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Maintenance Proposals to Increase the Reliability of Logging Units

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Abstract:- The research design was of an applicative, descriptive and non-experimental type; Regarding the population and sample, it was the same because there were only five logging units to study using as techniques and tools the observation, the documentary analysis, the questionnaire or survey and evaluation record by means of the ISO 9001: 2002 standard, obtaining that maintenance management scored 61% in the application of the questionnaire and 68% in evaluation with the ISO 9001: 2002 standard, the average reliability of the logging units during the 2012-2019 period was 88.46%, which was considered deficient , the proposal was prepared based on a goal of 95% reliability, using the cause-effect diagram, Pareto and FMEA as improvement tolos.

Keywords:- *Maintenance Management, Reliability, Logging Units, FMEA, Autonomous Maintenance.*

I. INTRODUCTION

The lack of cleaning and lubrication in the machines of different companies causes various failures causing their useful life to come to an end, when the machines are producing in any way generating wear. Likewise, the problem becomes greater with the lack of maintenance policy, often waiting for corrective maintenance, which causes business expense. [1]

The common problems in different companies that avoid maintenance are: that the failure of the equipment generated time delay, the adjustment of machines in the operational stage delayed production, that the obstruction in the distribution of inputs generated delay in the production, that the non-compliance The speed of production generated higher costs, that the defects in the production brought as a consequence costs against the company and the costs that were generated in the trial periods.

The lack of maintenance in the production machines and added to an untimely stagnation produces defects in the same that can add great economic losses for the companies; Likewise, the importance of doing preventive maintenance rather than corrective maintenance, since the latter often turns out to be more expensive.

Preventive maintenance is important for any process that uses equipment, therefore the hierarchy of equipment must be based on criticality, the planning of preventive maintenance depends on a multicriteria and not only on costs and time. [2]

Well logging is an operational activity that lowers logging equipment to record petrophysical and geological parameters that are transmitted to the surface for interpretation. [3]

One of the most important territorial centers in the treatment and extraction of oil in the country, is located in the province of Talara, here different oil companies develop their activities, such as those dedicated to providing services related to the exploration and exploitation of the subsoil, within this Category is the company Geowell SAICy F. with fiscal domicile in the city of Buenos Aires in Argentina, and with a Branch in Peru, called Geowell SAICy F. Peruvian Branch, located in the Geowell Base of Talara-Alta, its main objective is to conduct the business and activities of the company in the country, providing Geophysical Profiling and logging services for oil wells using 5 logging units.

Currently the company keeps its maintenance records in notebooks and only performs corrective maintenance on its units; they also do not have a maintenance management system; In the information provided by the company, it has been possible to see that the equipment in 2019 has been presenting many failures in its operation, it is recorded that during that year there were 14% of failures in the lubrication system, which, of continue, they will continue to cause staff to paralyze their activities and decrease the reliability of the company's logging units.

In an environmental way, a better maintained equipment generates less emissions of polluting gases, less spillage of lubricants and fuels, by increasing reliability, environmental pollution is reduced.

Economically, it will favor the reduction of maintenance costs, labor costs, spare parts costs, logistics costs, optimizing the proper functioning of the units.

For maintenance it is important to consider imagination, intelligence and prompt decision making to provide solutions to the innumerable problems presented in a company; but only effectiveness gives sustainable results. [4] On the other hand, Moubray says that maintenance responds to changing expectations, such as an increase in awareness to assess the accepted limit of unit failures without affecting safety and the

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environment; the relationship between maintenance and product quality is considered, and the urge to achieve high availability while maintaining a low cost [5].

Maintenance Management is a set of actions aimed at correcting, by means of adequate conservation, the wear and tear produced in the facilities [6]. The effectiveness of maintenance management will allow us to minimize indirect costs, those associated with production losses and ultimately customer satisfaction [7].

Maintenance seeks to keep a productive object functional so that it can comply with the production of goods or services. It also indicates that the main objective of maintenance is that the units remain functional and in good condition over time [8]. On the other hand, Shohet defines it as a group of techniques aimed at keeping facilities and units in service, as long as possible and with performance [9].

II. MATERIAL AND METHOD

In order to analyze the current management of the maintenance of the logging units in the company, a diagnosis was carried out on this management that involves evaluating the wear and the conservation of the units through the use of indicators; Through a questionnaire addressed to workers in the maintenance area and the evaluation of maintenance management based on the ISO 9001: 2002 standard.

Secondly, in order to determine the reliability of the logging units in the Geowell SAIC and F company, a documentary analysis was carried out on the activity control sheets of the units that have been found in operation in the production process, and added to the equipment that has been in disuse during this time, product of wear, malfunction, among others.

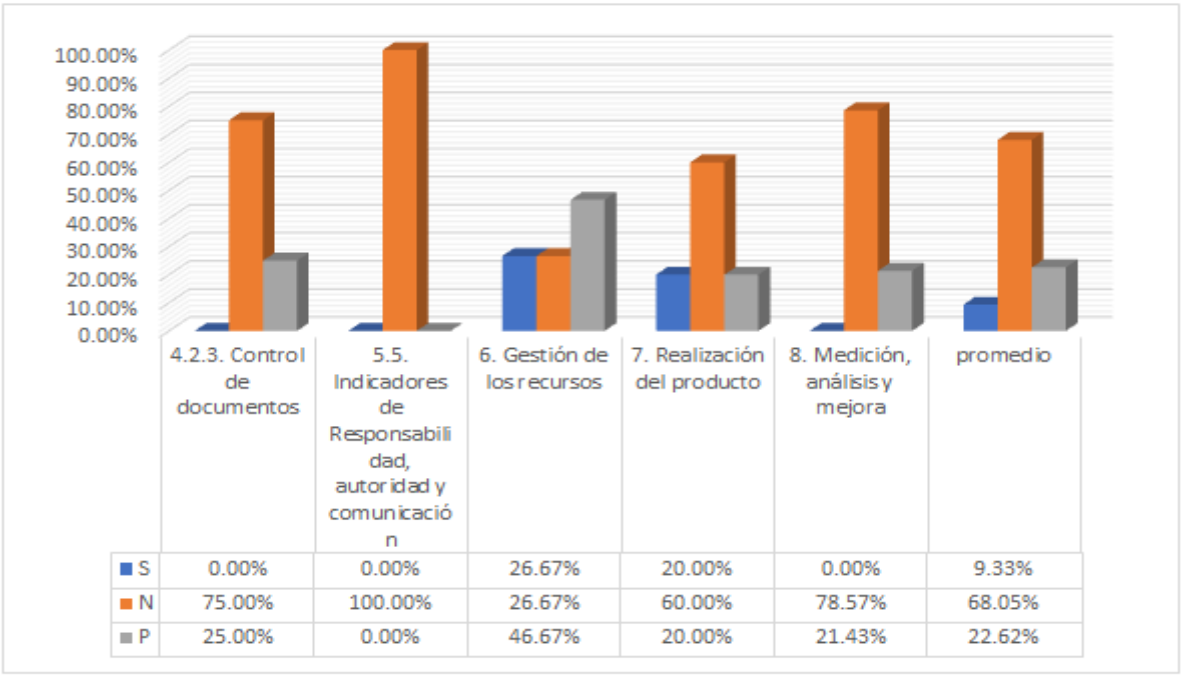
To describe the content of the equipment maintenance management proposal in the Geowell SAICY F company, it was carried out having as a source of information the survey and the evaluation of maintenance management based on the ISO 9001: 2002 standard; From this, the cause-effect diagram was made together with Pareto to focus the proposal on the most significant problems that allow an improvement in the reliability of the equipment.

Finally, the cost benefit of the management proposal was detailed by comparing the results obtained after the investigation, compared to the initial analysis of the situation of the maintenance management of the company Geowell SAICy F, Talara.

III. RESULTS

The results of the questionnaire corresponding to the thirteen questions or items applied to the Geowell SAICYF personnel summarized in situations or responses favorable to the responses normally and always, as well as unfavorable to the responses sometimes, often and never. Approximately% of the questions are unfavorable, the most serious being the non-existence of an inspector and a shortage of suppliers of spare parts for the machinery with 72.8%, likewise, field operators little committed to the care of the machinery, little training in autonomous maintenance and lubricant changes with 81.80%, with these results a global average of favorable responses of approximately 39% and 61% of unfavorable responses were obtained,this indicates a poor handling of maintenance management.

On the other hand, an evaluation of the maintenance management was carried out in the Geowell SAICYF company based on the ISO 9001 standard, with the following results.



	4.2.3. Control de documentos	5.5. Indicadores de Responsabilidad, autoridad y comunicación	6. Gestión de los recursos	7. Realización del producto	8. Medición, análisis y mejora	promedio
S	0.00%	0.00%	26.67%	20.00%	0.00%	9.33%
N	75.00%	100.00%	26.67%	60.00%	78.57%	68.05%
P	25.00%	0.00%	46.67%	20.00%	21.43%	22.62%

Fig. 1 Level of compliance with ISO 9001 by Geowell

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In figure 1, a mismanagement can be observed with regard to maintenance management in the company Geowell SAICYF, where the indicators of responsibility, authority and communication can be highlighted with 100%, measurement, analysis and improvement with a 78.57% and the control of documents with 75% the most worrying cases since there is no good management in these indicators. The global average of this evaluation is that approximately 68% indicate that there is no effective management of maintenance management, while 23% indicate partial management.

Below is a summary of the reliability of the equipment by year and the average for each equipment during the period 2012 - 2019:

Table 1: Average reliability of Geowell equipment period 2012 - 2019

YEAR	TEAM				
	GP-03	GP-06	GP-08	GP-09	GP-11
2012	0	0.00%	74.70%	66.20%	0.00%
2013	0	0.00%	92.10%	91.20%	0.00%
2014	82.70%	78.20%	84.60%	86.40%	97.00%
2015.	95.10%	99.00%	93.10%	93.10%	98.00%
2016	89.30%	95.10%	90.20%	92.10%	97.00%
2017.	80.90%	84.60%	84.60%	86.40%	96.00%
2018	0	0	0	0	0
2019	0	77.30%	0.00%	79.10%	0

Table 1 shows the summary of the reliability of each team of the Geowell company by year, in which it can be observed that in most cases the indicators are deficient, it can also be noted that in some years there are no reports of corrective maintenance, being more noticeable in 2018, where no type of report has been made, these results generated an improvement in maintenance controls.

A cause and effect diagram was drawn up, which allowed the preparation of table 2, which presents the summary of the causes that generate a deficient management of maintenance management, these have been rated from 1 to 100, based on the surveys carried out to the Geowell SAICYF company operators and maintenance management evaluation based on ISO 9001: 2002 standards.

Table 2: Organization of the causes in descending order according to their rating

Actual position	(Causes and ordered data)		Cumulative frequency	Percentage	Accumulated percentage
1	No maintenance planning	80	80	8%	8%
two	Historical non-existence of maintenance	80	160	8%	17%
3	Low frequency of preventive maintenance	80	240	8%	25%
4	Poor equipment lubrication	70	310	7%	33%
5	There is no evaluation with maintenance indicators	70	380	7%	40%
6	Little operator training	60	440	6%	46%
7	Unskilled personnel	60	500	6%	53%
8	Complex corrective maintenance performed by third parties	60	560	6%	59%
9	Few tools for maintenance	60	620	6%	65%
10	Supplier shortages	fifty	670	5%	71%
eleven	Unawareness of autonomous maintenance	fifty	720	5%	76%
12	Non-existence of forms, work orders and records	fifty	770	5%	81%
13	Complex spare parts	fifty	820	5%	86%
14	Inadequate space	fifty	870	5%	92%
fifteen	Little commitment from staff	40	910	4%	96%
16	Stock of materials	40	950	4%	100%

Table 2 shows the causes organized in a descending way according to the rating given to determine the most significant causes that generate mismanagement of maintenance management in the Geowell SAICYF company, in order to make the Pareto diagram according to the which can be indicated that 80% of the causes that generate a deficient management of maintenance management is made up of the first twelve that appear in table 2, for which it is necessary to take them into account in the proposal of this research work.

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Table 3: Root Causes and Proposed Equipment Improvements

CAUSE - ROOT	PROPOSED IMPROVEMENTS	ASPECTS
There is no maintenance planning Historical non-existence of maintenance Lack of maintenance indicators Non-existence of documents: work orders and records	M1: Maintenance management planning	Establish goals and objectives of maintenance management. Prepare a history of the logging units of the Geowell company Preparation of maintenance control documents
Low frequency of preventive maintenance Poor equipment lubrication Complex corrective maintenance performed by third parties	M2: Establish the types of maintenance to be carried out	Establish the periods of preventive maintenance. Incorporate autonomous maintenance.
Little operator training Unskilled personnel Unawareness of autonomous maintenance	M3: Incorporate a maintenance personnel training plan.	Identification of technical needs of maintenance personnel. Development of training of maintenance personnel according to schedule.
Few maintenance tools Supplier shortages	M4: Organization of the maintenance area warehouse	Carrying out an inventory of the warehouse. Identification of complex spare parts. Identification and evaluation of suppliers

Organization of improvements

Once the causes were determined, these were grouped according to similarity or similarity with respect to some common characteristic to establish the improvements, which correspond to four according to table 3, these improvements were.

Maintenance management planning that allows solving four causes such as:
There is no maintenance planning
Historical non-existence of maintenance
Lack of maintenance indicators
Non-existence of documents: work orders and records.

Establishment of maintenance types that allow solving three causes such as:
Low frequency of preventive maintenance
Poor equipment lubrication
Complex corrective maintenance performed by third parties

Incorporate a staff training plan whose purpose was to solve three causes which are:
Little operator training
Unskilled personnel
Unawareness of autonomous maintenance

Finally, the organization of the maintenance area warehouse for the solution of two causes, which are:
Few maintenance tools
Supplier shortages.

Objectives and Goals of maintenance management

A) Objectives
Maximize logging equipment availability by reducing downtime due to failures through planned maintenance
Guarantee the operational availability of each of the logging units for any eventuality
Improve maintenance activities in logging units through optimum reliability and availability of these.

B) Goals
The goals should be established based on basic maintenance indicators that guarantee efficient and effective development, such as those established in table 5.

Technical Analysis of Maintenance Management:

In order to know in detail the technical causes that occur in maintenance management, an effect and failure mode analysis (FMEA) has been carried out and to evaluate a certain weighting was taken into account. The degree of criticality of the equipment is taken according to the following criteria: the cost of the equipment and the degree of complexity when performing maintenance [10].

Maintenance management in current times is analyzed by reviewing a history of failures of the useful operating time of the equipment to locate them according to the range of colors and values specified below [11]:

High criticality, color Red, values $50 \leq CT \leq 125$
Medium criticality, color Yellow, values $30 \leq CT \leq 49$
Low criticality, Green color $5 \leq CT \leq 29$
The results with their respective solutions are shown below in the table.

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Table 4: Cause effect analysis (FMEA)

ITEM	COMPONENTE	MODO DE FALLO	EFECTO	SEVERIDAD	OCURRENCIA	DETECCIÓN DEL CONTROL	NPR	SOLUCIÓN	SEVERIDAD	OCURRENCIA	DETECCIÓN DEL CONTROL	NPR
1	MOTOR	Bomba de inyección no funciona	Problema de arranque y estancamiento del motor	10	5	1	50	Revisar tanque de combustible, tubos de combustible hasta la bomba de transferencia, tubos de bomba de inyección, filtros de combustible	10	4	1	40
		Motor inestable su aceleración	Baja potencia del motor	8	5	1	40	Revisión general de Fallo de encendido, válvulas y mezcla	8	4	1	32
		Cadena de Drone deteriorada	Parálisis del servicio de perfilajes	9	5	2	90	Cambio de cadena	9	4	1	36
		Manguera de Drone deficiente	Trabajo deficiente del drone	8	4	2	64	Cambio de manguera	6	2	1	12
2	CABINA	Luna de cabina rota	Dificulta para realización del servicio del perfilaje	6	4	1	24	Cambiar la luna	6	2	1	12
		Pantalla del motor en mal estado	Dificulta para el control del equipo de perfilaje	6	4	1	24	Revisión general de la pantalla por personal capacitado	6	2	1	12
		Intermitencia en el sistema de adquisición	Deficiencia en manejo de equipo	7	5	2	70	Arreglar el controlador de pantalla/actualizar o desinstalar aplicaciones incompatibles	7	4	1	28
		Chasis en mal estado	Comunicación deficiente con operadores	7	6	1	42	Revisar su sistema eléctrico componentes del chasis	6	4	1	24
		Sensores en mal estado	Control deficiente de los equipos	8	5	2	80	Cambiado antes que la situación se agrave	8	3	1	24
		Luces de tablero	Control deficiente de los equipos	8	5	1	40	Revisar sus cables o componentes	8	2	1	16
3	DIRECCIÓN	Sistema hidraulico del winche falta fuerza	Deficiente servicio de perfilaje	6	5	2	60	Revisión general de todo el sistema	6	2	2	24
		Caja de cambio en mal estado	Fugas de aceite o problemas de embrague	9	4	1	36	Desmontar la caja y comprobar que rodamientos, piñones y el eje de los componentes se encuentran en buen estado.	9	2	1	18
4	SISTEMA DE ENFRIAMIENTO	Manometro en mal estado	Baja calidad en el trabajo de la sierra	8	5	1	40	mecánica, pulsación y sobrecalentamiento. Buscar solución o	8	3	1	24
		Fallas sensor de temperatura	Control deficiente de la temperatura de los equipos	8	6	2	96	Cambiar para evitar algún accidente	8	2	2	32
5	LUBRICACIÓN	Fuga en hidrolina	Deficiente control del la unidad movil	10	5	1	50	Revisar las mangueras y juntas para encontrar posibles sitios para la fuga	10	2	1	20
		Falta de lubricación en ptos de las unidades	Deficiente manejo de los componentes de la unidad	8	6	1	48	Establecer un periodo para lubricar las unidades de perfilaje	8	3	1	24
		Fuga de aceite	Sobrecalentamiento del motor	10	4	1	40	Revisar manguera y juntas	10	1	1	10
6	SISTEMA ADMISIÓN DE AIRE	Manguera de aire defectuosa	Baja fortaleza mineria de los frenos	10	6	2	120	Revisión o cambio de la manguera	10	3	2	60
		Empaque de compresor de aire en mal	Fugas de aire	8	5	1	40	Cambio de empaques	8	2	1	16
		Presión de aire muy alto (100 psi)	Accidentes	10	5	2	100	Revisión de manómetro	10	2	2	40
		Compresor de aire en mal estado	Peligro de explosión	10	4	2	80	Revisión exhaustiva y solucionar según la falla	10	1	2	20
		Filtro de aire desgastado	Mal funcionamiento del sistema	7	4	1	28	Cambio de filtro	7	2	1	14
7	SISTEMA DE ESCAPE	Tubo de escape roto	Excesivo uso de combustible	8	4	1	32	Soldar parte afectada o cambiar según la falla	8	2	1	16
8	SISTEMA DE COMBUSTIBLE	Fuga de Diesel	Excesivo uso de combustible	8	3	1	24	Revisar manguera y juntas	8	2	1	16
		Filtro de petróleo en mal estado	Problemas de arranque	8	5	1	40	Cambio de filtro	8	2	1	16
9	SISTEMA ELÉCTRICO	Focos dañados	Parálisis de trabajos nocturnos	8	5	1	40	Revisar foco o cambiarlos	8	2	1	16
		Batería de unidad en mal estado	Daño en los componentes del motor	8	3	2	48	Revisar bornes de batería o cambiar batería	8	2	2	32
		Monitor LCD presenta falla	Bajo control del sistema	9	3	2	54	Revisión exhaustiva	9	1	2	18
		Cuchillas de corriente desgastadas	Corto circuito	10	3	1	30	Revisar cuchillas y neutrólos	10	1	1	10
10	EMBRAGUE	Embrague de trompetas en mal estado	Descontrol entre la caja de cambios y el motor	7	4	2	56	Detectar la falla y solucionar según la gravedad	7	2	2	28
11	TRASMISIONES, EJES Y PTO	Templadores en mal estado	Deficiente servicio de perfilaje	7	3	1	21	Cambio de templadores	7	1	1	7
		Cables de rotaria en mal estado	Deficiente servicio de perfilaje	7	4	1	28	Cambio de cables	7	2	1	14
12	FRENOS	Fallas en los pedales de frenos	Descontrol en la movilidad del equipo	7	3	1	21	Ajustar los pedales y revisión frecuente de estos	7	1	1	7
13	LLANTAS Y AROS	Aros delanteros presentan agujeros	Rotura del aro	6	3	2	36	Cambio de aros de llantas	6	1	2	12
		Sonido de arrastre en llanta posterior	Movimiento de fricción de las llantas	6	5	1	30	Revisión de todo el sistema de frenos y solucionar según la falla	6	2	1	12

The indicators were prepared according to the needs of having availability and reliability greater than 95%

Table N 5: proposed indicators for improving maintenance

NAME	INITIALS	DEFINITION	FORMULA	FREQUENCY	GOAL	RESPONSABLE
Availability	D	Percentage of uptime	$\frac{Hras\ periodo - Hras\ Mtto}{Hras\ periodo}$	Monthly	95%	Maintenance Coordinator
Reliability	C	Confidence level that a unit operates without failures in a given period	$C(t) = e^{\frac{-\lambda t}{100}}$	Monthly	95%	Maintenance Coordinator
Mean time between failures	TMEF	Average time between failures occur (Hours)	$\frac{Total\ Horas\ Periodo}{\sum Trabajos\ correctivos}$	Monthly	> 5% Period previous	Maintenance Coordinator
Average time to repair	TMPR	It is the average time it takes to repair a unit each time it is intervened (Hours)	$\frac{\sum Tiempos\ correctivos}{\sum Trabajos\ correctivos}$	Monthly	> 5% Period previous	Maintenance Coordinator

History of Geowell logging units

The history of the logging units must be established from the following document in which the main characteristics of each unit and their respective preventive and corrective maintenance will be described.

Documents for the logging unit history
Work report format
Maintenance control documents

Next, a control format is presented to carry out preventive and / or corrective maintenance taking into account all the components of the logging units such as: engine, cabin, steering, cooling system, lubrication, intake system of air, exhaust system, fuel system, electrical system, chassis and suspension, clutch, transmissions, axles and PTO, gimbals and spreaders, brakes, tires and rings with their respective actions as shown below.

The first document or maintenance report format is considered type A, its content apart from the components already established, contains the maintenance activities that are suggested to be carried out by component to guarantee the optimal operation of the logging units.

The type B maintenance format is designed for logging units that have completed 500 hours of operation or work in logging activities. Next, the formats type C, Type D, Type E, Type F and type G are presented, corresponding to 1,000 hours, 2,000 hours, 3,000 hours, 8,000 hours and 10,000 hours respectively.

Establishment of maintenance types

The types of maintenance to be carried out are preventive, autonomous and corrective, the latter being the one that is carried out less frequently, as long as the other two are carried out efficiently and effectively; For this, it will be defined what each one consists of.

Preventive Maintenance

It is the maintenance whose mission is to maintain a certain level of service in the equipment, scheduling the interventions of its vulnerable points at the most opportune moment. It is usually systematic in nature, that is, it is intervened, even though the team has not shown any symptoms of having a problem [12].

In the case of the company, preventive maintenance was developed according to the number of hours: A, B, C, D, E, F.

Autonomous maintenance

The term "autonomous maintenance" refers to the performance of industrial maintenance tasks by machine or equipment operators, not by professional maintenance technicians [13].

Establishment of preventive maintenance schedule

After making the definitions below, the preventive maintenance schedule according to the evaluation of each of the logging units will be presented.

Table N 6: preventive maintenance schedule per unit

GEOWELL	PROGRAMACIÓN DE MANTENIMIENTO PREVENTIVO				Fecha:		
					Revisión:	0	
EQUIPOS	**Set-20**	**Oct-20**	**Nov-20**	**Dic-20**	**Ene-21**	**Feb-21**	**Mar-21**
UNIDADES PESADAS							
GP-9			A	C	B	B	F
GP-6			A	B	C	A	B
GP-11			A	B	D	D	D
UNIDADES MASTIL							
GP-3			C	B	C	C	B
UNIDADES LIVIANAS (pick up)							
GP-11			F	B	C	C	B

Incorporation of autonomous maintenance

Once the analysis of the maintenance management problems present in the logging units in the Geowell company has been carried out and based on the implementation work carried out, the steps of autonomous maintenance are followed [14]:

Step 1: Security

The reduction of the rates of work accidents should be one of the main points before the start of any activity, since the costs generated by these are significantly high and generate losses in every organization, therefore it is important to raise awareness among all the workers of the company Geowell with respect to the following actions:

All actions or interventions to be carried out in the logging units such as cleaning, modifications and tests must try to isolate all types of energy Location of symbols and procedures easy to distinguish, as well as to interpret.

Supervise the components and subcomponents of the logging units that can generate accidents. Establish the risk points in the components of the logging units.

Step 2: Initial cleaning

Cleanliness in any situation is essential, with respect to the home and work area it allows to maintain a healthy life physically and mentally since the benefits are numerous, influencing people emotionally; since it is different to work in a totally clean area because it generates the desire to actively develop their activities to work in a totally dirty space here the mood decreases to work. Therefore, clean environments generate greater productivity, less accidents and better comfort for the worker.

The actions to be taken to have the areas totally clean are the following:

Use of the senses by the Geowell company operators, being like a kind of human sensors, to detect any type of abnormality, in this case the senses of smell, sight and touch are important when observing the components of the units. logging or touching some parts to determine if they are clean and smell to detect leaks.

Cleaning together with the inspection should prevent adjustments of the screws or parts, the condition of the wiring, oil or hydroline leaks, wear, etc.

Step 3: Elimination of sources of contamination and areas of difficult access.

The actions (FDC), Elimination of Contamination Sources and (ADA), Areas of difficult access allow to have the following benefits: with respect to the first, it simplifies the cleaning, tightening, lubrication and inspection tasks (LALI) and the second allows the non presence of ergonomic or safety problems by improving incorrect positions when carrying out operations or inspections due to the difficult access of some hidden places.

For the implementation of the FDC and ADA, the following ECRS definitions must be taken into account:

E: Eliminate sources of contamination
C: Contain and eliminate spillage
A: Relocate contamination
S: Simplify through visual controls

The actions to be taken to comply with the ECRS would be:

Implementation of cards to determine the FDC and ADA in the components of the logging units. Green, yellow and red card, to classify them as low or minimum, medium and high respectively.

Prepare a matrix of the sources of contamination and areas of difficult access that they have determined.mAnalyze the sources of contamination or areas of difficult access to take immediate and systematic actions. Document the actions taken as part of the evidence.

Implementation of interim standards for cleanliness, tightness, lubrication and inspection (LALI)

The standardization of cleaning, tightening, lubrication and inspection actions will allow all operators to have a good focus on the autonomous maintenance activities that must be carried out on a daily basis, which will allow the logging equipment to not present breakdowns, defects, losses or accidents.

The LALI standards are made up of the following activities:

Section of logging units (components).
Logging units diagram
Definition of application to unit stopped or unit operating.
Establishment of actions
Standardization of actions in logging units
Work method
Tools necessary for the development of autonomous maintenance
Frequency of carrying out activities.
Standard time to carry out the activity.
Actions to take if there is an abnormal situation of cleaning and inspection.

The key points to take into account to carry out the LALI standards are:

Placement of visual controls to facilitate cleaning, tightening, lubrication and inspection.
Officially allocate the time required for cleaning, tightening, lubrication and inspection as part of daily work.
Clarify places, methods, standard, problem solving, frequency and target time.

To measure the LALI standards, the following indicators have been established:
LITTLE: LALI time reduction.
LONG: Extend the LALI period.
A LOT: Increase in LALI points.

Step 4: Improve Operator Skills

The purpose of step 03 is for the Geowell company operators to understand and understand the basic operations of the logging units in order that they can detect small defects which can cause chronic losses through breakdowns and defects, once identified, solve them properly. Therefore, it is necessary to develop skills in these workers, thereby ensuring the proper functioning of the equipment. To achieve this step, training in the following skills is proposed:

Module in basic mechanics.
Module in hydraulics.
Module in lubrication.
Module in electricity.
Module on logging units
LALI standards module

Warehouse organization of the maintenance area

Carrying out a warehouse inventory and identifying complex spare parts

The inventory of the maintenance warehouse in Geowell must be based on the standardization of the materials, tools and spare parts that are used in the maintenance activities of the logging units. On the one hand, those that are necessary and frequently used when there is a change or replacement of a component or part that is being maintained or inspected.

Once the standardization has been carried out, an inspection of the warehouse area must be carried out with a team of three to five operators whose actions should be:
Taking photos of the strategic points of the warehouse.

Cleaning of all spaces that allow identifying materials, obsolete spare parts and tools that have already been used and should be replaced due to the space they occupy and generate utility for effective and efficient maintenance.

Review the shelves and their distribution in the warehouse.
Quantify and classify tools, spare parts and materials.
Strategically relocate shelves if necessary based on the volume and weight of tools, spare parts and materials.
Make a detailed description of each of the existing articles and tag them.
Preparation of the list of tools, spare parts and materials taking into account the quantities, descriptions and their location.

The following documents are proposed below for organization of the maintenance warehouse.
Inventory Format
Materials list sheet
Physical Stock Sheet

Identification and evaluation of suppliers

Once the organization of the maintenance warehouse of the Geowell company has been carried out, the following actions must be carried out:

Identify the most necessary and most complex spare parts for the logging units and / or components. When carrying out the needs analysis, three aspects must be considered: benefit, quality and service.

Possible suppliers that can meet the needs of the maintenance area should be sought and investigated; Aspects to be taken into account are: time dedicated to spare parts for logging units, list of tools and spare parts that meet the needs of the company, costs and quality of service, availability of spare parts, especially the most complex ones.

Once the suppliers that can meet the requirements for efficient maintenance of the logging units are known, meetings should be coordinated with the representatives of the houses or spare parts stores to establish purchase - sale mechanisms and the attention service at all times according to the materials or spare parts that are needed in maintenance activities.

Regarding the previous action, you must have at least two suppliers to be able to have the materials and spare parts at the time they are needed, especially when there are corrective maintenance because these generate untimely stops and a stock break is incurred which It is possible that the established deadlines with the services that are carried out are not fulfilled, likewise, a cost control of said materials and spare parts can also be carried out.

Geowell SAICYR is an organization considered a large company, therefore it is important to determine that its suppliers are houses or well-established spare parts stores, this means that if a company is too small, there may be an inability to meet all the requirements of the company. business.

Determining the suppliers with which to work, now you have to implement a control system based on the quality of their products and the service that accompanies it. The achievement of these quality and service objectives must be developed through automated tools such as spreadsheets to track orders placed and delivery notes received, in addition to assessing other aspects such as the delay of deliveries, the price, the delivery system. communication, corporate reputation, etc.

Finally, establish work clauses with suppliers, one must be related to the annexes that must be taken into account for better relations and the other the requirements for the attention of orders. Regarding the first, the relationship quantity versus orders must be considered to establish discount mechanisms, this will allow to determine the economic batch of materials and spare parts.In addition, the added value and general expenses must also be considered in the price of the material, thereby establishing a formula price supervision. Finally, it is necessary to prevent the fulfillment of the needs of the maintenance area and coordinate deliveries with the following characteristics, quantity of materials and spare parts, forms of packaging, date, place and time.

Therefore, the average number of failures per year is 5 failures in order to achieve 95% reliability, thereby establishing a control index that can be interpreted as there should be one failure for each quarter approximately.

Table 7. Number of hours stopped per year

TEAM	No. Hours Unemployed Period 2012 - 2019	No. Hours Stopped per year
GP-03	1296	185.14
GP-06	1656	236.57
GP-08	2016	288.00
GP-09	2664	380.57
GP-11	288	41.14
Average		226.29

Source: self made

Knowing that well services are developed during 24 hours, the cost per hour of the service was calculated, this being $ 203.88 dollars per hour, with this the cost per stop per month was determined from Table 7 where the time is determined average in hours per year which is 226.29 hours which when expressed per month corresponds to 18.86 hours / month with these data the stop cost per month is calculated according to the following calculation.

Cost of standing per month: 203.88 * 18.86 = $ 3,845.18

Now with a shutdown of 5 failures per year in hours it would be 120 hours, which on a monthly basis the machine shutdown hours should be a maximum of 10 hours, with this the cost of shutdowns per month would be:

Cost of standing per month: 203.88 * 10 = $ 2,038.8

This reduced logging unit shutdown costs by approximately 47%.

Table 8: cost-benefit of the proposal

Discount rate	10%
INCOME	$ 1 783 226.35
EXPENSES	- $ 1 251 248.05
INVESTMENT COST (Expenses + investment flow)	- $ 1 401 288.59
COST-BENEFIT	1.272561808

Source: self made

IV. DISCUSSION

All management developed in a given company or organization must be evaluated, analyzed and diagnosed within the framework of continuous improvement, as was done by reference [15] that applied the hierarchical analytical processes method, determining that planning is the second most important criterion. With 17.7%, this indicates that there must be a well-structured planning that allows to improve any process, in this case it was the proper and optimal operation of the electrical and mechanical equipment. In accordance with the research carried out, an analysis of the current situation was also developed by applying a survey to the staff of the Geowell SAICYF company and an evaluation of maintenance management through ISO 9001 standards:

After having analyzed the current situation of the Geowell company from a planning point of view; Technical evaluation is also important, which is why reliability and availability indices are basic indicators for the evaluation and analysis of equipment maintenance, in this case the reliability of the five equipment of the Geowell company was determined during the period 2012-2019 , being able to obtain an average value of all the equipment of 88.5% according to table 1 considered deficient, therefore it was necessary to investigate the reasons for the low reliability of the equipment and its proposal for improvement, this reliability value is coincident with [17] who I also analyze the reliability,

V. CONCLUSIONS

A maintenance management proposal was designed in the Geowell company whose purpose was to establish as a goal or objective the improvement of the reliability of the logging units whose indicator should be 95% with this, the number of acceptable failures per year was determined for Meeting the goal, whose value is 5 failures, which corresponded to a 120-hour annual shutdown, and in 10-hour months, the cost per shutdown was reduced by 47%.

The current state of maintenance management was analyzed with respect to the logging units, using as tools the application of a survey to the workers of the Geowell company, obtaining that said management is only complied with in 61%; on the other, maintenance management was also evaluated using the ISO 9001: 2002 standard, and the average result was that there was only 68% of maintenance management management, therefore both results gave us unfavorable information regarding the management of maintenance in the logging units of the Geowell company.

The reliability of each of the logging units was determined during the period 2012 - 2019 to then calculate the average of each one, with the results for the GP-03 unit of 87%, GP-06 unit of 86.84%, GP-unit - 08 of 86.55%; GP - 09 of 84.93% and GP - 11 of 97% being the average of all the teams in the established period of 88.46% considered deficient taking as goal a reliability of 95%.

The maintenance management proposal to improve reliability was elaborated from the application of the cause-effect and Pareto diagram, obtaining twelve causes that generated poor management, from which four improvements were established which were the maintenance management planning , establish the types of maintenance to be carried out, incorporate a training plan for maintenance personnel and finally the organization of the maintenance area warehouse

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