplify the detection of weaknesses and implementation of improvements, with direct employee inclusion. Moreover, integrating safety measures into 5S is made easier with digitalization. Using Industry 4.0 principles, we can monitor and maintain 5S implementation as a mindset, while enabling informed decision-making by providing up-to-date information. To further eliminate waste and achieve operational excellence, it is essential to standardize work processes and integrate continuous improvement tools. However, we found that the success of Industry 4.0 implementation depends on the level of lean maturity. Therefore, companies must determine the optimal time for Industry 4.0 implementation based on their current level of lean implementation. The question of which Industry 4.0 technologies to prioritize and implement first remains.

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