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Investigation into the Interaction of Failure Mode Effect Analysis, Overall Equipment Effectiveness, and Reliability Allocation

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Abstract

This paper made an attempt to establish a relationship between failure mode effect analysis (FMEA), overall equipment effectiveness (OEE), and reliability allocation (RA). All the parameters of OEE (i.e. availability, performance rate and quality Rate) are evaluated with respective to FMEA (i.e. severity, occurrence and detection) and also reliability allocation (i.e. intricacy (I), state-of-the-art(S), performance time (P), and environment (E)). All hypotheses are analyzed by using the statistical software of SPSS. The results of statistical analysis showed that there is a positive relationship between OEE and RA and an inverse relationship FMEA and RA as well as between OEE and FMEA.

Keywords:

OEE; FMEA; Allocation; Regression analysis; Hypothesis

1 Introduction

1-1 FMEA

Failure mode and effects analysis (FMEA) has proven to be a useful and powerful tool in assessing potential failures and preventing them from occurring. According to definition of Chrysler [1] failure mode and effect analysis can be described as a set of purposeful activities to identify and evaluate potential failures in productions, processes and their effects. Failure means inability to fulfill to desire process or necessity function that result in a low quality a bind of problem or service as perceived as a reason of dissatisfaction by the customer. FMEA is prevention methodologies that have the capacity to with engineering and permanent method. This method is very significant in showing potential failures in production, process and provides effective management a powerful technique for system safety and reliability analysis of products and processes in wide range of industries-particularly aerospace, nuclear, automotive and medical [4, 5]. This technique is yet another powerful tool used by system safety and reliability engineers/analysts to identify critical parts, functions and components whose failure will lead to undesirable outcomes such as production loss, injury or even an accident. The main objective of FMEA is to discover and prioritize the potential failure modes by computing risk priority numbers (RPNs), which is a product of the risk factors occurrence (O), severity (S) and detection (D) [6]. Occurrence and severity are the frequency and seriousness (effects) of the failure, and detection is the ability to detect the failure before it reaches the customer. The three risk factors are evaluated using the ratings (also called ranks or scores) from 1 to 10. Generally, the higher RPN of a failure mode, the more important degree it should be assigned. With respect to the scores of RPNs, the failure modes can be ranked and then proper actions will be preferentially taken on the high-risk failure modes.

1-2 OEE

Overall Equipment Effectiveness (OEE) is a way to monitor and improve the efficiency of your manufacturing process. Developed in the mid 1990's, OEE has become an accepted management tool to measure and evaluate plant floor productivity. OEE is broken down into three measuring metrics of Availability, Performance, and Quality. These metrics help gauge your plant's efficiency and effectiveness and categorize these key productivity losses that occur within the manufacturing process. The world class standard of OEE as stated by frost and Sullivan (2005) is 85% derived from three OEE factors with Availability 90%, Performance 95% and Quality 99%. However, based on the OEE rating, it is impossible to meet the actual demand. Based on the initial observation, it is found that the actual setup time required is longer than the setup time claimed by the production. OEE empowers manufacturing companies to improve their processes and in turn ensure quality, consistency, and productivity measured at the bottom line. By definition, OEE is the calculation of Availability, Performance, and Quality. $OEE = Availability \times Performance \times Quality$ OEE begins with Planned Machine Run Time and with reductions from the three metrics, Availability (Downtime Losses), Performance (Speed Losses), and Quality (Quality Losses) determines the Final Machine Run Time. Availability takes into consideration any Down Time Losses Performance takes into consideration any Speed