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AN INVESTIGATION INTO ROOT CAUSE FAILURE ANALYSIS (RCFA) PRACTICES IN OIL AND GAS INDUSTRY

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ABSTRACT

To remain profitable, it is important for oil and gas companies to reduce plant shutdown due to system or equipment failure. Effective root cause failure analysis is crucial to ensure that real causes of failure are identified, corrected and prevented from recurring. The effectiveness of RCFA depends on various factors such as expertise and organizational system which vary from one plant to another. This paper aimed to investigate current RCFA practices in oil and gas industry and propose areas for improvement. In this study, a comprehensive survey was conducted among RCFA investigators from various plants on important aspects of RCFA namely; investigation team, data collection, process knowledge, tool competency, report, recommendation and RCFA system in organization. From the survey, some good practices were highlighted especially in team formation and tool competency. Nevertheless, some areas need improvement such as RCFA database and sharing information.

Keywords: root cause failure analysis, oil and gas industry.

INTRODUCTION

Unplanned shutdown has big effect on plant profitability due to loss in production, opportunity and increase in maintenance costs. To increase plant availability, oil and gas companies implement various reliability improvement actions including root cause failure analysis (RCFA). RCFA aims to identify underlying root causes, control and prevent them from recurrence [1-4]. To be effective, RCFA requires proper and systematic analysis process and tools. The problem need to be identified accurately so that effective solution can be implemented [3]. RCFA competency and skills are hence very importance for every member in the investigation team. Management support is also crucial for RCFA to be conducted successfully since without their support it is very hard for the investigation team to gather all data, interview witnesses, propose and execute solutions [5]. Other importance factors include teamwork, sufficient resources and data availability [6].

From the literature, there are many reasons why RCFA fails. Insufficient resources have been raised by many teams as one of major issues in executing effective RCFA [7]. Poor understanding and execution on RCFA steps, improper selection of tools and shallow level of analysis are common among unsuccessful RCFA projects [8]. Yuniarto [9] highlights the lack of system perspective and unavailability of relevant data as other reasons for RCFA failure. Poor communication on the findings and follow up on corrective actions have also been pointed out as major issues that cause recurring of failures [10].

The objectives of the study are to investigate various issues related to RCFA project implementation in oil and gas companies and identify potential improvement areas. The findings from the study can be used for planning and implementing appropriate actions to improve the quality, effectiveness and efficiency of RCFA.

METHODOLOGY

The main part of the study involves conducting a survey to RCFA practitioners in oil and gas companies. The overall study methodology is shown in Figure-1.

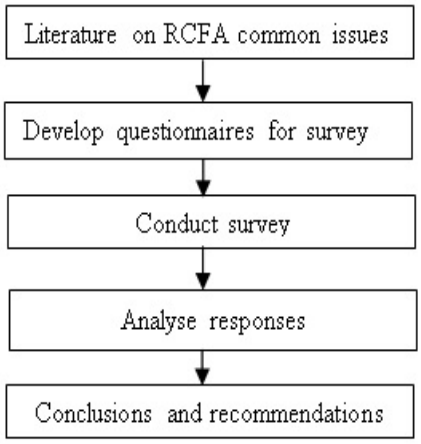

Figure-1. Research flowchart.

Questionnaires for the survey are categorized into seven main elements, which are considered critical to RCFA implementation. Table-1 describes those elements and main issues to be investigated. In each element a set of statements are presented and the respondent need to select the corresponding score ranges from 1 to 5 based on Likert scale, where score 1 indicates strong disagreement and score 5 designates strong agreement with the statement given. Score 3 means neutral or not sure.

Besides answering to the questionnaires, respondents are also requested to state their background. Apart from that, there is an open section for them to put comments on issues and improvement opportunities with

regards to RCFA practices in their organization particular on areas not covered in the survey

Table-1. Survey elements and issues to be investigated.

Elements	Main Issues to be investigated
1. Team formation and management	-To find out any issue in RCFA team formation and process
2. Data collection process	-To find out any issue in data collection process - Is RCFA database is important and necessary in investigation?
3. Process knowledge	-To find out any issue in RCFA methodology/ process -Is guidelines helpful in assisting investigation?
4. Tools competency	-To find out any issue in RCFA Tools / competency - Is RCFA tool software needed for investigation
5. RCFA report/presentation	-To find out any issue in producing RCFA report - Is software assisted tool needed to assist report? production -Is sharing report important?
6. Recommendation / corrective actions	-To find out any issue in producing effective corrective actions
7. RCFA system in organization	-To find out any issue in RCFA system -Is RCFA database well established?

RESULTS AND DISCUSSION

The survey was conducted in 2015 on 14 different oil and gas related companies with total responses of 65 received. The focus group were those who have led RCFA projects (RCFA team leader). Large percentage of respondents were male, engineers and aged below 40, ideally represents common characteristics of RCFA project execution in oil and gas industries. Respondent experience with regard to leading RCFA investigation is fairly distributed. Figure-2 depicts the demographic of respondents.

Classification	%
Gender	Male (75%), Female (25%)
Age	<30 (32%), 30-40 (43%), 41-50 (20%), >50 (5%)
Position	Engineer/Exec (69%), Managerial (31%)
Experience as RCFA Team leader	<3 (38), 3-5 (34%), >5 (28%)

Figure-2. Respondents demographic.

The survey findings on each of seven elements based on the analysis of results are discussed next.

a) Team formation and management

This survey element focuses on the RCFA team condition including number of team members, participation level, multidisciplinary team and teamwork. Example of survey results based on Likert scale is shown in Table-2

Table-2. Summary of survey results for team formation and management.

Statement	Mean	Std
1.The number of my team members is sufficient to conduct RCFA most of the time	3.14	0.97
2.There is no issue in choosing team member	3.38	1.07
3.Everyone in the team participated and played active roles	3.18	0.95
4.The team received full support from top management	3.48	0.85
5.Teamwork is very important factor for successful RCFA	4.69	0.53
6. My RCFA team consists of multidisciplinary members	3.95	0.98
7. Having team members with different background / job scopes is important for successful RCFA	4.51	0.64
8. As a Team leader, I am competent to guide team members in RCFA process	3.78	0.8
Overall	3.76	0.85

From the response, it can be concluded that:

- Generally, respondents agreed that team formation and management are important.
- Respondents strongly agreed that teamwork and multidisciplinary team members with diverse background / job scopes are crucial for successful RCFA.

b) Data collection process

Investigations explored here include data quality, verification, accessibility, the importance of previous RCFA reports and RCFA database. The following response are found:

- Generally, respondents strongly agreed that relevant and accurate data and previous RCFA reports are important for RCFA.

- Respondents strongly agreed that database for RCFA reports are required for successful RCFA investigation.
- They highlighted that accuracy of Maintenance data has large room for improvement.
- They agreed that relevant data for RCFA is rather difficult to collect.

c) Process knowledge

This element examines the level of knowledge on the RCFA process including understanding on the process, competency to complete the investigation, time constraint and the need on training and guidelines. From the survey it is found that:

- Large majority of the respondents moderately agree that they have sufficient knowledge to perform and complete RCFA investigation.
- However, they agreed that not every team member fully understood the RCFA processes.
- They were not able to decide whether the time given to them for the RCFA investigation is adequate.
- The respondents marginally agreed that they have the competency to analyse data of RFCA.
- They agreed guidelines help to facilitate RCFA process
- They highlighted the need for more training to perform RCFA.

d) Tools competency

In this section, the competency level of team in understanding and applying RCFA tools is assessed. The findings indicate:

- The team members hardly used RCFA software while doing RCFA investigation.
- The respondent marginally agreed that the team always apply the right RCFA tools during investigation. This demonstrates their earlier claim that not all members fully understood the RCFA tool and its application in RCFA
- However, they agreed that the Fault tree analysis (FTA) analysis is not difficult.
- They were marginally competent in Sequence of Event analysis. They felt that Sequence of Event is tedious, however can be done.
- They are moderately competent in 5 Why analysis.

e) RCFA reports and presentation

Team report and presentation conditions are explored in this section. Areas covered include time spent on the matter, tools used, the need of template, user friendly software assisted tool and sharing of report. From the survey it is found that:

- The team members strongly agreed that sharing of RCFA reports with others is important for the organization.
- However, they were concerned with time taken to prepare the presentation slides using the available RCFA template.
- They highlighted the needs for more user friendly and faster method (software based assisted tool) to draw standard event flow and 5 Why / FTA charts

f) Recommendations and corrective actions

The following findings are found from the responses:

- The respondents quite agreeable on the difficulties in getting the acceptance of the management to the RCFA recommendations put forth by the team.
- Having said that, they agreed that majority of the recommendations were accepted by the management.
- The respondents moderately agreed that the RCFA team follows up with the recommendation/actions until completion.

g) RCFA system in organization

This last section examines the condition of existing RCFA system in respective organization. The followings are the findings:

- The statistics revealed the difficulty in accessing the online RCFA system/database. This could be due to the unavailability of the online RCFA system/database.
- The respondents marginally disagreed that the existing system can track the closure of RCFA action items.
- It can be concluded that the existing online RCFA system/database has large room of opportunities for improvement.

From the open ended section where participants were asked to put their comments, various issues and potential improvement areas have been highlighted. Some of the main areas mentioned include manpower, incentive / motivations, support, training, RCFA documentation and database system.

CONCLUSIONS AND RECOMMENDATIONS

- The study had successfully revealed the existing RCFA practices in oil and gas industries and highlighted certain issues for improvement. Based on the study it is found that the current team formation practice was good with regards to multi-disciplinary members and commitment. The survey also indicated that many practitioners have adequate tools competency and strongly advocated the importance of sharing RCFA data. Major issues highlighted included the accuracy and accessibility of relevant data, in-depth understanding on RCFA process, generation of report and presentation, and the condition of RCFA database system.

- To further improve RCFA effectiveness in the organization the followings actions are recommended:
- Establish more comprehensive and integrated RCFA database system that can store all RCFA related reports, share with others and able to track RCFA process from beginning until closure
- Emphasize more training on understanding RCFA process, besides RCFA tools
- Employ more user friendly and faster method / tool for generating report and presentation.

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