International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2015): 78.96 | Impact Factor (2015): 6.391

The Help Tool according to Pareto's Decision and the Notion of the Criticality of Equipment in a Production Company: Case of Mining Companies in the DRC

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Abstract: ***In a perpetual world of technological change or competition reigns in being responsible without tools capable of competing results are in vain. Pareto's decision-making tool combined with the criticality concept of Equipment has enabled us to understand the basis on which we rely to make decisions in order to improve the availability of production equipment. Let us not forget that the first mission of a company is to make profits. The hierarchization is nothing if one does not have a quick analysis of the position of the Equipment in the kinematic chain or that of production. A bad decision of a stop an Equipment lose to the company a lot of money.***

Keywords : Pareto, Criticité, décision, Equipment, entreprise, ABC

1. Introduction

In the context of decision-making based on the availability of production equipment, it was mentioned in our work that we can find decision-making mechanisms allowing us to classify the priorities of the machines on which we must intervene. Indeed, this classification is not possible if we do not pay attention to the function, the importance of the equipment in the kinematic chain or production of the company. This operational efficiency that we seek in order to be able to minimize the expenses due to the period of failure generally leads to the choice of the method of maintenance to be adopted; preventive, curative, long- or medium-term or immediate; which will ensure the lifetime of the equipment.

2. Production Plant Main Mission

The main mission of a mineral production enterprise (Copper, cobalt, gold) and to increase its profits to the least cost. Using this objective, maintenance is meant to be proximity, quality. By fulfilling its role, that of being an important support for an optimum production. Managers must be able to make sound, effective, objective decisions in order to take advantage of the downtime to the maximum within the time allowed. In general, the role of the maintenance department has always been to:

- Availability of equipment
- Reliability of equipment
- At optimal cost
- By a skilled or competent hand
- Preserving the environnent
- Being safe

Safety being a very important element, we then comes to find a simple method linking the two theories "Pareto and criticality of the equipment". It is not said that life has no price.

3. Safety-Risks

Safety and risk are two notions that combine together. In business management or project management; security generally consists in guaranteeing the security of assets, people and also the durability of the company or project. Risk is an undesired situation with negative consequences resulting from the occurrence of one or more events whose occurrence is uncertain. It is always associated with notions of probability, damage, adverse and / or dreaded events, severity. Eliminating or reducing risks ensures that the company is operating at an environmental, social and economic level, which generates the company's beneficial activity. Let us not forget that mining companies have a mission to produce safely and Lower cost. (1)

According to jean Yves monk, the risk "and the possibility that a project will not run in accordance with the forecast of completion date, cost and specifications. These deviations from the forecasts are considered acceptable, difficult to accept or even unacceptable.

So it is unacceptable to only be able to use the ABC method for the sole purpose of staggering the priority of the tasks without studying the various unexpected, alea, uncertainty and opportunity that can enable us to make a good decision.

4. Equipment Criticality

Knowledge of the production chain is very important in a production company. It is the production chain that defines daily production (money produced); and this is simply.

Function of the position of the Equipment within this chain. Each machine, however, does not have the same critical importance, or criticality in terms of production. The PARETO method should then take account of this notion of criticality in the strict sense, otherwise it would solve problems but would not answer the question of equipment availability and optimum production. It is then convenient to associate a method to estimate the level of importance. We used the PEMSEQ method (Production, Equipment, Maintenance, Safety, Environment and Quality). Which is a method based on the grid of criticality, for each Equipment one assigns a score ranging from 0 to 3.

0 being the most critical and 3 the least critical. Then, by summing the result obtained for each criterion, an overall score corresponding to the criticality of the Equipment is obtained. The lower the rating, the more critical the Equipment. By classifying the equipment according to their criticality and adding the Pareto analysis it is really possible to make a good decision prioritizing the tasks to be carried out taking into account all notions of importance of equipment in the production chain.

5. The Law of Pareto

The Pareto chart (20/80 rule or ABC method) is an important diagnostic graphic tool which presents the dominant causes of a problem and facilitates the choice of action. A criterion must be chosen to assess the problem. In general, the result is presented by a curve which must be interpreted. But this is usually easy when defining performance indicators; which are the elements allowing us to evaluate the actions taken. It defines certain steps in order to make a good decision.

Steps to follow:

- Classes causes in families;
- Establish the duration of the study;
- Issue evaluation criteria;
- Build the frequency matrix
- Draw the diagram

For Pareto, it is because a phenomenon presents uniformities that it can be the object of a scientific study. Laws are the statements of these uniformities, and the criterion of the truth of science can only be the verification by experience or observation of the statements of these laws. (2)

Pareto proposes a classification into three groups: A, B and C hence the name, method ABC. (3)

- Group A is composed of causing 80% of the effects of the phenomenon which generally represent 20% of the causes
- Group B is composed of causing 15% of the effects of the phenomenon which generally represent 30% of the causes
- Group C is composed of the causes constituting 5% of the effects of the phenomenon which generally represent 50% of the causes.

6. Maintenance Performance Indicators

6.1. Indices of maintenance

a. The MTBF, Mean Time between Failures, for average time to failure or even Average Good Operating Time, is an important parameter in the calculation of reliability. In fact, it measures the average period of time for a device to function properly, in other words the average time between two failures. Of course, at the most this one is big, at the most our equipment is reliable and produces in the best way. (4)

b.

$$MTBF = \frac{TBM}{NP} \quad (1)$$

c. The MTTR, Mean Time To Repair, Average repair time, is a performance indicator of maintenance services. It allows to define with a good probability a repair time under defined conditions.

d.

$$MTTR = \frac{TP}{NP} \quad (2)$$

So, MTTR influences availability directly but not reliability

6.2. Indicators of maintenance

Knowing the indices, we will be able to calculate the various indicators of maintenance. (5)

a. Maintainability

Maintainability defines the probability of the duration of a repair and is most often the reflection of the level of simplicity that the maintenance of a piece of equipment. It is calculated on the basis of MTTR:

$$Ma\,\text{int}\,enabilit\acute{e} = \frac{1}{MTTR} \quad (3)$$

Conversely, at the closer we get to 1, at most our maintainability is good.

b. Availability

Availability expresses the likelihood of equipment to be "available", that is, to be able to operate in a normal state (according to NF-X-60-010).

It is calculated as follows

$$Disponibilit\acute{e} = \frac{MTBF}{(MTBF + MTTR)} \quad (4)$$

An availability of X% indicates that (100-X)% of the time my equipment is in good working condition.

c. Repair rate

Last indicator often used, the repair rate, it will translate; the number of repairs carried out by maintenance per unit of time. It is calculated as follows:

$$tauxdereparation = \frac{1}{MTTR} \quad (5)$$

6.3. Costs

a. Downtime Costs

Costs of downtime are the costs of stopping production failures or losses. It is a type of cost difficult to calculate because the parameters are numerous and vary with the circumstances. It is, however, essential to evaluate them because losses of production due to failures often cost considerably more than maintenance costs. In terms of unavailability costs, an attempt can be made to evaluate the lost profit margin, uncovered fixed costs, non-reincorporated variable costs, etc., in the event of a breakdown that directly affects production. We will aim at an optimum to achieve, ie a lower total cost for these two costs

b. Maintenance costs

These are the costs directly attributable to the operation of the maintenance service. They may, however, be separated into operating or investment expenses. These costs are mainly:

- Workforce
- Spare parts and consumables (oil, grease, ...)
- Tools and maintenance equipment
- Contracts for maintenance with external companies and subcontracting
- The cost of possession of the stock of spare parts (shop, overhead,)
- Training

7. Results Interpretation

The results of this analysis showed that:

Table 1a: Stop Analysis

Lixiviation Analyses d'arrets				
	Downtime reason	Duration	Frequency	Duration×Frequency
1	planned shut down	24.1	4	96.4
2	VBF valure	12.18	4	48.72
3	Power failure	11.26	12	135.12
4	PLS stock high	7.20	6	43.2
5	Leaching tank failure	8.13	6	48.78
6	Pipeline failure	3.54	4	14.16
7	Pump failure	3.15	5	15.75
8	Non availability of trucks	3.10	1	3.1
9	LIT problem	1.10	1	1.1
10	Non availability of slurry	2.36	2	4.72
11	DCS failure	2.20	1	2.2
12	Valve Failure	1.55	1	1.55
13	CCD disturbance	1.50	1	1.5
14	Eh correction	0.15	1	0.15

Table 1a shows the different stops and frequencies.

The different facilities are:

- VBF
- Tank
- Pump
- CCD: Decanter

Table 1b: Breakdown analysis

Lixiviation Analyses d'arrets				
	Downtime reason	Critical Factor	% C.F	Cumulative % C.F
1	planned shut down	6.9	23%	23%
2	VBF vailure	3.5	12%	35%
3	Power failure	9.7	32%	67%
4	PLS stock high	3.1	10%	78%
5	Lixiviation tank failure	3.5	12%	89%
6	Pipeline failure	1.0	3%	93%
7	Pump failure	1.1	4%	97%
8	Non availability of trucks	0.2	1%	97%
9	LIT problem	0.1	0%	98%
10	Non availability of slurry	0.3	1%	99%
11	DCS failure	0.2	1%	99%
12	Valve Failure	0.1	0%	100%
13	CCD disturbance	0.1	0%	100%
14	Eh correction	0.0	0%	100%

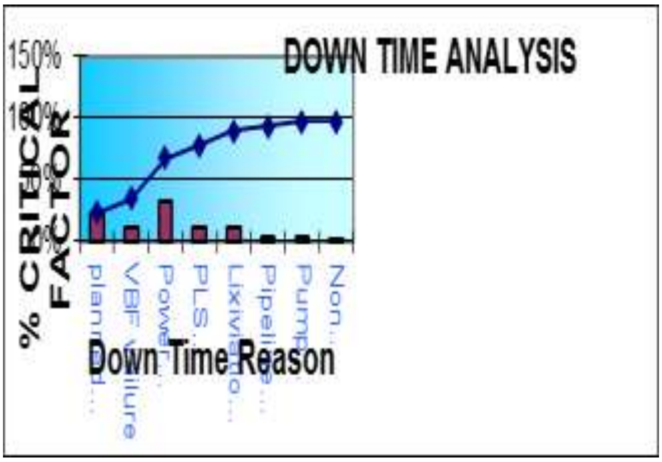

Figure 1: Diagramme de Pareto

Table 2: Action and report

Action Report Of Critical Down Time factors				
Sl. No	**Down Time Reason**	**C.F**	**Zone**	**Action Plan**
1	planned shut down	**0.23**	**A**	need to shut the plant
2	VBF failure	**0.12**		
3	Power failure	**0.32**	**B**	No availability
4	PLS stock high	**0.10**		
5	Lixiviation tank failure	**0.12**		
6	Pipeline failure	**0.03**	**C**	Correct
7	Pump failure	**0.04**		
8	Non availability of trucks	**0.01**		
9	LIT problem	**0.00**		
10	Non availability of slurry	**0.01**		
11	DCS failure	**0.01**		
12	Valve Failure	**0.00**		
13	CCD disturbance	**0.00**		
14	Eh correction	**0.00**		

Compared to the criticality analysis we have:

1. VBF
2. Power Failure
3. Leaching Tank

8. Conclusion

The ABC diagram is simple tool and handy used. In association with the tool a Knowledge of Equipment and its position in the production chain is an essential element in determining the maintenance policy to be chosen for the next intervention, we are able to demonstrate that we can establish a good maintenance plan by reducing the cost of losses from fortuitous stops. The improved availability of equipment allows us to ensure the longevity of the factories.

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