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Importance of Fracas toEnsure Product Reliability: A Theoretical Perspective

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ABSTRACT:*FRACAS is an acronym for failure reporting, analysis and corrective action system. This paper studies uniform requirements and criteria to implement a Failure Reporting, Analysis and Corrective Action System. FRACAS is intended to provide management visibility and control for reliability and maintainability, improvement of hardware and associated software by timely and disciplined utilization of failure and maintenance data to generate and implement effectively corrective actions to prevent failure recurrence and to simplify or reduce the maintenance tasks. It is an excellent reliability tool that can be used to control or eliminate repetitive failures to attain sustainable development. This is a process based on giving importance to every failure by collecting data from detailed failure reports. Design, production and maintenance each area plays its own role in failure. Many times the cost of failure remains unknown because the causes of failure are so many. However, time and costs will nearly always be saved in the long run if the first occurrence of every failure mode is treated as a problem to be investigated and corrected.*

Keywords:*failure, reliability, corrective action, analysis, continuous improvement*

I. INTRODUCTION

Failure Reporting Analysis and Corrective Action System (FRACAS) is an excellent reliability tool to ensure product and process improvement by eliminating failures; if correctly applied. FRACAS requires data to be collected from all the stages of a product lifecycle, i.e. design, development, maintenance etc. Failure reports can come in many forms. The key is to have a disciplined plan to review failure reports over a time period and then to develop actions toeliminate failures [1]. To fulfil this purpose failure review board is required to be set up with the task of assessing failures, instigating and monitoring corrective action and monitoring reliability growth [2]. Finally FRACAS helps to determine failure mode for a system. FRACAS produces highly realistic solutions if applied with FMEA/FMECA. It is a closed loop system which leads to continuous improvement by eliminating failures. By implementing FRACAS, a reactive system turns into a proactive system, which is highly favorable for a continuous improvement process.

II. FAILURE REPORTING

All failures which occur and noticed, are to be reported in details. While filling failure reports sometimes it seems very tedious and time consuming. But, in long run this exercise saves both time and cost. It is possible to report failure in different forms. The attention should be given to build up a disciplined plan to review failure reports and to develop action to eliminate reported failures. Failure report types given in Table 1 can be included as a part of FRACAS. A clear, simple and compact form can be used for reporting of failures occurring in a process. The below mentioned points should be covered in the failure reporting form [2].

a) Date/time of failure.
b) Lot number.
c) Part number (if available).
d) Failure classification (e.g. design, manufacturing, maintenance).
e) Brief description of failure.
f) Equipment operating time at failure.
g) Operating conditions.
h) Immediate action taken (if any).
i) Report of investigation.
j) Recommendations to correct failure mode.
k) Corrective action follow-up.

Table I: Types of reports

Reports	Remarks
Part-Defect-Cause Report	Should be reported monthly by maintenance and reliability engineers. This report can identify common failure threads within operations. Resolving these issues can make a quick impact on failure elimination.
Cost Variance Report	Should be reported by production supervisor to maintenance and production management on a monthly basis. This report should not be acceptable without the reason of variance.
Mean Time Between Failure (MTBF)/Mean Time Between Repair (MTBR)	Should be reported by maintenance or reliability engineers on a monthly basis on the top 5 – 20% of critical equipment.
Asset Health Report	Should be reported by the maintenance management to production management on a monthly basis. RED carding is to be done in case of assets with identifiable defects, till the elimination of the defect.

III. FAILURE REVIEWAND ANALYSIS

A failure review board is to be set up including the project reliability engineer and the designer. Other persons who might be able to help with the solutions, such as the quality engineer, can also become a board member. The failure review board is a team which works together to solve problems. It is very easy and tempting to disregard a failure as 'irrelevant'. But the board is to verify all reported failures as actual and is to determine how critically it is affecting the process. Failure verification is determined either by repeating the failure mode on the reported item or by evidence of failure [3]. Verified failures are to be analyzed to determine the cause of failure. The investigations and analysis of failures can consist of any applicable method (e.g. Root Cause Analysis, dissection, X-ray analysis, microscopic analysis etc.) that is necessary and fittest to determine the failure cause.

The board is also responsible to ensure that the corrective action taken is effective in preventing further recurrence of the failure. The failure review board has similarities with quality circle in the style of operation. It is recommended to implement the solutions given by the board as quick as possible. If the board cannot decide on immediate action, then the project management should be reported immediately.

IV. KAIZEN LOOPOF FRACAS

After a failure is reported, analysis of Part-Defect-Cause on critical assets helps to make improvement in operations reliability. The Kaizen loop of FRACAS is given in Fig. 1[4]. The loop begins with Work Order History Analysis. Depending on this it is decided that whether we need to apply Root Cause Analysis (RCA), Reliability Centered Maintenance or Failure Modes and Effect Analysis (FMEA) to eliminate the reported failures. The result of RCA leads to the necessary adjustments required to prevent or predict failures. Depending on the results of the previous activities, failure modes are determined. But, it is very difficult to determine actual failure modes and it requires thorough analysis. Determining a correct failure mode is a function of correct data collection. Performance monitoring after strategy adjustment may uncover new failure modes which was not considered during application of the new strategy. Now a new failure code can be made to track the new failure mode during the review of work order history. This is a continuous improvement loop or Kaizen loop of FRACAS. To attain this continuous improvement by implementing FRACAS, the process should be necessarily repeatable and disciplined.

Figure1: kaizen loop of failure reporting analysis and corrective action system

V. FRACAS WITH FMEA

Equipment failure are typically caused by the catastrophic failure of an individual part [4]. The primary goal of a Preventive Maintenance is to eliminate the cause and prevent the failure to occur, whereas a Predictive Maintenance or Condition Based Monitoring focuses on detecting defects and manage the potential failures before they become catastrophic. The best way to identify failure modes is to use a facilitated process [1]. It will be found that a small number of failure codes are covering a large number of failure modes. It is recommended to train a small team on the concept of Part-Defect-Cause analysis. Fig. 2 is elaborating an example of the concept. The analysis shall be done on the basic equipment types, such as bearings, gear boxes, pumps, motors etc. The failure modes developed during this exercise can later become the basis for the Reliability Centered Maintenance (RCM) and Failure Mode and Effect Criticality Analysis (FMECA).

Although FRACAS and FMEA are designed and capable of being performed independently, they can produce more effective solutions when applied together. The primary goal of FMEA is to eliminate a failure or to minimize its effects. The FMEA/FMECA is an analytical approach to determine failure modes and the effects of the failure on the process. FRACAS is involved in eliminating actual failures based on 'real world' experiences. FMEA can benefit FRACAS by providing a comprehensive failure effect and failure severity information for the assessment of actual failures. Whereas FRACAS provides a means of verifying the completeness and accuracy of the FMEA.

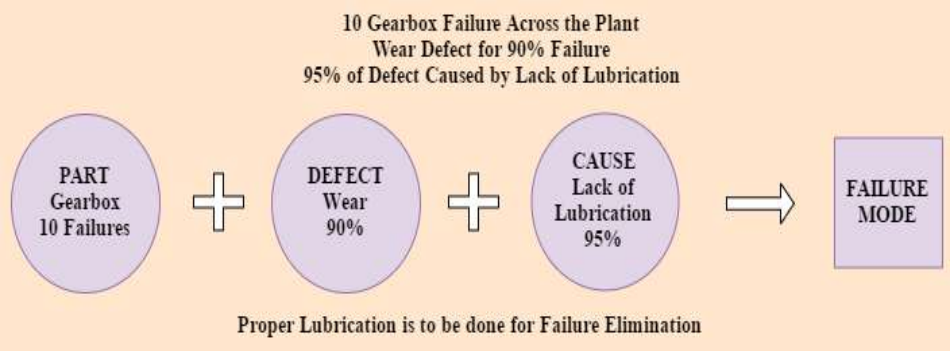

Figure2: part-defect-cause analysis

VI. EFFECTIVENESSOF CORRECTIVE ACTION

After the determination of failure, a corrective action shall be developed, documented and implemented to eliminate or to reduce the effect or to reduce the recurrence of the failure. Approval from the responsible authority is required for implementation of the corrective action. After implementation of corrective action, it is recommended to repeat the test which generated the failure to ensure that the corrective action is effective. Sometimes implementation of a corrective action uncovers a new failure mode. Therefore, retest is also important to ensure that no new problems has been introduced to the system. Detailed analysis of the test results helps to determine the effectiveness of the corrective action taken. But, unless the failure mode is very well understood, it is recommended that total effectiveness should not be assumed.

VII. IMPLEMENTATIONOF FRACAS

Maintenance strategy is a detailed prescriptive plan to preserve or protect an asset. This involves all elements that take the plan toward a common goal. An effective maintenance strategy includes Preventive or Predictive maintenance program based on Part-Defect-Cause report, Asset Criticality Analysis, Failure Mode Elimination Strategy etc. FRACAS is the last part of the maintenance strategy. FRACAS is something that must be sustainable because it is the continuous improvement process for the maintenance strategy. Following are the basic steps to implement an effective FRACAS [5].

a) Determine the goals and success factors for the organization.
b) Map the process workflow.
c) Create a data collection plan.
d) Determine organizational roles and responsibilities.
e) Create FRACAS Policies and Procedures Manual, clearly indicating the items determined in steps (a), (b), (c) and (d).
f) Implement a pilot FRACAS program and accept feedback.
g) Develop and execute a FRACAS training plan.
h) Implement company-wide FRACAS.
i) Monitor and adjust.

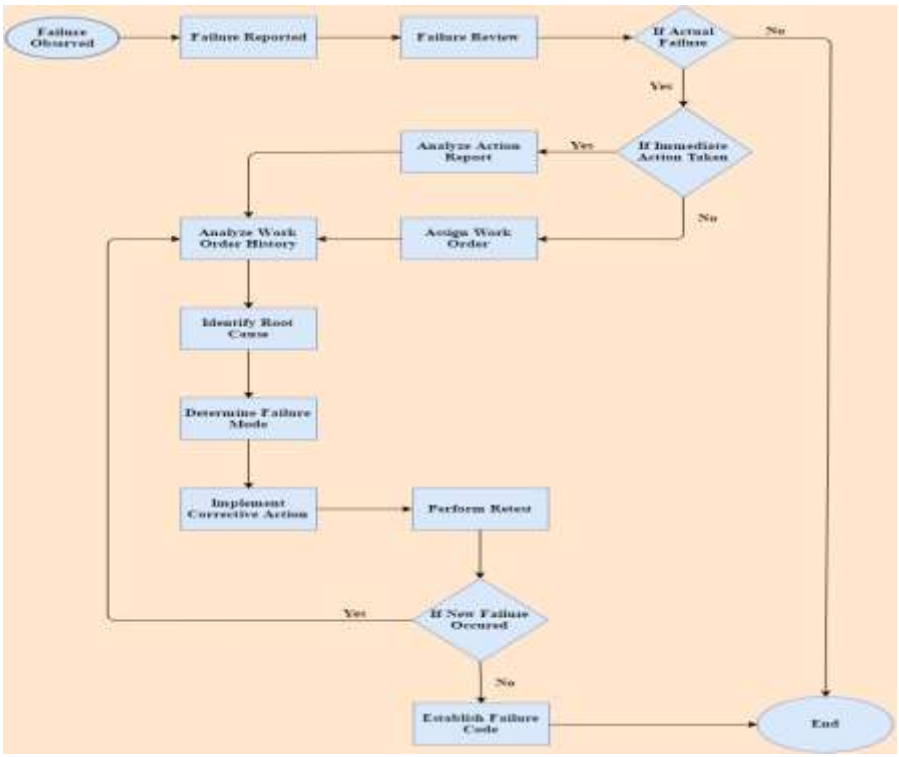

Figure3: flowchart of failure reporting analysis and corrective action system

VIII. CONCLUSION

Correct implementation of FRACAS will benefit the entireorganization by speeding up the developmentprocess, reducing failure, accumulating useful information and improving product reliability. Fig. 3 is showing a simplified flowchart of functioning of FRACAS. Some potential application and benefits of FRACAS are as follows [6]:

a) Provide a closed-loop system for managing corrective actions.
b) Streamline incident reporting and problem resolution activities.
c) Address data capture and management deficiencies to provide timely and accurate product reliability, quality and safety.
d) Contribute to design improvements, faster product release, better service and enhanced customer satisfaction.
e) Benefits in business through better product designs, enhanced control of product warranties and more efficient customer support.

This paper have covered the importance, benefits and general application structure of FRACAS. Whereas this study have not mentioned various web based FRACAS applications and reliability software, which is the latest trend in implementation of FRACAS. Implementing a FRACAS system involves multiple functional departments and sometimes need to change the company's culture. FRACAS is not a quick fix solution, it may take years to make the implementation successful.

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