EFFECTS OF THE IMPLEMENTATION OF 5S IN HEAVY MACHINERY MAINTENANCE WORKSHOPS

Cristina Ruiz, Tito Castillo and Marcel Paredes

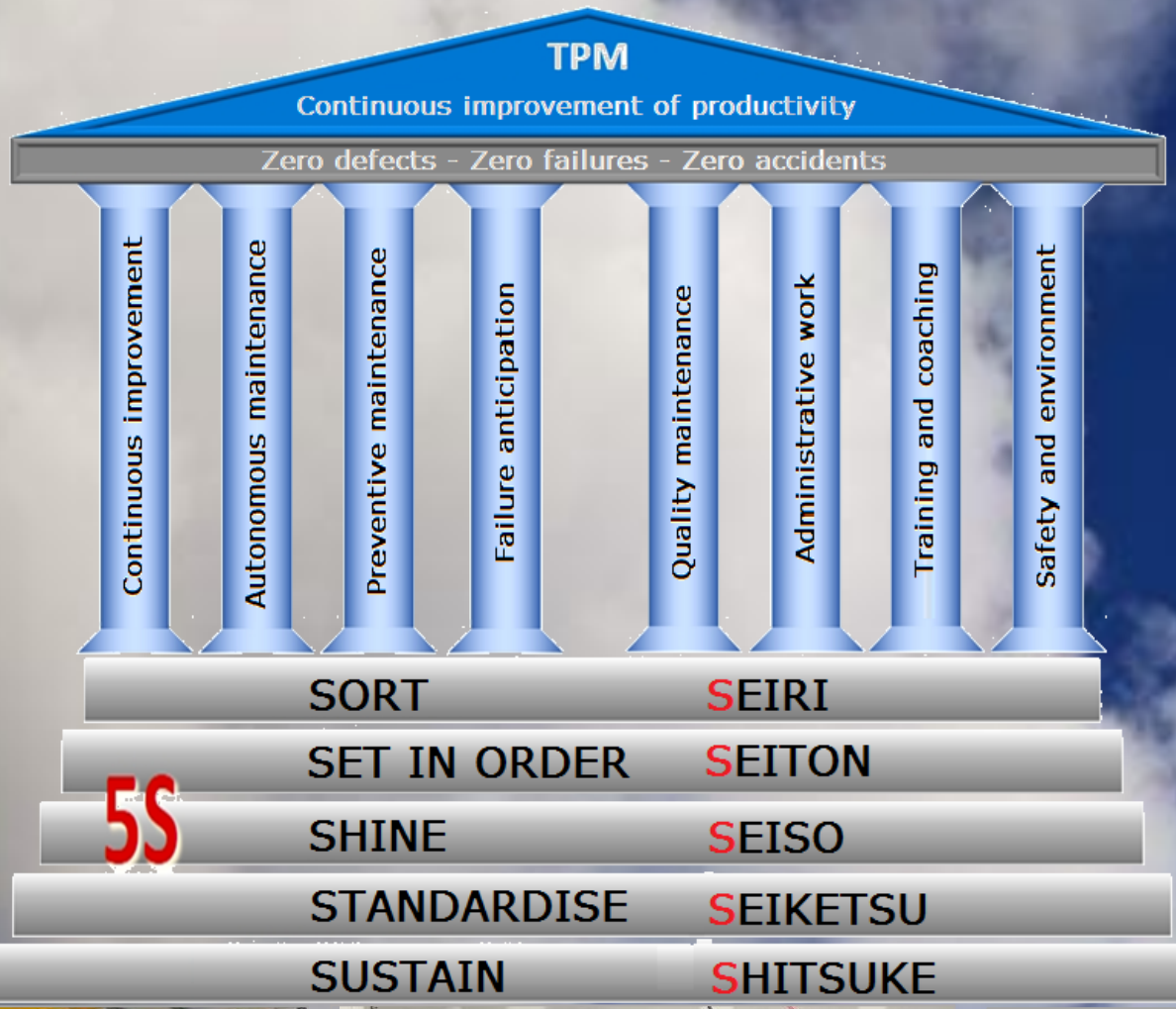
1. Background

The intensive use of machinery is the **PRODUCTION CORE** of a road construction company

- Maintenance works
- Availability of the equipment
- High machinery mobility costs and several days of work stoppage

Heavy equipment maintenance workshops

- Conventional techniques
- Unskilled personnel
- Inadequate site conditions



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LEAN

MANUFACTURING

2. PROBLEM

5S is a little known concept

- Low availability of equipment
- Frequent repairs
- Accidents rate in workshops

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3. HYPOTHESIS AND OBJECTIVES

HYPOTHESIS

If 5S is implemented in the workshop of a road construction company, will improve its efficiency and availability of heavy machinery and occupational safety indicators

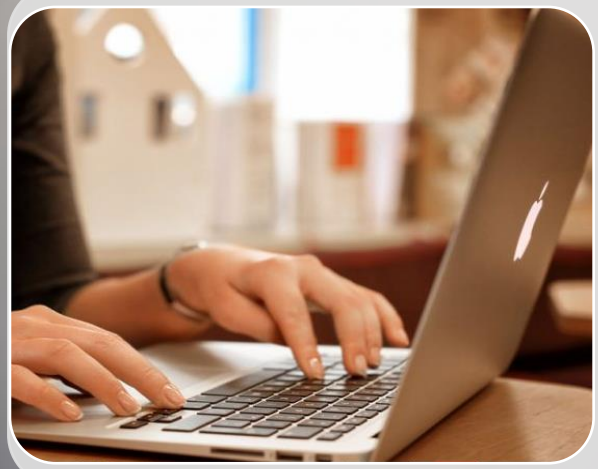
GENERAL OBJECTIVE

Know the effects of 5S implementation

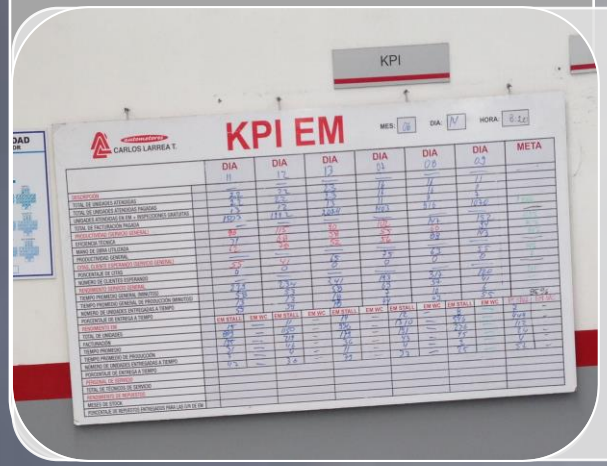
SPECIFIC OBJECTIVES

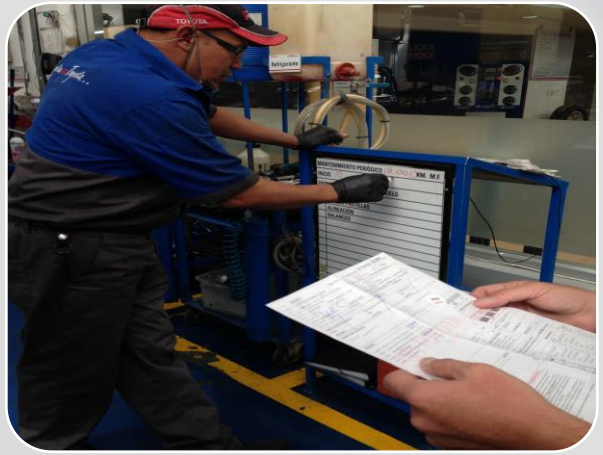
- Implement 5S in the machinery maintenance workshop of a road construction company
- Measure the current situation of the workshop under study, using indicators of maintenance of road equipment and occupational safety

4. Methodology



Bibliographic review of 5S





Technical visit was made to a Toyota car maintenance workshop

Meeting with the workers of the company under study

Opinion survey (Seven questions) carried out on 20 workshop workers

KPI (CALCULATION AND EVALUATION EQUATION)

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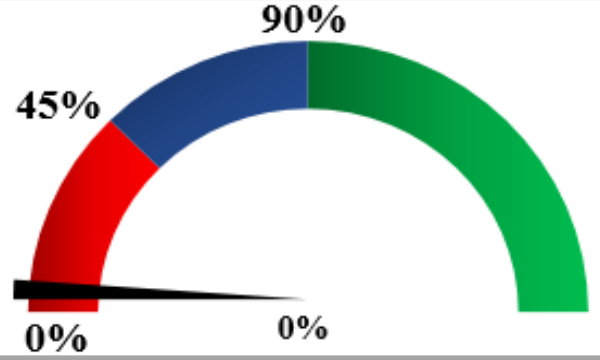
1. EQUIPMENT AVAILABILITY

$$DA = \frac{\frac{\text{Worked hours}}{\text{Number of stops}}}{\frac{\text{Worked hours}}{\text{Number of stops}} + \frac{\text{Hours under repair}}{\text{Number of stops}}} x100$$

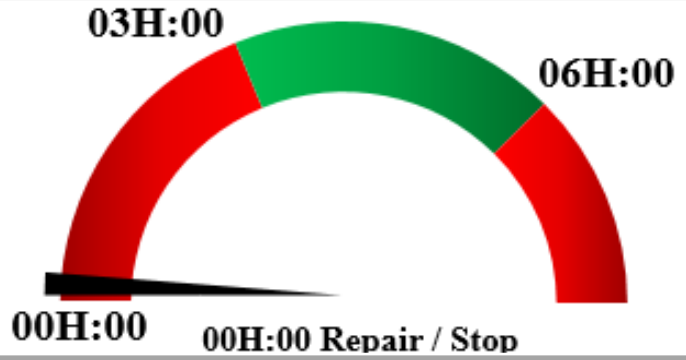
DA = %, Equipment availability



2. AVERAGE TIME IN MAINTENANCE

$$MTTR = \frac{\text{Hours in repairs}}{\text{Number of stops}}$$

MTTR, Average time in maintenance

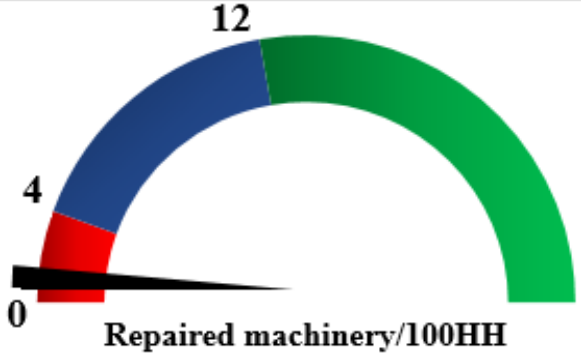


3. REPAIRED EQUIPMENT

$$PT = \frac{\text{Repaired equipment}}{\text{Man hours employed}} x100$$

PT = Repaired equipment/100HH

PT, Repaired equipment

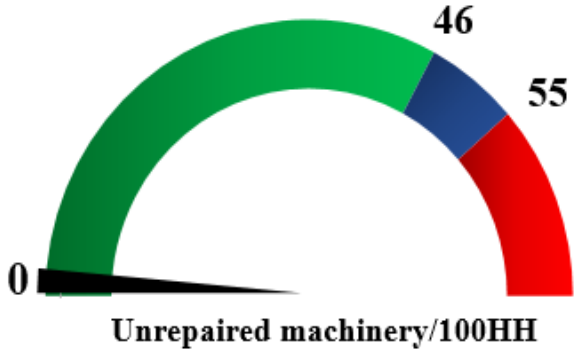


4. WORK OVERLOAD

$$B = \frac{\text{Work pending to be executed}}{\text{Man hours available}} x100$$

B = Non repaired equipment/100HH

B, Work overload

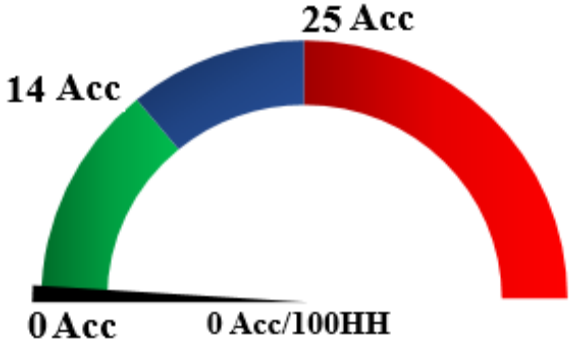


5. ACCIDENTS INDEX

$$IFA = \frac{\text{Number of accidents}}{\text{Man hours available}} x100$$

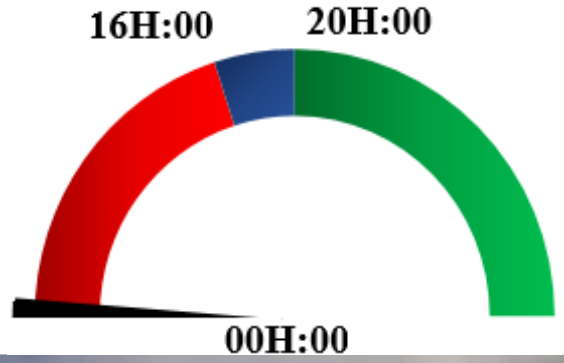
IFA = Accidents/100HH

IFA, accidents index



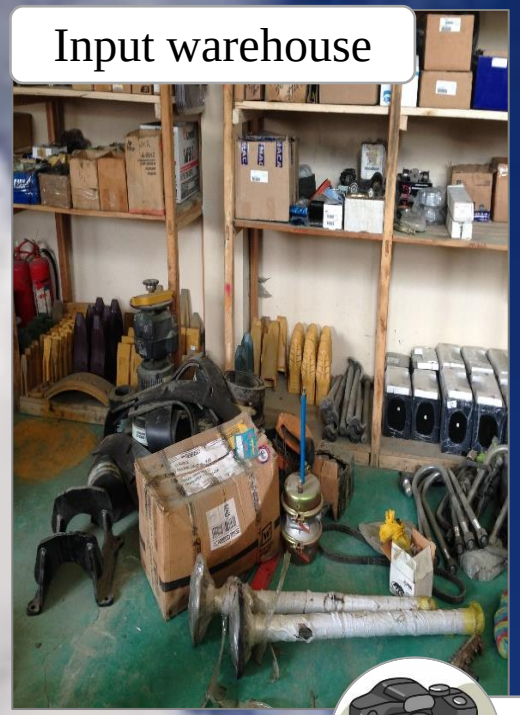
6. TRAINING HOURS

$$Training = \frac{\text{Training hours}}{\text{Maintenance hours}}$$



KPI board

Input warehouse



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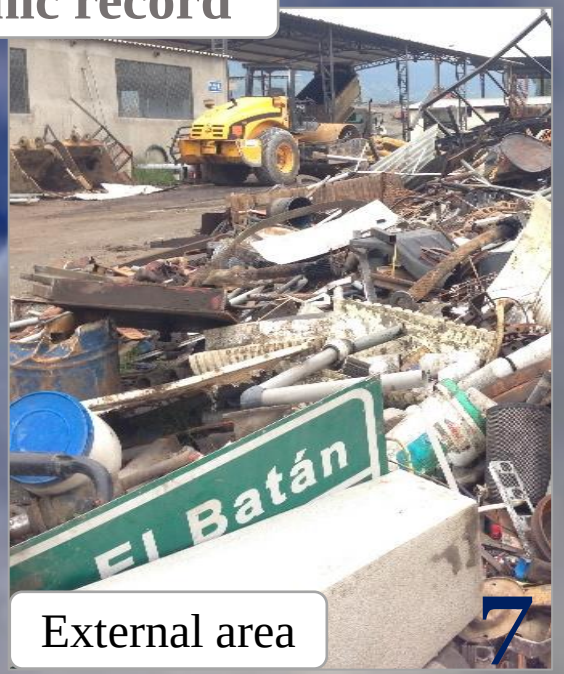
Mechanics

Photographic record

Adaptation of the worker to the 5S methodology

Storage cellar



External area

Implementation 5S

Frequent use

Occasional use

Rare use

Improbable use

FIRST S, SORT

Can it be located in another warehouse?

NO

YES

Re-use

Waste

To sell

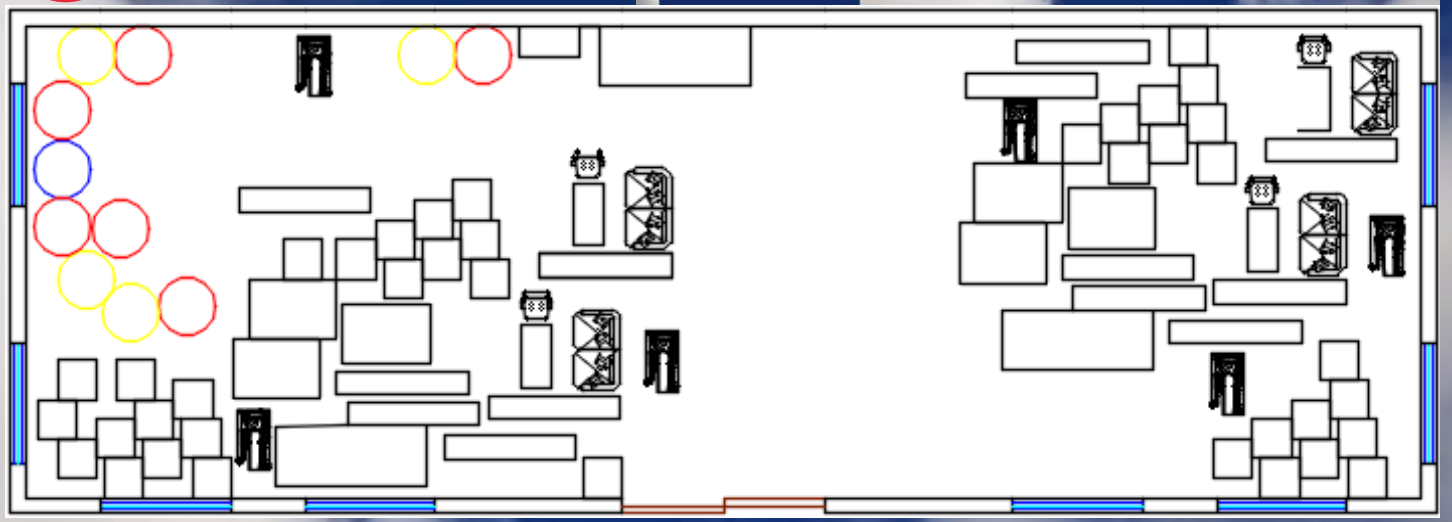
Repair

Ordenar

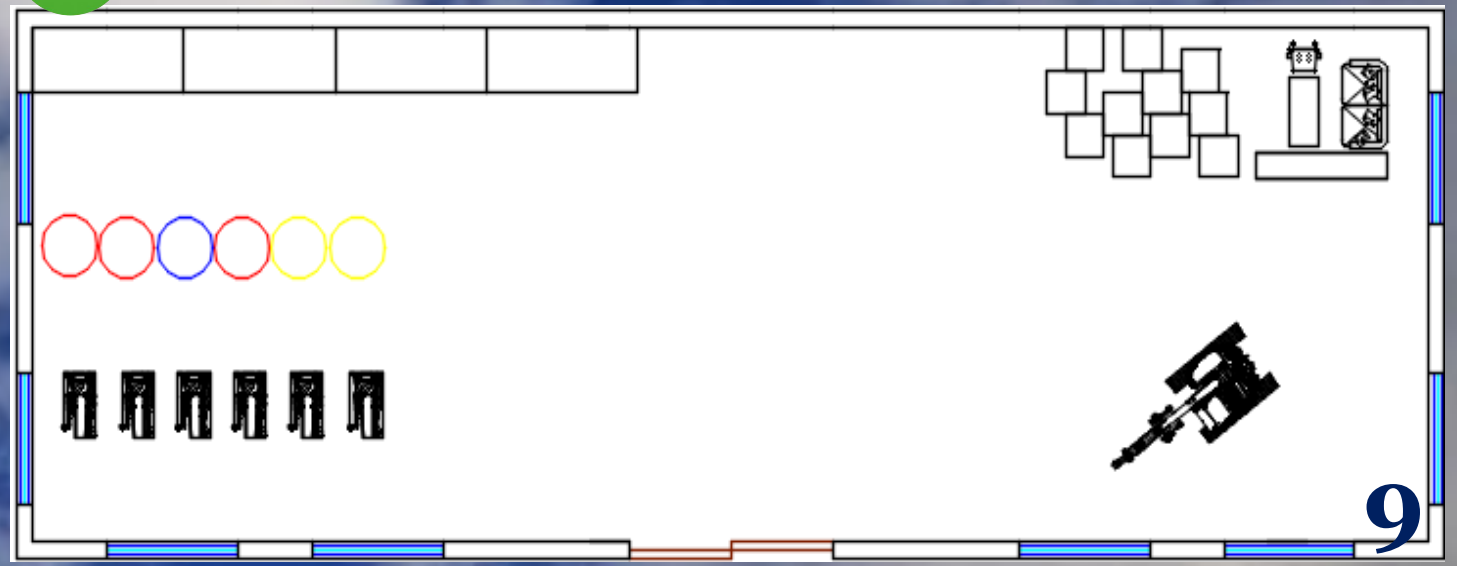
Relocate

SECOND S, SET IN ORDER

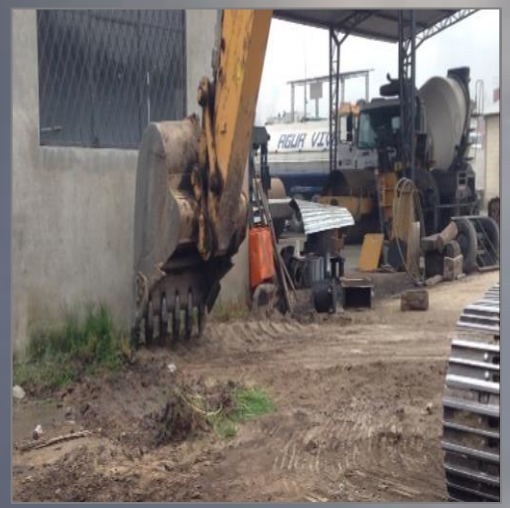
WITHOUT 5S



WITH 5S



THIRD S, SHINE



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FOURTH S, STANDARDIZE

5. RESULTS AND DISCUSSION

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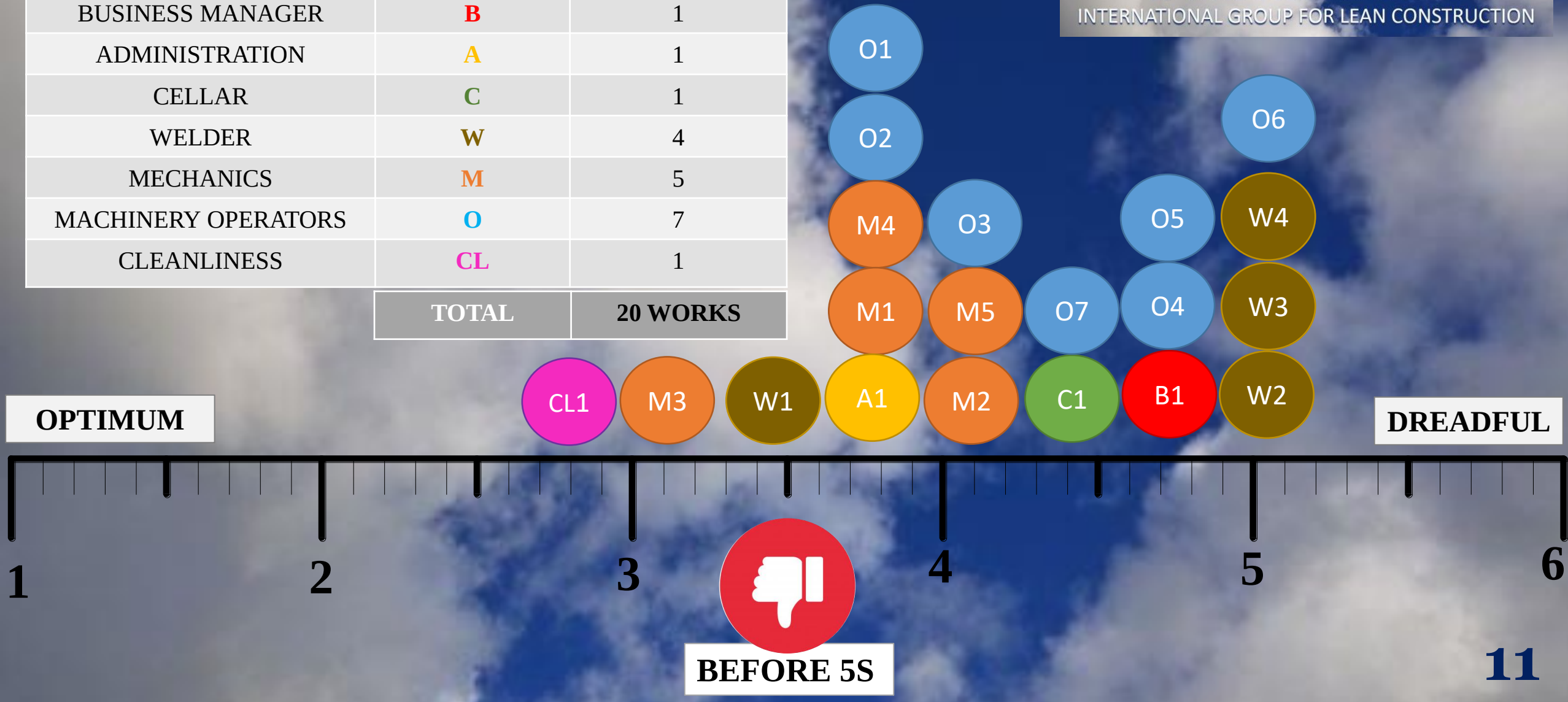
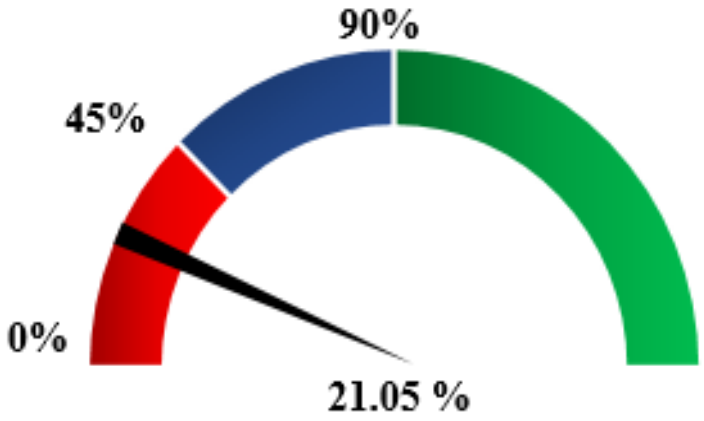
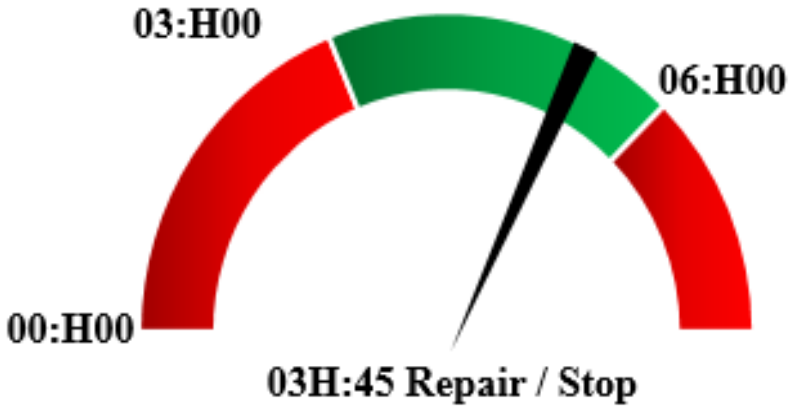
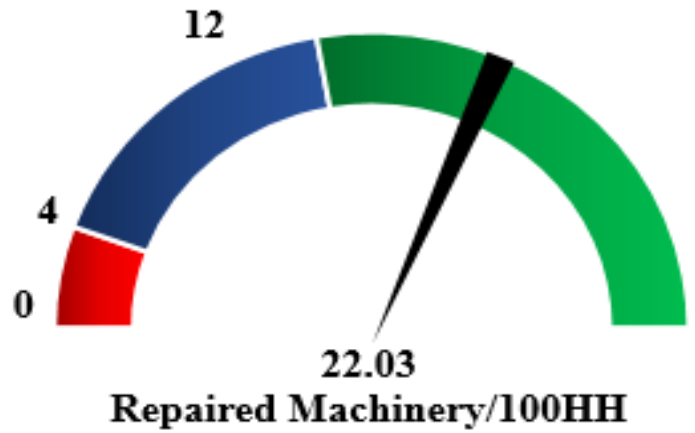
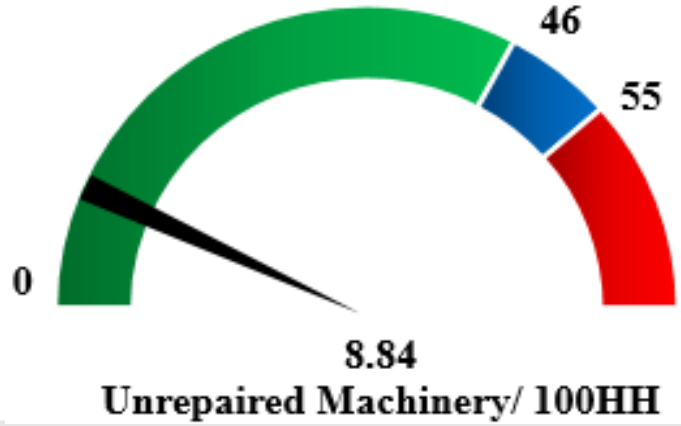
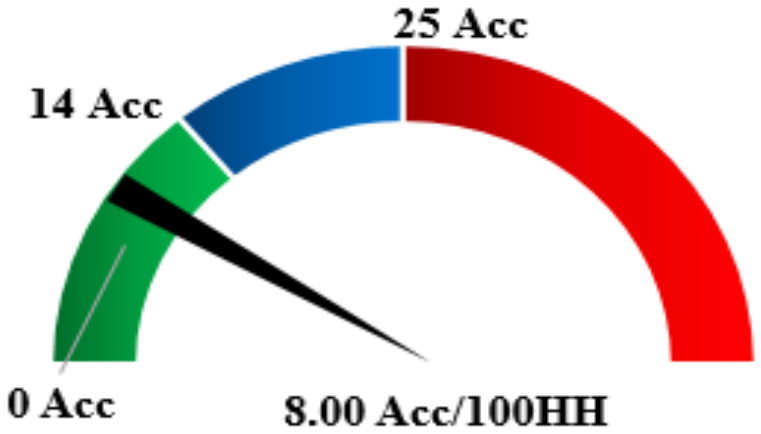
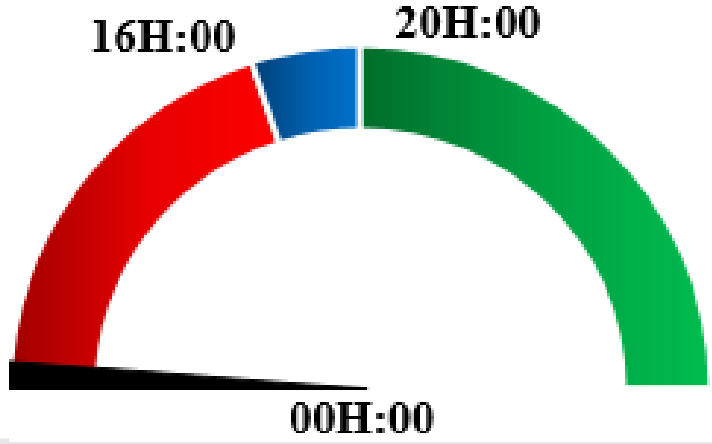
BASE LINE OF WORKER PERCEPTION

AREA	SYMBOLOGY	QUANTITY
BUSINESS MANAGER	B	1
ADMINISTRATION	A	1
CELLAR	C	1
WELDER	W	4
MECHANICS	M	5
MACHINERY OPERATORS	O	7
CLEANLINESS	CL	1
	TOTAL	20 WORKS



INDICATOR BASE LINE

1. EQUIPMENT AVAILABILITY	2. AVERAGE TIME IN MAINTENANCE	3. REPAIRED EQUIPMENT
		
HIGH repair frequency	Maintenance carried out **CORRECTLY**	Machinery **CORRECTLY** repaired
4. WORK OVERLOAD	**5. ACCIDENTS INDEX**	**6. TRAINING HOURS**
		
NO WORK OVERLOAD	**ACCEPTABLE** accident rate	**DO NOT INVEST** hours of training

WORKER PERCEPTION AFTER 5S

AREA	SYMBOLOGY	QUANTITY
BUSINESS MANAGER	B	1
ADMINISTRATION	A	1
CELLAR	C	1
WELDER	W	4
MECHANICS	M	5
MACHINERY OPERATORS	O	7
CLEANLINESS	CL	1
TOTAL		20 WORKS

OPTIMUM

DREADFUL

AFTER 5S

WITHOUT 5S

WITH 5S

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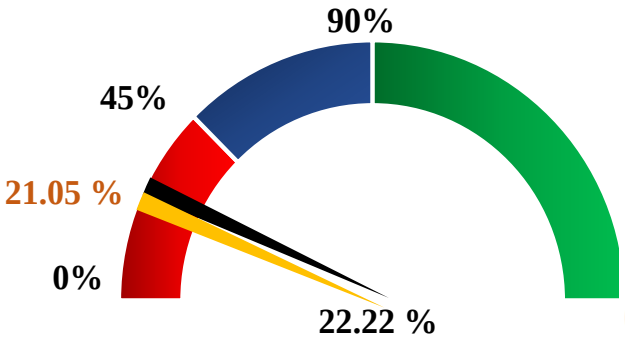
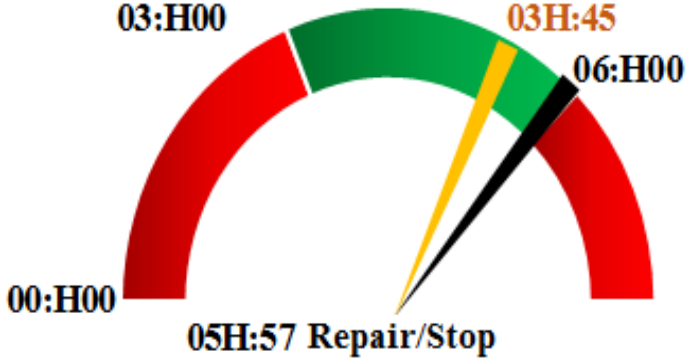
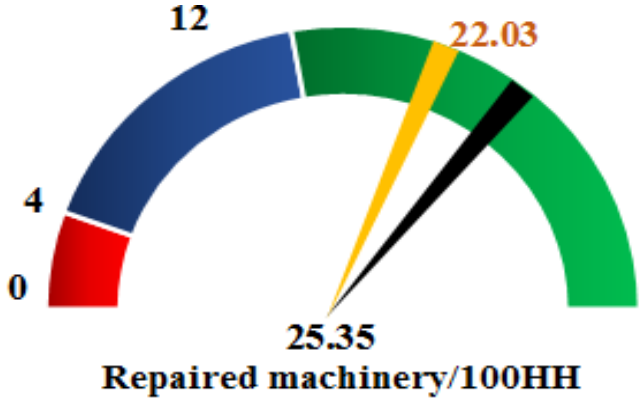
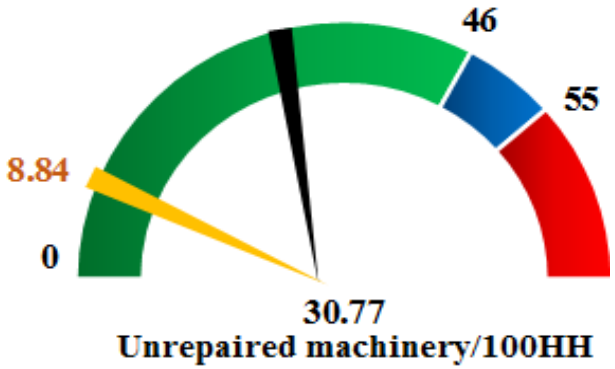
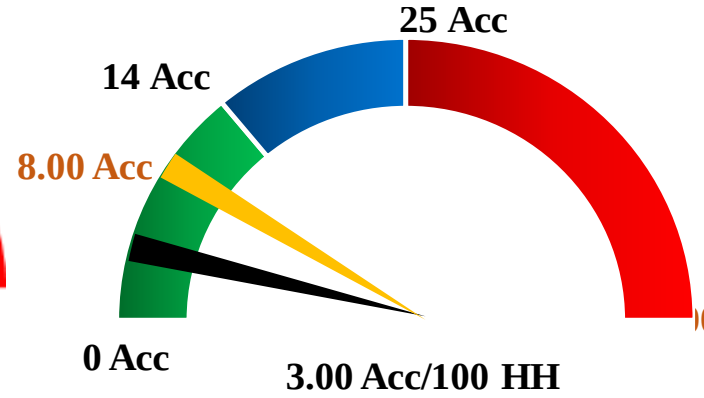
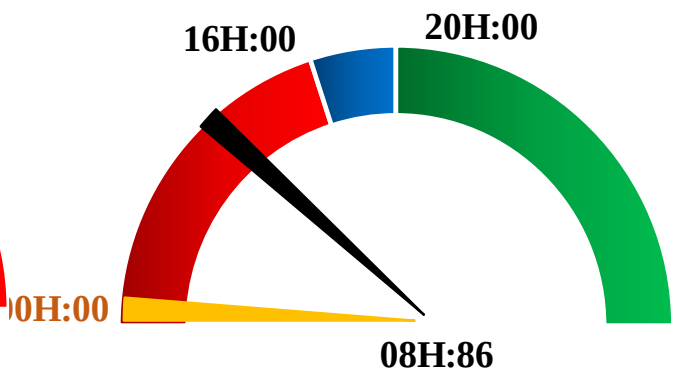
1.EQUIPMENT AVAILABILITY	2.AVERAGE TIME IN MAINTENANCE	3.REPAIRED EQUIPMENT
		
HIGH repair frequency	Maintenance carried out **CORRECTLY**	Machinery **CORRECTLY** repaired

4.WORK OVERLOAD	5.ACCIDENTS INDEX	6.TRAINING HOURS
		
NO WORK OVERLOAD	**IMPROVEMENT** of the accident rate	**INCREASED** hours in staff training

6. CONCLUSIONS

The hypothesis raised at the beginning of this investigation was confirmed for the work efficiency indicators and not for all indicators of machinery availability

Several indicators did not improve because the machinery has exceeded its useful life

5S achieved a significant improvement in occupational safety indicators measured as accidents

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7. RECOMENDATIONS

The time allocated for the implementation of 5S must be constant and methodical process

Use incentives to motivate and maintain implementation of 5S and continuous improvement

The use of visual tools is recommended, since its use generate interest in senior management and engagement of workers in the development of the methodology.