# FMECA Analysis (A Heuristic Approach) For Frequency of Maintenance and Type of Maintenance

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**Abstract --** Present study is an approach for finding the suitable maintenance practice and frequency of maintenance with the help of criticality factor of equipment it is based on failure mode evaluation and criticality analysis. Criticality means the failure probability of the equipment is very high. The miner failure of critical equipment may leads to sever impact on the performance of the equipment. So critical equipment needs very high degree of maintenance activity and maintenance frequency to prevent any failure. This model has implemented in process industry and many OEE like factor has been improved.

**Key-words-** FMECA, Criticality Factor, and Overall Equipment Effectiveness

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## 1. INTRODUCTION

The Failure Modes and Effects Criticality Analysis (FMECA) is really an extension of the FMEA, focusing on the quantitative parameters for a criticality assigned to each probable failure mode, and is discussed below. A widely accepted military standard for conducting FMEAs is Mil-Std-1629. This military standard details the specifics in conducting a FMEA. Like any analytical tool, if used and implemented correctly the FMEA is a powerful design engineering aid, and is used in the aerospace, military, automotive and space sectors. These industries have their own variance on how to and why conduct a FMEA, however their intent is the same. For instance NASA focuses on the qualitative aspect of failure modes and their effect on a system, rather than a quantitative approach, which would not be the case in conducting a FMECA as opposed solely to a FMEA. Supporting the NASA FMEA process is a Critical Items List (CIL). This list contains all the failure modes that would have catastrophic effects on a system or mission. The Failure Modes and Effect (Criticality) Analysis is termed as a bottoms up analysis. The FMEA is based on an qualitative approach, whilst the FMECA takes a Quantitative approach and is an extension of the FMEA, assign a criticality and probability of occurrence for each given failure mode. Maintenance is now a significant activity in industrial practice. According to Halasz et al [1] on the 1996 costs of maintenance across 11 Canadian industry sectors. "In addition to every dollar spent on new machinery. An additional 58 cents is spent on maintaining existing equipment. This amounts to repair costs of approximately $15 billion per year". .As a consequence. The importance of maintenance optimization becomes obvious. According to a survey conducted by Jensen [2] based on MATH DATAB.ASE of STY. From 1972 to 1994, the number of publications with keyword "Reliability" is $3521 and in addition. 1909 papers have keywords "Maintenance" or "Repair". These papers account for about 0.8% of all mathematical publications which are related to reliability and maintenance. This shows the importance of this field and in the meantime. The difficulty of providing a complete overview on the subject. Several intensive surveys can be found in the journal of Naval Research Logistics Quarterly. Where Pieskalla and Voelker [3] has 259 references. Sherif and Smith [4] has an extensive bibliography of 52.1 references and Valdez-Flores and Feldman [5] has 129 references. Certainly it is getting harder and harder to grasp this huge and growing field. Attempting to summarize this field with several universal optimization models is definitely infeasible. The different maintenance policies are used depending on the characteristic of the equipment. The complexity of maintenance planning is through higher because of some characteristic that distinguish from other types of scheduling (Noemi & William, [6]). Waeyenberg and Pintelon, [7] proposes a maintenance policy decision model to identify the correct maintenance policy for a particular component.

## 2 .CRITICALITY ANALYSES

### Criticality Analysis

<u>Criticality analysis is based on failure mode evaluation analysis.</u>
Criticality means the failure probability of the equipment is very high. The miner failure of critical equipment may leads to sever impact on the performance of the equipment. So critical equipment needs very high degree of maintenance activity and maintenance frequency to prevent any failure

Criticality Factor = Frequency Factor X Severity Factor X Protection Factor

Where,

**Frequency Factor:** It is a number awarded depending on the frequency of failure. More the no. of failure more is the value given to the factor.

**Protection Factor:** It is a number awarded on the account of ease to protect the equipment from failure. Minimum no. is given when protection against the failure is easy. Maximum no. is given when protection against the failure is very difficult.

**Severity Factor: Severity** factor represents the effect level of failure on the equipment on the basis of down time, scrap rate and safety

Severity Factor = (Down time factor + scrap rate factor + safety factor)

**Down time factor**

It is the no. awarded in accordance with the failure time associated to the equipment. More the down time more is the factor, less the down time less is the factor.

**Scrape rate factor**

If the chances to scrap the whole equipment or component in the case of failure are high then the scrap factor value is taken more and in the case of less chance to a scrape the equipment or component factor value is taken less.

**Safety factor**

It represents risk associated in the case of failure. If the chances of injury (both man and machine) are high in the case of equipment failure more is the value given to the safety factor and less the chances of injury, less is the value given to the safety factor. On the basis criticality factor of all the component of the any industry is calculated.
This process is given the name **failure mode effect and criticality analysis (FMECA).**
The factors associated to the criticality analysis have different impact level on criticality of the equipment so different range or weightage is provided to them

| | Factor | Range of Weightage |
|---|---|---|
| 1. | down time factor | 1-10 |
| 2. | Scrape factor | 1-5 |
| 3. | Safety factor | 1-20 |
| 4. | Protection factor | 1-10 |
| 5. | Frequency factor | 1-15 |

Allocation of TBM and CBM schedule on the basis of criticality factor value

| Criticality factor value | Maintenance practice | Frequency of maintenance |
|---|---|---|
| More than 1000 | TBM & CBM both | Daily or twice a day |
| Between 1000 to 500 | CBM | Daily or twice a week |
| Between 500 to 200 | CBM | Weekly |
| Between 50 to 200 | CBM or breakdown maintenance | Monthly or fortnightly |
| Less than 50 | Breakdown maintenance | At the time of failure |

## 3 HOW IT WORK IN PROCESS INDUSTRY

**FLOW CHART FOR CRITICALLY FACTOR VALUE**

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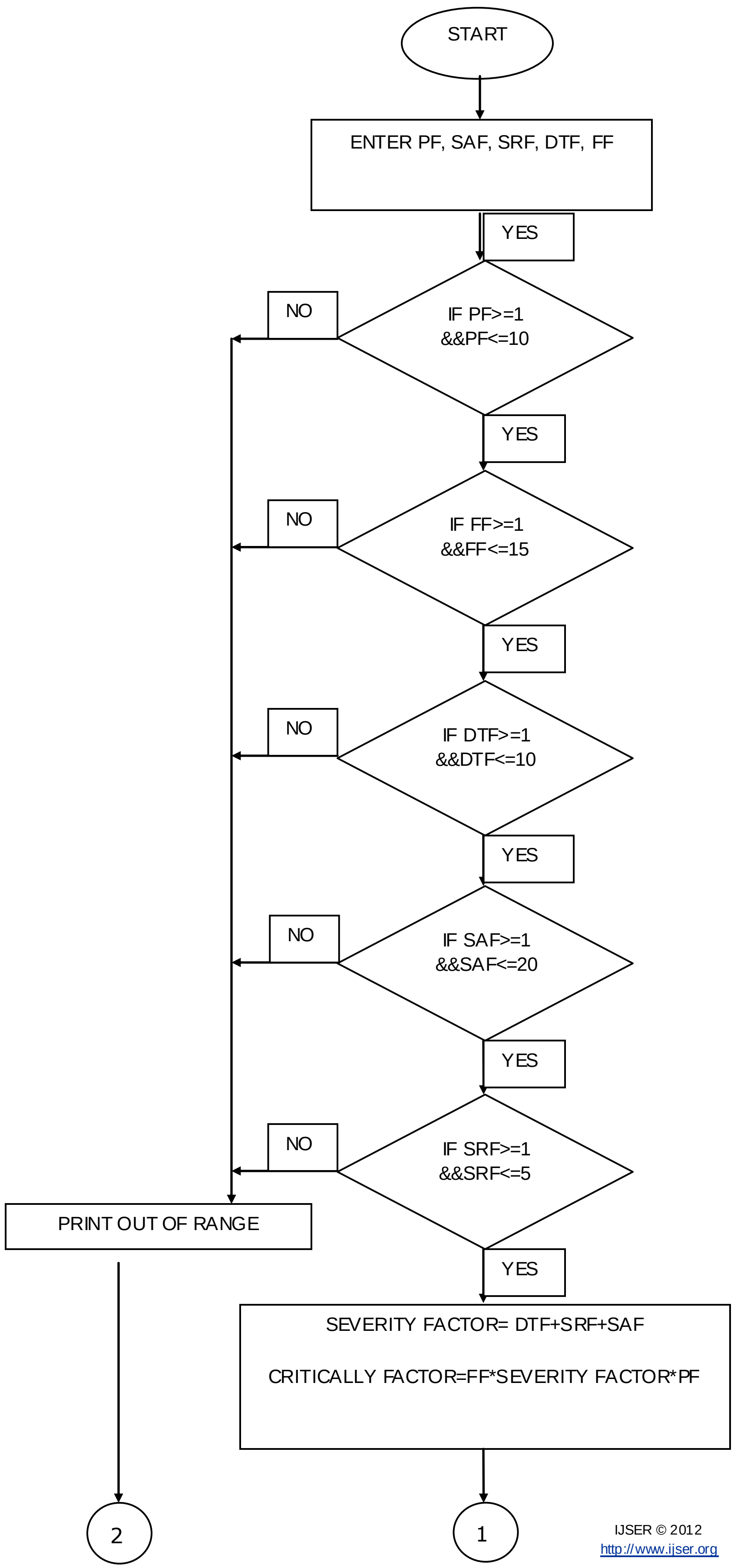


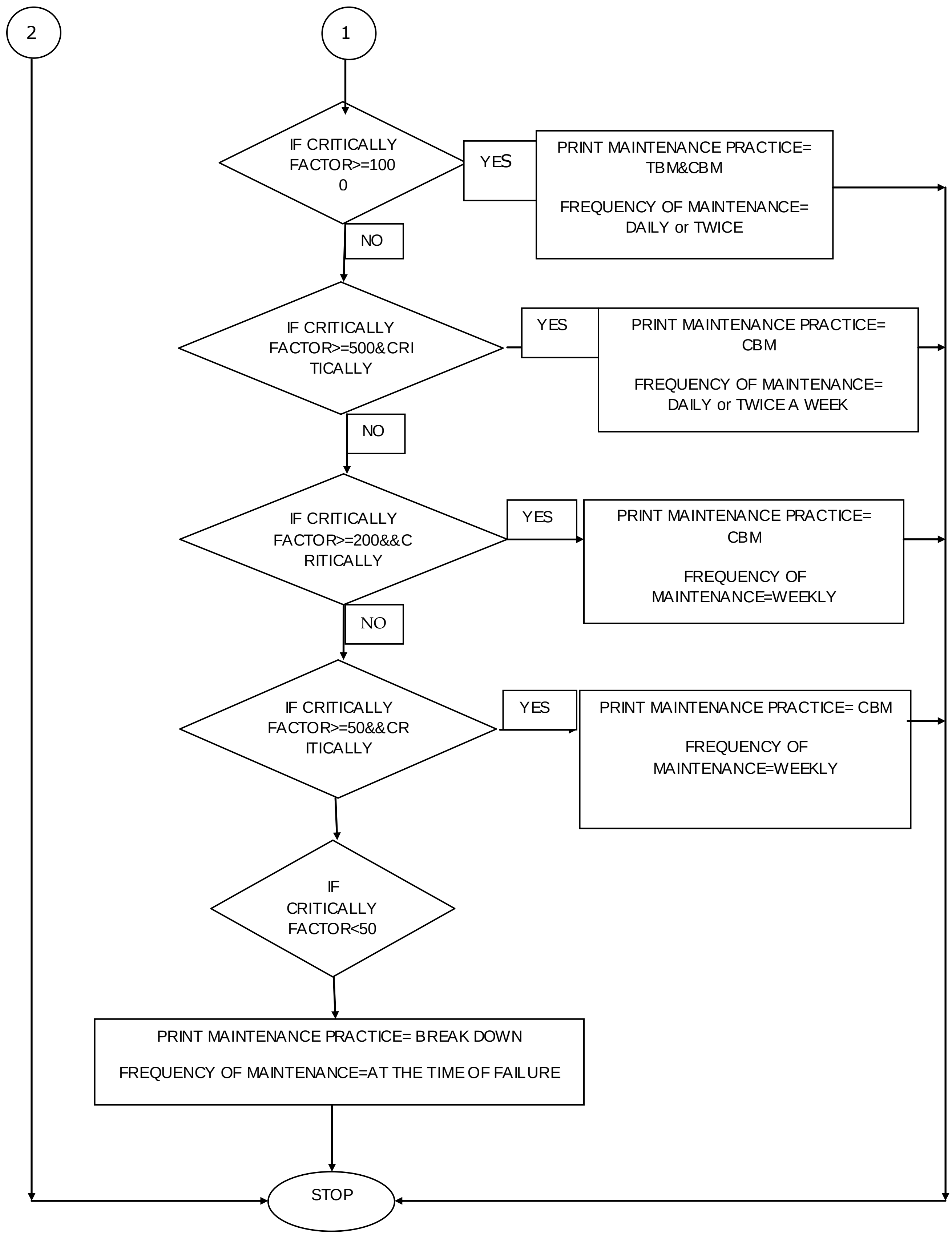

Were,

PF=PROTECTION FACTOR

SAF=SAFETY FACTOR

SRF=SCRAPE RATE FACTOR

DTF=DOWNTIME FACTOR


2
1
IF CRITICALLY FACTOR>=1000
YES
PRINT MAINTENANCE PRACTICE= TBM&CBM
FREQUENCY OF MAINTENANCE= DAILY or TWICE
NO
IF CRITICALLY FACTOR>=500&CRITICALLY
YES
PRINT MAINTENANCE PRACTICE= CBM
FREQUENCY OF MAINTENANCE= DAILY or TWICE A WEEK
NO
IF CRITICALLY FACTOR>=200&&CRITICALLY
YES
PRINT MAINTENANCE PRACTICE= CBM
FREQUENCY OF MAINTENANCE=WEEKLY
NO
IF CRITICALLY FACTOR>=50&&CRITICALLY
YES
PRINT MAINTENANCE PRACTICE= CBM
FREQUENCY OF MAINTENANCE=WEEKLY
IF CRITICALLY FACTOR<50
PRINT MAINTENANCE PRACTICE= BREAK DOWN
FREQUENCY OF MAINTENANCE=AT THE TIME OF FAILURE
STOP

## 4. RESULT

The presented knowledge model defines a structure for maintenance system model. This is logical tool for finding maintainance of machine which need more care for avoiding failure with the help of this model first we collecting data for crticality of machine parts and then on the basis of FMCA analysis(a heuristic approach) for example we can see if Criticality factor(CF)in a range of 1000 to 500 then Maintainnance practice(MP) is CBM & Frequancy of maintainance (FM)will be daily or twice a week. On the basis of criticality analysis some of the factor has been improved.

## 5. CONCLUSIONS

In this paper the complexity of different main areas and parameters or performers in a system has been discussed. Companies need to be increasingly aware of the parameters affecting their production systems. It might be better to optimize one main area and some parameters first. In this paper, assumptions have been made that refer to FMECA, Criticality factor. The study is very helpful for new industry or small scale industry for selecting the best maintenance practice and frequency of maintenance for economic point of view it is new concept for selection of maintenance practice and enhance the moral of employee for taking a strong decision. The time consumption for taking a decision is less in this concept

## ACRONYMS

- **FMECA-** The Failure Modes and Effects Criticality Analysis
- **FMCA**- Failure mode effect analysis
- **CF-**Criticality factor
- **OEE** –Overall Equipment Effectiveness
- **MP-**Maintenance prevention
- **CBM-**Condition base maintenance
- **TBM-**Time base maintenance

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