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Maintenance Resources Optimization Using Pareto Analysis:

Instrumentation Air Compressor in Oredo, Nigeria

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ABSTRACT

Managing resource allocation for optimum effectiveness at various levels of maintenance activities is always a challenging task. Optimizing maintenance resources enables an organization to set priorities towards achieving certain goals which are availability and reliability of the equipment for operational excellence. The purpose of this analysis is to determine the optimum resources allocation proportions among the failure modes and to identify the failure modes that have the greatest cumulative effect on the equipment's downtime. This paper presents a methodology using the Pareto analysis in conjunction with failure mode effect and criticality Analysis in maintenance resources optimization. The approach is based on ensuring all failure mode criticality number are considered to obtain the significant failures mode that you should focus on as a priority. The analysis shows that failure mode; FM5, FM 3, FM 2, FM 12, FM 7 and FM 13 are confirmation to the Pareto principle, identifying that most of the downtime of the Instrumentation Air Compressors originated from these failure modes.

KEYWORDS

Failure Mode, Pareto Analysis, Optimization, Maintenance, Resources, Availability, Reliability

1. INTRODUCTION

Maintenance resources optimization consists of the development and analysis of mathematical models aimed at improving or optimizing maintenance resources allocation. Resource allocation is a critical task in the oil and gas industries. Effectively allocating resources is critical to the success of any project or initiative. Resource allocation is the process of assigning and managing resources to meet equipment maintenance requirements and achieve organizational goals which is availability and reliability of these equipment. It involves balancing the needs and constraints of the project with

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the resources available. Resource allocation can be a complex task in maintenance activities, and organizations need to have a systematic approach to ensure that they allocate resources effectively.

There are several different approaches to resource allocation, each with its strengths and weaknesses. One approach that has gained popularity in recent years is Pareto analysis. Pareto analysis is a statistical technique in decision making that is used for the selection of a limited number of tasks that produce significant overall effect. The results of a Pareto analysis are typically represented through a Pareto cart. Talib et al. (2010) presented a study to identify and propose a list of “vital few” Total quality management (TQM) and critical success factors (CSFs) for the benefit of researchers and service industries practitioners, quality tool “Pareto analysis” was used to sort and arrange the CSFs according to the order of criticality. They concluded that top-management commitment was listed as the top CSFs with customer focus and satisfaction close behind. Pareto chart is a graphical tool that helps to break a big problem down into its parts and identify which parts are the most important (Talib et al., 2010). One key area in addressing inefficiencies is to find out where limited resources should be deployed to create maximum benefit. The Pareto analysis is also referred to as the 80-20 rule or the rule of the “vital few”, holds that much of any given set of effects or outcomes (80%) can be attributed to result from a minority of causes (20%) (Joiner Associates, 1995). Pareto analysis is a problem-solving technique that involves identifying the 20% of factors that contribute to 80% of the results. In the context of resource allocation, Pareto analysis can be used to identify the resources that have the most significant impact on project outcomes. In the oil and gas industry the factors or events that contribute to the results (unreliability/downtime) are the failure mode of the equipment or components, hence we talk about failure mode effect analysis (FMEA). When extended by Criticality Analysis procedure (CA) for failure modes classification, it is known as Failure Mode Effects and Criticality Analysis (FMECA). Ora et al. (2017) discussed the failure mode effect analysis of various equipment used in ceramic industry and identify the hazards associated with all those critical equipment which may lead to life loss, property damage or may cause harm to environment also. A total of seven different equipment was considered so that based on risk priority number, Pareto chart was drafted and on the basis of their findings action plan can be suggested. Their results will provide significant insights for the management in dealing with the issues of numerous hazards which may lead to mishap, based on RPN and if it is significant then refer action plan to resolve it as per their need. Aziz et al. (2013) discussed the use of pareto analysis to determine the allocation proportions among these groups and to identify the faculties that have the greatest cumulative effect on the university budget allocation. From their analysis they identified the areas of highest financial operation management allocation that have the greatest cumulative effect on the university’s overall budget. The study established that ten faculties have been identified as dominant faculties since they received high budget allocations in proportion to the total university’s budget. These results will provide significant insights for the management in dealing with planning budget allocation. Khan et al. (2019) presented a methodology to analyse and improve the allocation of junior doctor resources through the study of pager calls using the Pareto principle. Their analysis of the pager frequency data showed confirmation to the Pareto principle, identifying that the majority of calls to the junior doctor/resident originate from a limited number of departments/locations. Such analysis has allowed a restructuring of resources, to better streamline departmental efficiency. De Castro, & Cavalca (2006) presented an availability optimization of an engineering system assembled in a series configuration, with redundancy of units and corrective maintenance resources as optimization parameters. His optimization method used a Genetic Algorithm based on biological concepts of species evolution. Their results indicated that the methodology is suitable to solve a wide range of engineering design problems involving allocation of redundancies and maintenance resources. The main contribution of their work is the availability optimization considering redundant components and maintenance resources. Schoenmakers, & Zeiler (2017) discussed the application of the Pareto Principle in the context of designing nearly Zero Energy Building (nZEB) hospitals. Braglia et al. (2003) presented an alternative multi-attribute decision-making approach for prioritizing failures in failure mode,

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