

5'S diagnosis in the substation department of the western transmission area

Diagnóstico de 5'S en el departamento de subestaciones de la zona de transmisión poniente

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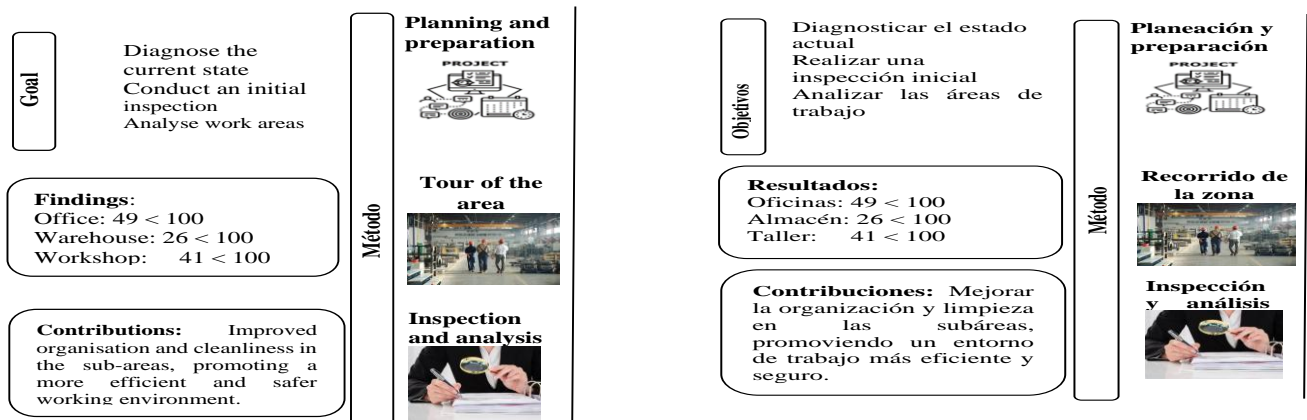
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Abstract

In the Western Transmission Zone, the current state of the 5S methodology was assessed in the substation department, covering offices, workshop and warehouse, due to delays caused by inefficient search for tools and documents. The level of 5S implementation was diagnosed, resulting in low scores: Offices 49/100, Warehouse 26/100 and Workshop 41/100, which showed poor organisation. It is recommended to apply the 5S methodology to improve efficiency and safety by eliminating unnecessary objects, maintaining cleanliness and encouraging this habit to increase productivity and competitiveness without additional costs.

Resumen

En la Zona de Transmisión Poniente, se evaluó el estado actual de la metodología 5S en el departamento de subestaciones, abarcando oficinas, taller y almacén, debido a los retrasos causados por la búsqueda ineficiente de herramientas y documentos. Se diagnosticó el nivel de implementación de las 5S, resultando en puntuaciones bajas: Oficinas 49/100, Almacén 26/100 y Taller 41/100, lo que evidenció una deficiente organización. Se recomienda aplicar la metodología 5S para mejorar la eficiencia y seguridad, eliminando objetos innecesarios, manteniendo la limpieza y fomentando este hábito para aumentar la productividad y competitividad sin costos adicionales.



Implementation, 5S Methodology, Efficiency

Implementación, Metodología 5S, Eficiencia

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Peer review under the responsibility of the Scientific Committee [<https://www.marvid.org/>]- in the contribution to the scientific, technological and innovation Peer Review Process through the training of Human Resources for the continuity in the Critical Analysis of International Research.



Introduction

The 5S methodology refers to five Japanese words (Seiri, Seiton, Seiso, Seiketsu and Shitsuke), first the selection of necessary and not necessary materials, second the order of all necessary elements, third cleanliness in furniture and facilities, fourth standardisation of the first stages and fifth discipline to be taken by the workers as the main problem detected in the industry, In particular, in the substation department of the Western Transmission Zone belonging to the Federal Electricity Commission, the lack of habits of order, cleanliness and the lack of commitment of the workers, conditions that cause low productivity and poor quality in the service provided.

With the diagnosis of the 5S methodology, it was identified where to reduce the response time to failures that require corrective maintenance, in addition to proposing scheduled daily activities through the organisation of tools, equipment, materials and information (folders, manuals, diagrams, plans, etc.), which can be consulted efficiently, reducing search times and the elimination of unnecessary activities that affect the operation process.

In the search for and elimination of unnecessary activities, the 5S methodology was used, which is part of the techniques of the Production Management System or Lean Manufacturing, because the process and results of continuous improvement depend on the leadership of top management and the commitment of all the organisation's staff (Piñero, Vivas, & Flores, 2018). For their part, Fernández E., Avella, and Fernández M. (2020), state that these are five steps that are implemented gradually, in order to create an attitude of respect in the members of the organisation to properly maintain their workplace, according to Aldavert, Vidal, and Lorente (2018), point out that the 5S aim to make agile changes through visual control and standardisation of resources, obtaining benefits such as minimising waste, increasing quality, productivity, efficiency, where the participation of the entire organisation is essential.

Taking into account Lay-De-León et al. (2022), in the application of Lean Manufacturing and its 5S technique, it promotes the interest of workers, bringing with it the increase of productivity and competitiveness. The 5S is focused on achieving order and cleanliness in all areas of the company, creating a discipline that eventually becomes a culture and common practice.

The implementation of the 5's methodology for continuous improvement in work processes has been a topic of interest for Huamán and Rodríguez (2021) in their thesis demonstrating that, the application of the 5's methodology improved overall efficiency from 32.27% to 74.78%, reducing waiting times in the dispatch process, saving a total time of 38.65 hours per person for 60 days.

Vargas and Camero (2021) present the application of kaizen and 5S in a manufacturing company with productivity problems for 4 consecutive years in the production area of aqueous adhesives, while Luna, et. al. (2020) propose an improvement plan based on 5S to increase productivity and reduce workplace accidents, stipulating that, after the application of this methodology, a safer and more efficient working environment is created, with workers committed to producing quality products.

The implementation of 5S, in the work of Arroba (2022), indicates that it had a positive impact, thanks to the order of inputs and tools, there was a favourable increase in productivity of 64% in the production of rolls, in addition to allowing the application of improvements for all staff, preserving their safety and ensuring the quality of their products, therefore the application of 5S leads to the implementation of Lean Manufacturing which is a philosophy of Japanese origin responsible for eliminating activities called 'dumb' that do not add value through the use of tools and methodologies; while Socconini (2019), defines Lean Manufacturing as, "a continuous and systematic process of identifying and eliminating waste or excess".

With the elimination of waste, costs are reduced by optimising processes and increasing productivity, improving the quality of products, from the point of view of [Vinodh \(2022\)](#), the purpose of Lean Manufacturing is to eliminate waste, streamline processes and improve value addition, based on the kaizen philosophy of standardising work processes and sustaining the improvements achieved (p.3), according to ([Muñoz et al. 2022](#)), they point out that, the main objective of the Lean philosophy is to increase the productivity, efficiency, competitiveness and profitability of companies (p.13), citing [Tapia et al. \(2017\)](#), rejects, failures and defects originate from the identification of non-conformities or from customer returns derived from products that do not meet optimal quality conditions and that must be reprocessed or destroyed (p. 172). To this end, overproduction that is not adjusted to demand must be avoided, reducing waiting time for industries implies costs by having downtime in the stages of a process manifested in waiting for material, information, tools, machinery, maintenance, excess production, material supply time, etc., ([Muñoz et al. 2022, p. 26-27](#)).

Similarly the application of Kaizen methodology involves a system of continuous improvement in all aspects, being a tool that contributes to the elimination of waste, according to [Suarez \(2015\)](#), states that Kaizen is a comprehensive philosophy, which seeks to improve daily activities, from work processes to the individual (p.20), seen in another way [Demirbaş, Blackburn, and Bennett \(2020\)](#), argues that some of the key objectives of Kaizen include quality control, just-in-time delivery, standardised work, use of efficient equipment and elimination of waste (p.5 For this purpose, a Gemba Walk should be used, which consists of a walk through all areas of a company, in which Cause-Effect diagrams are made, which is a graphical representation of causes that produce a specific problem, as well as a check sheet, which is a quality tool used for inspection and audits.

The Kaizen methodology from the approach of [Boero \(2020\)](#), describes it as a graphic representation of all the possible causes of a phenomenon, generally presented in the form of the backbone of a fish on a central axis directed to the effect and on the same axis placing the causes, to end with a SWOT matrix is a tool for study and analysis applicable to companies, products, individuals, etc., its name derives from the external factors and internal factors. According to the perspective of [Castillo and Banguera \(2018\)](#), they point out that the main objective of applying the SWOT matrix is to provide a diagnosis to make strategic decisions and improve in the future.

The research shows that the implementation of the 5S methodology improves efficiency by optimising the search for the elements necessary for the development of maintenance and operation activities, creating comfortable and safe work spaces for all members of the substation department of CFE's Western Transmission Zone. By means of objectives that will make it possible to measure: Diagnose the current state of the 5S methodology, to identify areas for improvement and propose corrective actions in the maintenance and operation activities of the electrical power substations belonging to the Western Transmission Zone of the Federal Electricity Commission (CFE).

Diagnosing the current state begins with an initial inspection to analyse the current state of order and cleanliness of the substation department, identifying the sub-areas to be worked on, and analysing the work areas by means of an inspection checklist to determine the degree of organisation and cleanliness of each area.

Methodology

The research is characterised as a mixed methodology, dedicated to collecting, analysing and integrating both quantitative and qualitative research, and from the perspective of [Rojas \(2023\)](#), the mixed method collects information of a quantitative and qualitative nature, using technical mechanisms of these two approaches, where methodological plurality prevails (p. 137).

The research design is related to the methods and techniques combined for the solution of the problem, reason that leads to the research the use of the field design, having as objective the compilation of data from the place of origin, besides being directly related to the applied methodological procedure 5S, citing Rojas (2023), states that in the field designs the data of interest are collected directly from reality, that is, from the empirical experience, and that they are the product of the research without any interruption (p. 140).

According to Corbetta (2023), this method is based on the collection of information by means of questions to the individuals who are the object of research, which form a representative sample, made up of two fundamental parts: questions and answers that, in a standardised way, are known as questionnaires (p. 204).

Planning and preparation

The survey applied to the staff (see Annex I), consists of a questionnaire of 8 closed questions, in which the knowledge of the 5S was raised. The qualitative data collection was carried out using the technique based on direct observation, taking into account Corbetta (2023), who states that through observation the researcher studies a given social phenomenon, first participating in it, in order to experience it and be able to offer a description of it (p. 302). In the execution of the project, direct observation was applied when carrying out a tour of the three sub-areas: offices, warehouse and workshop, with the support of tools such as Gemba Walk and a checklist format prepared according to the needs of each of the sub-areas.

The application of surveys, collected important data related to the 5S methodology, one of relevance is that 67% of workers have knowledge of the 5S, an advantage to promote its application, however, 14 of the 18 workers indicate that their workplace is not commonly kept clean and tidy, ie. 78% do not meet the requirements of order and cleanliness, implying delays in performing their maintenance activities and operation of different substations, in addition to risks to their safety by falls, blows, etc.

Which indicates that the 5S methodology is not being applied, 78% do not comply with the requirements of order and cleanliness, implying delays when carrying out their maintenance and operation activities in the different substations, as well as safety risks due to falls, blows, etc., which indicates that the application of the methodology is substantial to improve their work space and productivity.

Tour of the area

The diagnosis began with a walk and direct observation of the substation department in three sub-areas: offices, warehouse and workshop (see table 1), where the Gemba Walk tool was applied to gather information and comments on the sub-areas under study.

Box 1

Table 1

Gemba Walk checklist


COMISIÓN FEDERAL DE ELECTRICIDAD	
WESTERN TRANSMISSION AREA	
GEMBA WALK CHECKLIST	1 OF 2
Walking area: Office and Workshop	
Walkabout participants: Work team	
A. Purpose of the walk (why do it): To identify the most vulnerable areas in terms of tidiness and cleanliness.	
B. Initial conditions observed in the area (strengths to reinforce opportunities for improvement): Documents are on top of the work area (office). Tools and/or work equipment are not in a specific place. Lack of cleanliness in work areas Lack of signposting in the work area	
C. Notes for pre-walk review with area leader and other walkers None	
D. Key questions during the walk (Turn the back of the card)	
E. Follow-up actions. Application of 5's checklists in each of the areas (office and workshop).	

Table 2 shows that tools, equipment and documents do not have a specific place, and unnecessary objects were found obstructing the work space in the three sub-areas. After detecting the problems in the substation department, it was determined that the lack of organisation and cleanliness is the main factor to be solved.

Box 2

Table 2

Gemba Walk checklist

 COMISIÓN FEDERAL DE ELECTRICIDAD WESTERN TRANSMISSION AREA GEMBA WALK CHECKLIST	2 OF 2
D. Key questions during the walk 1. How are things in general? Normal workflow, safety for all staff, punctuality, productivity.	
2. HMMEEL conditions Tools: There is no classification of tools, plus they are not in a fixed location Tools: There is no classification of tools, plus they are not in a fixed location.	
Material: The material is untidy, unsorted, and it is difficult for workers to find it efficiently.	
Manpower: Manpower is good, however, the tools are not in a specific place, which prevents the work flow from being more efficient.	
Equipment: Equipment is a bit dirty and with unnecessary objects around it.	
Safety: Personal protective equipment is not complete. Space: The workshop does not have a defined area, there are objects obstructing the way.	
Key areas, customers, suppliers. The work carried out is of high quality	
What to maintain to start with? Start with small habits of cleanliness and organisation.	

Note: A Gemba Walk format was presented on the collection of information, based on direct observation in each of the sub-areas of the substation department.

Once the problems had been detected, an Ishikawa diagram was drawn up showing the possible causes based on the analysis of five critical factors: machinery, labour, method, material and environment; the lack of culture is one of the aspects that must be modified to improve conditions and increase efficiency in the work processes.

Box 3

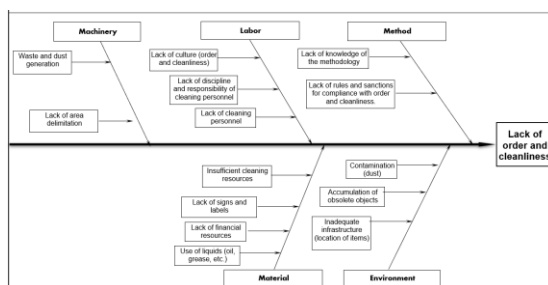


Figure 1

Figure 1 Cause-effect diagram: Lack of order and cleanliness

Figure 1 shows the analysis of the Ishikawa diagram, which shows that the workers do not have a comfortable work space, due to a lack of hygiene habits, when they carry out maintenance activities they use various products that generate solid waste on floors, work tables, etc., and are not disposed of correctly, another cause of disorder is the accumulation of documents and obsolete objects.

Another cause of disorder is the accumulation of documents and obsolete objects; a critical factor identified is the lack of signage and delimitation of work stations, it is necessary to relocate various equipment, machinery and tools, as well as using colours on the floors as visual aids, for the safety of all staff.

Stage 1: Seiri (Select)

In the ‘Seiri’ stage (see figure 2), photographs were taken of the sub-areas: offices, warehouse and workshop, in order to establish the beginning of the methodology, where the lack of order and cleanliness is demonstrated.

Box 4



Figure 2

Offices, warehouse and substation workshop


Initial inspection and analysis

To determine the level of compliance with the 5S methodology, an initial inspection was carried out by applying a checklist to control compliance with the order and cleanliness requirements of the substation department to be evaluated (see table 3), which shows the checklist applied in the office sub-area, and the checklists for the warehouse and substation workshop sub-areas are shown in annexes 2 and 3; These forms show the different items and the ordinal scale for evaluation, which ranges from 4 to 0 points, with the rating being given according to the attributes observed for each site, with the answers being related to the characteristics of each item: excellent= 4 points, good= 3 points, regular= 2 points, insufficient= 1 point and does not comply= 0 points, this being the lowest rating.

Box 5

Table 3

Check list inspection inicial 5S: offices

5'S AUDIT CHECKLIST				
COMISIÓN FEDERAL DE ELECTRICIDAD				
NORTHERN TRANSMISSION ZONE: Substation Department				
Evaluation date: 24 July 2023		Objective: To implement the 5s methodology to improve the efficiency of maintenance and operation processes in the substation department of the Western Transmission Zone of the Federal Electricity Commission.		
Assessor: 1				
Area: Offices		Weightings		
		4	Excellent	
		3	Good	
		2	Regular	
		1	Insufficient	
		0	Does not comply	
				
Aspects to verify	No.	Description	Score	Remarks
1. SEIRI (SELECT) Differentiate between what is necessary and what is unnecessary.	L.1	Tools and work equipment are tidy, in the assigned place, identified and clean.	1	The tools do not have a specific location, so it takes longer to carry out their programmed activities.
	L.2	There is a clear identification of unsafe conditions in the area, equipment and operations.	2	
	L.3	The walkways and common areas are free for pedestrians and vehicles.	2	
	L.4	There are unclassified tools or equipment for the execution of the activities.	1	
	L.5	Unnecessary broken / unserviceable items, or items from another process (tools, equipment, PPE) are separated or identified.	2	
Maximum scores:			20	
Total:			8	
Aspects a verificar	No.	Descripción	Puntaje	Observaciones
2. SEITON (ORGANISE) Ordering of items, establishing a specific location.	2.1	There are demarcation lines for access, circulation, etc. (There are signs and delimitation of areas).	3	Folders are not organised, it is difficult to identify documents, there are obsolete documents on the desk.
	2.2	Documents and folders are identified with dividers or marked with acronyms, and are filed under a consecutive number.	1	
	2.3	Documents, equipment and tools have a fixed location and are always in place.	1	
	2.4	There are objects that are not necessary for the development of the area's activities.	1	
	2.5	The distribution of items (tools, equipment, etc.) is adequate.	1	
Maximum scores:			20	
Total:			7	
Aspects to verify	No.	Description	Score	Remarks
3. SEISO (CLEANING) Eliminating dirt and avoiding soiling	3.1	The area is free of dust and dirt (computers, desks, tables, etc.).	1	The department has cleaning supplies, however, there are areas that are not adequately cleaned.
	3.2	Waste containers, which are regularly emptied without exceeding their capacity.	2	
	3.3	The floor of the work area is clean and free of obstacles that could cause falls from the same level.	2	
	3.4	Cleaning is carried out as scheduled in the cleaning plan, and is inspected by a person responsible for the area.	3	
	3.5	The necessary cleaning material is available and accessible.	4	
Maximum scores:			20	
Total:			12	
Aspects to verify	No.	Description	Score	Remarks
4. SEIKETSU (STANDARDISE) Getting the first 3s implemented	4.1	Cleaning standards are complied with and checked that they are correctly applied.	1	The office area does not comply with the level of order and cleanliness, and there are no regulations within the substation department to control order and cleanliness.
	4.2	Resources for cleaning and work organisation are provided.	3	
	4.3	Personnel wear personal protective equipment that is clean and in good condition.	3	
	4.4	Desks, tables, computers, etc., are kept clean and in good condition.	2	
	4.5	Cleanliness, control and tidiness records are kept.	2	
Maximum scores:			20	
Total:			11	
Aspects to verify	No.	Description	Score	Remarks
5. SHITSUKE (DISCIPLINE) Make the 5S activities a habit.	5.1	All personnel collaborate in the cleaning tasks (they comply with the existing rules related to keeping the workplace in complete order, cleanliness and cleanliness).	1	It is observed that the personnel do not adequately apply the 5s, however, they are willing to collaborate to improve the conditions in their work areas.
	5.2	The workstation is delivered and received in optimal conditions: clean and tidy.	3	
	5.3	Inappropriate use of the facilities (disorder) is reported to the person in charge of the area.	3	
	5.4	Signage is respected throughout the facility.	2	
	5.5	All employees eat, smoke or drink only in the areas designated for this purpose.	2	
Maximum scores:			20	
Total:			11	

The application of the 5S verification format, see table 3, shows that the office sub-area mainly lacks order, pointing out the lack of hygiene in bookshelves and desks, in addition to the items identified that are alien to the process and that make access to documents, tools and other items difficult.

Results

Offices

The following are the initial results after the application of the checklist within the sub-areas in which there are various deficiencies in order and cleanliness.

Box 6

Table 4

Initial inspection results: offices

COMISIÓN FEDERAL DE ELECTRICIDAD			
WESTERN TRANSMISSION AREA			
Department (Criterion): SUBSTATIONS			
Results Initial inspection 5'S methodology			
24 July 2023	Area: Offices		
Result	Goal	Real	Percentage %
Selection	20	8	40%
Order	20	7	35%
Cleanliness	20	12	60%
Standardisation	20	11	55%
Discipline	20	11	55%
General	100	49	49%
Colour coding			
81 - 100	Outstanding! Strong 5S culture in place		
60 - 80	Strong 5S implementation but room for improvement		
< 60	Significant potential for improvement		

Inspección inicial 5'S : Oficinas

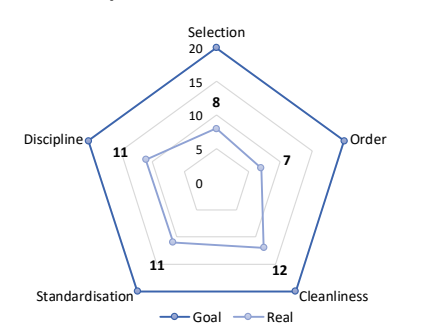


Table 4 shows that in the office sub-area 49 points were obtained, order was the most critical factor due to the fact that documents do not have a specific folder and area, causing time delays, followed by the selection of items.

Warehouse

The warehouse is the most serious sub-area in terms of 5S compliance (see table 5), where it is indicated that order and cleanliness are the points affected because, folders of documents, tools and equipment that are kept in this area do not have an established (fixed) place, there are no signs and there is a lack of a cleaning programme.

Box 7

Table 5

Initial inspection results: warehouse

COMISIÓN FEDERAL DE ELECTRICIDAD			
WESTERN TRANSMISSION AREA			
Department (Criterion): SUBSTATIONS			
Results Initial inspection 5'S methodology			
24 July 2023	Area: Substation Department Warehouse		
Result	Goal	Real	Percentage %
Selection	20	5	25%
Order	20	3	15%
Cleanliness	20	4	20%
Standardisation	20	8	40%
Discipline	20	6	30%
General	100	26	26%
Colour coding			
81 - 100	Outstanding! Strong 5S culture in place		
60 - 80	Strong 5S implementation but room for improvement		
< 60	Significant potential for improvement		

In Table 5, an overall score of 26 points was obtained, stating that the implementation of 5S should be taken as a routine to maintain safety in the area.

Workshop

In the substation workshop there are no delimitations (see table 6) in the workstations, which can cause health risks to workers, order and selection is an issue to be addressed, reaching an overall score of 41 points, see table 6.

Box 8

Table 6

Initial inspection results: workshops

COMISIÓN FEDERAL DE ELECTRICIDAD			
WESTERN TRANSMISSION AREA			
Department (Criterion): SUBSTATIONS			
Results Initial inspection 5'S methodology			
24 July 2023	Area: Workshop		
Result	Goal	Real	Percentage %
Selection	20	8	40%
Order	20	6	30%
Cleanliness	20	9	45%
Standardisation	20	10	50%
Discipline	20	8	40%
General	100	41	41%
Colour coding			
81- 100	Outstanding! Strong 5S culture in place		
60 - 80	Strong 5S implementation but room for improvement		
< 60	Significant potential for improvement		

According to Siddiqui et al. (2024), the implementation of energy audits not only optimises efficiency, but also improves the quality of energy supplied, reduces costs and minimises energy waste. The results reflect the lack of a culture of order and cleanliness, it follows that the implementation of the 5S methodology should be taken as a habit to improve the workspace, reduce times in the execution of maintenance activities, increase productivity, quality in the power transmission service, and reduce risks to workers, the most important component for the company.

Conclusions

The analysis indicates that the lack of culture in the application of 5S, together with the accumulation of unnecessary objects and poor signage, are the main causes of these problems. To improve, it is recommended to reinforce the 5S culture, properly organise tools, documents, and improve signage and delimitation of spaces. Implementing these actions will help to create a safer and more productive working environment.

The initial inspection to analyse the state of order and cleanliness of the substation department has exposed areas for improvement. Using a checklist adapted to the office, warehouse and workshop sub-areas, the levels of compliance with the 5S methodology were evaluated.

To improve conditions, it is recommended to implement corrective actions focused on the organisation of workspaces by implementing a structured filing system for documents and materials, ensuring that all documents are properly classified and stored in specific folders or containers. Create defined workspaces with appropriate furniture to facilitate access and use of tools and documents. Disposal of Unnecessary Items, by making an inventory of all items present in the offices and eliminating those that are unnecessary or not used on a regular basis. Establish procedures for the disposal of obsolete documents and materials, ensuring that safe and efficient disposal practices are followed. Implement a regular cleaning programme that includes daily cleaning of desks, bookcases and other work areas. Assign specific responsibilities to employees or cleaning staff. Provide cleaning materials: Ensure that sufficient cleaning materials, such as disinfectants, wipes and other necessary products, are available and accessible in the offices.

Train staff on the 5S methodology, emphasising the importance of order and cleanliness in the work environment. Promote an organisational culture that values and continuously practices order and cleanliness through workshops, meetings and frequent reminders. Develop and implement clear policies on maintaining order and cleanliness in the workplace, with specific guidelines and expectations. Use visual tools, labels and signage to clearly identify the use of spaces and tools, making them easy to locate and encouraging tidiness. Install dashboards or visualisation systems to track compliance with organisational and housekeeping practices, and to communicate progress and areas for improvement.

The analysis of the work areas by means of the inspection checklist has shown significant deficiencies in the degree of organisation and cleanliness in the sub-areas evaluated: The rigorous implementation of the 5S methodology is essential to improve work spaces, reduce maintenance activity times, increase productivity and minimise occupational risks. Install adequate signage for the identification and location of elements.

In terms of the workshop, it is recommended to clearly delimit work stations and specific areas for different activities. Establish a system of order and labelling for tools and materials.

These solutions will help to improve organisation and cleanliness in the sub-areas, promoting a more efficient and safer working environment.

Annexes


Annex 1

Survey

CFE Comisión Federal de Electricidad		5'S METHODOLOGY
		SURVEY
Below are a series of questions related to the 5's Methodology, please read each question carefully and mark your answer with an "X".		
1. ¿Are you familiar with the 5's methodology?		
yes	<input type="radio"/>	No <input type="radio"/>
2. Do you consider it important to keep the work areas clean and tidy?		
yes	<input type="radio"/>	No <input type="radio"/>
3. Do you have the necessary cleaning equipment to keep the area clean (waste bins, brooms, mops, etc.)?		
yes	<input type="radio"/>	No <input type="radio"/>
4. Do you have the necessary tools and equipment for the execution of your activities?		
yes	<input type="radio"/>	No <input type="radio"/>
5. Do you have a specific place for tools and equipment?		
yes	<input type="radio"/>	No <input type="radio"/>
6. How do you consider your productivity?		
Excellent	<input type="radio"/>	
Good	<input type="radio"/>	
Regular	<input type="radio"/>	
Insufficient	<input type="radio"/>	
7. Is access within the whole area easy and unobstructed?		
Sí	<input type="radio"/>	No <input type="radio"/>
8. ¿Los lineamientos de trabajo establecidos por la organización son cumplidos habitualmente?		
Sí	<input type="radio"/>	No <input type="radio"/>
THANK YOU FOR YOUR PARTICIPATION!		


Annex 2

5S initial inspection checklist: Workshop

5'S AUDIT CHECKLIST																
COMISIÓN FEDERAL DE ELECTRICIDAD																
NORTHERN TRANSMISSION ZONE: Substation Department																
Evaluation date: 24 July 2023		Objective: To implement the 5s methodology to improve the efficiency of maintenance and operation processes in the substation department of the Western Transmission Zone of the Federal Electricity Commission.														
Evaluator: 2																
Area: Taller																
		<table border="1"> <thead> <tr> <th colspan="2">Weightings</th> </tr> </thead> <tbody> <tr> <td>4</td> <td>Excellent</td> </tr> <tr> <td>3</td> <td>Good</td> </tr> <tr> <td>2</td> <td>Regular</td> </tr> <tr> <td>1</td> <td>Insufficient</td> </tr> <tr> <td>0</td> <td>Non-compliant</td> </tr> </tbody> </table>			Weightings		4	Excellent	3	Good	2	Regular	1	Insufficient	0	Non-compliant
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1	Insufficient															
0	Non-compliant															
Aspects to verify		No.	Description	Score												
1. SEIRI (SELECT) Differentiating between the necessary and the unnecessary	1.1	1	Work tools and equipment are tidy, in the assigned place, identified and clean.	1												
	1.2	2	There is clear identification of unsafe conditions in the area, equipment and operations.	2												
	1.3	2	Walkways and common areas are clear for pedestrians and vehicles to pass through.	2												
	1.4	1	There are unclassified tools or equipment for the execution of activities.	1												
	1.5	2	Unnecessary broken / unserviceable items (tools, equipment, PPE) are separated or identified.	2												
	Maximum score:		20													
Total:		8														
Aspects to verify		No.	Description	Score												
2. SEITON (ORGANISE) Outlining of items, establishing a specific location	2.1	2	There are demarcation lines for access, circulation, machinery, storage, etc. (Access routes and demarcation).	2												
	2.2	0	There are signs and demarcation of areas	0												
	2.3	1	Equipment and work tools have a fixed place and are always in place.	1												
	2.4	1	Obsolete items (machinery, tools, equipment) are disorganised	1												
	2.5	2	The distribution of items (tools, equipment, etc.) is adequate.	2												
Maximum score:		20														
Total:		6														
Aspects to verify		No.	Description	Score												
3. SEISO (CLEANING) Removing dirt and avoiding soiling	3.1	1	The area is free of dust and dirt.	1												
	3.2	1	There are dustbins, which are regularly emptied without exceeding their capacity.	1												
	3.3	0	Visible signage is free of dust and in good condition.	0												
	3.4	3	Cleaning is carried out as scheduled in the cleaning plan, and is inspected by a person responsible for the area.	3												
	3.5	4	The necessary cleaning materials are available and accessible.	4												
Maximum score:		20														
Total:		9														
Aspects to verify		No.	Description	Score												
4. SEIKETSU (STANDARDISING) Getting the first 3s implemented	4.1	1	Cleaning standards are compiled with and checked that they are properly applied	1												
	4.2	3	Resources for cleaning and work organisation are provided.	3												
	4.3	3	Personal protective equipment is properly worn by staff and is clean and in good condition.	3												
	4.4	1	Machinery, equipment and tools are kept clean and maintained in good condition.	1												
	4.5	2	Visual evidence is used regarding the maintenance of order and cleanliness conditions.	2												
Maximum score:		20														
Total:		10														
Aspects to verify		No.	Description	Score												
5. SHITSUKE (DISCIPLINE) Make the 5S activities a habit.	5.1	2	All staff cooperate in the cleaning work.	2												
	5.2	0	The workstation is handed over and received in optimal conditions: clean and tidy.	0												
	5.3	2	Inappropriate use of the facilities (disorder) is reported to the person in charge of the area.	2												
	5.4	1	Signs are respected throughout the facility.	1												
	5.5	3	Cleanliness, control and tidiness records are kept.	3												
Maximum score:		20														
Total:		8														

Annex 3

5S Initial Inspection Checklist: Warehouse

5'S AUDIT CHECKLIST																
COMISIÓN FEDERAL DE ELECTRICIDAD																
NORTHERN TRANSMISSION ZONE: Substation Department																
Evaluation date: 24 July 2023		Objective: To implement the 5s methodology to improve the efficiency of maintenance and operation processes in the substation department of the Western Transmission Zone of the Federal Electricity Commission.														
Evaluator: 3																
Area: Substation Department Warehouse																
		<table border="1"> <thead> <tr> <th colspan="2">Weightings</th> </tr> </thead> <tbody> <tr> <td>4</td> <td>Excellent</td> </tr> <tr> <td>3</td> <td>Good</td> </tr> <tr> <td>2</td> <td>Regular</td> </tr> <tr> <td>1</td> <td>Insufficient</td> </tr> <tr> <td>0</td> <td>Non-compliant</td> </tr> </tbody> </table>			Weightings		4	Excellent	3	Good	2	Regular	1	Insufficient	0	Non-compliant
Weightings																
4	Excellent															
3	Good															
2	Regular															
1	Insufficient															
0	Non-compliant															
Aspects to verify		No.	Description	Score												
1. SEIRI (SELECT) Differentiating between the necessary and the unnecessary	1.1	0	Tools and work equipment are tidy, in the assigned place, identified and clean.	0												
	1.2	2	There are articles, objects, tools, etc., outside the established area.	2												
	1.3	0	Walkways and common areas are free for pedestrians to pass through.	0												
	1.4	1	There are tools or equipment not classified for the execution of activities.	1												
	1.5	2	Unnecessary broken / unusable items or items from another process (tools, equipment, PPE) are separated or identified.	2												
Maximum score:		20														
Total:		5														
Aspects to verify		No.	Description	Score												
2. SEITON (ORGANISE) Outlining of items, establishing a specific location	2.1	0	Documents are quickly located	0												
	2.2	0	Documents (folders), tools and/or equipment have a fixed place and are always in their place	0												
	2.3	0	Shelves allow for easy access to documents	0												
	2.4	1	The work area has signs in good condition, the folders (documents) are labelled by sections or areas.	1												
	2.5	2	The distribution of items (documents, folders, tools, etc.) is adequate.	2												
Maximum score:		20														
Total:		3														
Aspects to verify		No.	Description	Score												
3. SEISO (CLEANING) Removing dirt and avoiding soiling	3.1	0	The area is free of dust and dirt.	0												
	3.2	0	There are dustbins, which are regularly emptied without exceeding their capacity.	0												
	3.3	0	Visible signage is free of dust and in good condition.	0												
	3.4	0	Cleaning is carried out as scheduled in the cleaning plan, and is inspected by a person responsible for the area.	0												
	3.5	4	The necessary cleaning materials are available and accessible.	4												
Maximum score:		20														
Total:		4														
Aspects to verify		No.	Description	Score												
4. SEIKETSU (STANDARDISING) Getting the first 3s implemented	4.1	0	Standards of cleanliness are adhered to and checked for correct application.	0												
	4.2	2	Visual evidence is used regarding the maintenance of tidiness and cleanliness.	2												
	4.3	2	Standardisation tools are in place to maintain order and cleanliness.	2												
	4.4	4	Resources for cleaning and work organisation are provided.	4												
	4.5	0	Records of cleanliness, control and tidiness are made.	0												
Maximum score:		25														
Total:		8														
Aspects to verify		No.	Description	Score												
5. SHITSUKE (DISCIPLINE) Make the 5S activities a habit.	5.1	2	All staff cooperate in the cleaning work.	2												
	5.2	0	The workstation is handed over and received in optimal conditions: clean and tidy.	0												
	5.3	1	Inappropriate use of the facilities (disorder) is reported to the person in charge of the area.	1												
	5.4	3	Signs are respected throughout the facility.	3												
	5.5	0	Cleanliness, control and tidiness records are kept.	0												
Maximum score:		25														
Total:		6														

Declarations

Conflict of interest

The authors declare that we have no conflicts of interest. We have no known competing financial interests or personal relationships that might have appeared to influence the research reported in this article.

Author contribution

The contribution of each researcher in each of the points developed in this research was defined based on:

Serrano-González, Sergio: Contributed to the project idea, research method and technique, Design of the Gemba walk instrument, 5S initial inspection check list, Ishikawa analysis and initial audit inspection results. I carried out data analysis and results, as well as writing the article.

Maturano-Maturano, Benito Armando: application of the field instrument for initial workshop inspection results. Carried out the processing of background information for the state of the art. Supported the design of the field instrument. Also contributed to the writing of the article.

Castellanos-Lopez, Liliana Yadira: application of the initial workshop inspection results field instrument. She contributed to the research design, the type of research, the approach, the method and the writing of the article.

Alvarado-Reséndiz, José Luis: worked on the application of the initial office inspection results field instrument, data collection and processing of the results. He also worked on the writing and style of the article.

Availability of data and materials

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Abbreviations

List abbreviations in alphabetical order.

HMMEL: Tools, Material, Labor, Equipment.
5 's: Seiri, Seiton, Seiso, Seiketsu and Shitsuke

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