# FRACAS as a System for management of Events, People and Processes

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## *INTRODUCTION*

Failure Reporting, Analysis and Corrective Action Systems (FRACAS) are widely used in today's practice in almost every industry. While the principles of FRACAS development and operation are well known and defined in various standards (military, industrial, commercial), the resulting picture is not always satisfactory.

It is not sufficient to see FRACAS as a "technical" data collection and data processing system. It is important to see and understand the function of FRACAS as a management system. In the framework of FRACAS, multiple management functions, related to events, people and processes, are implemented.

Many FRACAS applications suffer from various deficiencies in definition and implementation, and as a result, the benefits from them fall behind the expectations.

This paper focuses on some of these deficiencies – potholes on the way to successful, useful FRACAS. The article is based on practical experience from existing failure reporting systems. It presents the problems, together with recommended methods to avoid them or control their negative impact.

This paper deals with many tasks of FRACAS definition, implementation and operation. Since success of FRACAS depends heavily on appropriate definition (requirements, approaches, algorithms etc.), the definition stage of system life is at the focus of attention. However, various aspects of data analysis and reporting are also addressed.

Among practical problems addressed in the paper, the issues of elapsed time and utilization measurement, standardization of failure reporting, identification of repetitive failures, methods of meaningful analysis on the basis of minimum data, issue of the management of FRACAS process, human errors and many others are presented.

For each of those problems, appropriate control methods are recommended, on the basis of extensive practical experience, acquired by the authors in practical failure reporting systems.

### *Corrective Action Processes*

The main purpose of FRACAS is to enable continuous improvement of the product via the mechanism of corrective actions. The process of definition, selection, implementation and verification of efficiency of corrective actions is one of the most critical parts of FRACAS, and it defines, to great extent, its success.

Corrective Actions (CA) are the "heart" of FRACAS, and good definition and implementation of the processes related to CA are crucial in order to get maximum return on the investment in FRACAS system.

In reality, this part of FRACAS is often completely overlooked, and the system is used only as a "technical" data management utility.

The logical process of CA in FRACAS should follow a systematic method for problem resolution, the most commonly used – the 8D method.

Typically, a CA process based on the 8D method will include the following steps:

1. Definition of the relevant team members to take part in the corrective action process
2. Description of a problem, which requires corrective action
3. Containment of the problem as a group of similar failures/events
4. Definition of possible root causes and possible corrective actions
5. Selection of the most appropriate corrective action
6. Implementation of the CA
7. Verification of effectiveness of the CA
8. Closure of the case in FRACAS – prevention of reoccurrence.

The identification of problems requiring corrective actions is usually based on the following criteria:

a. Recurrent failures of similar nature (similar part number, failure mode, end effect etc.)

b. Inconformity with Targets/KPI's (i.e. incompliance with reliability requirements or with expectations based on similar equipment),

c. Safety failures or high damage failures.

Identification of problems requiring corrective actions should be built in, to the most possible extent, into automatic algorithms of FRACAS, in order to ensure timely and precise identification of the problems. Subsequent process of alerts and information flow to the relevant decision makers must make high visibility and traceability of the findings.

Definition of possible corrective actions requires participation of various functions, according to the nature of the root problem: designers, manufacturing engineers, ILS/Maintenance specialists etc.

Selection of the preferred corrective action is based on various criteria. In most cases, the dominant criterion is the economic one. This is because of considerable direct cost of design changes and/or other corrective action, together with such indirect costs as delay of product deliveries etc. Accordingly, this process requires participation of management.

A corrective action cannot be considered completed, unless its effectiveness is verified. Proper verification of effectiveness of a CA may require a long follow-up, and not always appropriate resources are allocated to this process. As a result, the effectiveness of a CA is estimated on the basis of "engineering intuition", and recurrence of the problem may consequently follow.

The entire CA process, including all its phases, is a complex multidisciplinary process, which requires involvement of large number of people, representing various functions. The CA process may be long and it may involve multiple actions: reviews, analyses, follow up etc. Thus, effective management of the CA process is required in order to complete it successfully, while minimizing necessary resources. Appropriate FRACAS software may support these management functions, making the management tasks easier and more efficient.

### *Data Collection Process*

Failure reporting is the primary process in FRACAS systems. Organization and management of this process defines how complete and how reliable the FRACAS data base will be. Poor organization of data collection process inevitably leads to poor quality of data, and consequently, poor data analysis and problem identification. The result is lack of ability to effectively define and implement Corrective Actions.

Even in highly sophisticated modern FRACAS, the primary task of data collection is done by people. Proper organization and management of the data collection process helps minimize human errors, improve personnel motivation and save working time. All of these contribute to reliable and successful FRACAS.

Clear procedures for data collection must be established, making sure the personnel responsible for this task will know how to deal with unusual situations. In practice, when unexpected situation occurs, people may deal with it very differently, and thus the data collected in FRACAS may be used incorrectly.

Examples of such nonstandard situations include:

1. Maintenance induced failures, or failures during attempts to correct a failure,
2. Failures which occurred during testing,
3. Cascading failures,
4. Late discovery of a failure etc.

The following features of FRACAS may greatly improve the quality of data collection process:

a. Wide use of libraries and lists for data entry, instead of free text,
b. Data control in real time,
c. Immediate alert about abnormal data combinations, even if they are formally possible (i.e. sudden sharp rise in failure rate, etc.)

All the above mentioned measures help minimize typing errors and other human errors, ensure standardization and consistency of terms, and precise identification of failed items. All these, in their turn, contribute to higher quality of data analysis.

However, it is also useful to provide necessary flexibility in failure reporting, including free text descriptions of failure symptoms and other relevant data. These descriptions may prove useful during detailed failure analysis, including identification of the root cause of the failure.

In order to be able to perform meaningful data analysis in FRACAS, it is insufficient to restrict the system to failure reporting only. Even the simplest task of reliability monitoring (Failure Rates, MTBF) requires also data about product usage. In many practical cases there are reliable data about failures, but usage data are insufficient or totally missing.

In fact, the process of collection of usage data may be quite difficult. In simpler cases, it may require recording of events of start of operation for each item and stop of operation (due to failure or any other reason). For more complex equipment, management of ETI (Elapsed Time Indicators) readings is required.

If FRACAS is intended to support more than minimal analysis, additional features become necessary. If there is a need to record and analyze reliability trends related to ageing (for example,

Weibull analysis for mechanical devices), the failure and usage data must be managed on the level of individual parts, using serial numbers of the parts for identification.

### *Data Access Rights*

A typical FRACAS system is operated by many people, representing different functions, with different needs for data access. In order to provide access to data to all these people, and at the same time keep data integrity and prevent loss of data, data manipulation and other undesirable effects, powerful data access management tools are required. Using these tools, FRACAS system manager can define in a flexible way data access rights for all FRACAS users, starting from limited data access rights for people responsible for raw data entry, to full data access rights for managers and people responsible for in depth analysis.

### *Data Analysis Process*

The data analysis process in FRACAS serves several purposes, among them:

1. Monitoring reliability characteristics of the project
    a. Planning of maintenance and support, including spare parts
    b. Proof of compliance with reliability requirements
    c. Understanding reliability trends
2. Identification of reliability problems that require some sort of Corrective Action.

Modern FRACAS systems have a developed set of reports, presenting statistical analysis of failure data from various points of view. Since FRACAS reports are intended not only for reliability professionals, but also for many other specialists, representing management, operation and maintenance, ILS, warranty and other various functions, it is important to present the reports in an understandable and easy to read form. Much effort is invested in creation of informative graphic presentation of the analysis results. Many FRACAS systems provide the user with appropriate tools for performing additional analyses, such as report generator.

In addition to reporting features, operated on request, modern FRACAS implementations include a mechanism of alerts and warnings. Unlike reports, alerts and warnings are provided automatically upon detection of a situation which requires immediate attention.

Alerts and warnings are provided at least in the following situations:

1. Suspected problem in data integrity or contradictory data

2. Especially severe reliability problem: sudden deterioration in reliability, large scale incompliance with reliability requirements or expectations, multiple recurrent failures, etc.

The alerts and warnings immediately focus managerial attention on important issues and prevent delays in dealing with them.

### *Specific Problems in FRACAS Process*

Several questions in FRACAS definition and utilization are so common that they arise in almost every implementation of the system.

A question that is often asked is: when is the right time to start collecting data in FRACAS? In many implementations, data collection starts with the beginning of field usage of the project. In other cases, data collection begins much earlier, at the stage of testing. Using FRACAS for failure reporting already at the stage of testing helps collect and analyze data earlier, and thus define and implement corrective actions (if necessary) earlier, saving time and money. On the other hand, using data from testing in FRACAS requires thorough management of the process, to make sure that these data are relevant. Minimum requirements for applicability of failure data from testing include:

1. Product configuration is comparable with final one,
2. Operational and environmental conditions are similar,
3. Skills of operation and maintenance personnel are not significantly different from the expected on the field. .

Another frequently addressed problem is providing meaningful conclusions on the basis of minimal data. When only small number of products is operating on the field and/or cumulative operation time is relatively small, the number of recorded failures will necessarily be small, and statistical analysis based on them may be problematic. Even the simplest calculation of field MTBF becomes impossible if the number of failures is very low. In such cases, the recommended approach is calculation of lower confidence limits for MTBF. This approach can be used even if no failures in some part have been recorded.

## *Conclusions*

Successful FRACAS is not just software, but a complex combination of software and organized FRACAS process, which has to be carefully defined and implemented in the organization. Though the principles of FRACAS are universal, it has to be tailored to a specific organization, and sometimes even to a specific product.

The problems mentioned in this paper are common for many FRACAS systems. The solutions, presented may help prevent difficulties in definition and implementation of FRACAS for new products.

Based on these solutions, it is possible to create a FRACAS system which will serve as an effective tool for managing events, people and processes on the way to a competitive product.

## *REFERENCES*

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