

What really went wrong? Root cause determination study and improvement initiative results

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Abstract

Many incident investigations stop before identifying the real root cause or all root causes. In 2004 with the implementation of a new corporate-wide incident reporting electronic database, an evaluation was made possible as to the quality of incident investigations and reports at all sites within the case study organization. After reviewing almost 1000 incident reports, the Occupational and Process Safety expertise teams in this organization determined a need for improvement in the determination of the real Root Causes of the incidents and development of appropriate Corrective Actions. A communication and training initiative across multiple functional groups ensued to enable all sites within the organization to better understand why incidents were happening and to develop Corrective Actions to successfully prevent recurrence of the same or related incidents. This paper will give a brief background of the initiative, demonstrate what activities were undertaken and illustrate the success of this approach.

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1. Introduction

One of the most respected experts in the process safety field, Dr. Trevor Kletz, has illustrated the need to learn from history and past mistakes through his phrase “*Organizations have no memory.*” [1] His purpose behind this statement is to encourage organizations to implement programs that establish an organizational memory by determining, sharing and retaining lessons learned from incidents, both big and small, as well as near-misses.

One key aspect of a program of this type is determining, as the title of one of his books states, “*What Went Wrong?*” [2]. However, it is apparent that many organizations do not determine for the incidents that take place, what are the true root causes—the absence, deficiency, or neglect of the management systems that control human actions and equipment performance—stopping rather at the human errors or equipment failures most closely related to the incident. These latter errors

or failures are more commonly known as Contributing Causes or Causal Factors. Therefore, a vital aspect of implementing a lessons-learned sharing program is determining *What Really Went Wrong.*

2. Background

BASF Corporation, like many other companies in the petrochemical industry, has been implementing a program for sharing lessons learned based on investigating incidents to determine the Root Causes and communicating the lessons learned from those incidents. Initially the program development focused on the methodologies for recording and communicating the lessons learned since these systems did not exist. Incident investigation and root cause determination were existing competencies and believed to be existing strengths of the program. Training programs for several different root cause determination methodologies had been carried out over the previous 5–10 years, engaging many of the key people involved in incident investigations, and Total Recordable Incident Rates (TRIR) compared favorably with industry peers. There was no explicit

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sign that incidents were being repeated. There was no indication that the investigations were not determining *What Really Went Wrong*.

In 2003 the organization began piloting an electronic Accident/Incident Management database. A few sites first piloted this system for several months, then in 2004 a rollout to all sites throughout North America was completed. By mid-year 2004, the database had approximately 750 incidents of all types and severities. This represented the first time access was available to all of the incident reports being filed across all North American sites in a uniform reporting format. Now that the information was available, it was possible to review all incident reports to determine just how good the incident investigation and reporting processes were.

BASF's process safety expertise team evaluated each of the 750 reports based on a number of criteria. Part of that assessment was an evaluation of the Causal Factors and Root Causes identified and documented by the investigation team for each incident. For consistency within the process, the assessment was based on the following definitions:

Causal Factors:

The *human errors* and/or *equipment failures* that, if eliminated, would have prevented the incident or would have substantially reduced the consequences of the incident.

Root Causes:

The most basic causes. They are almost always the absence, deficiency, or neglect of the management systems that control human actions and equipment performance.

The results of the evaluation showed that as a whole, the incident investigations had some strong points as well as some areas for further improvement. Surprisingly, the area of greatest improvement potential was found to be root cause determination. The data from the assessment showed that based on the definitions above, almost all reports documented a root cause, but approximately half of those were determined to not be completely correct (see Fig. 1).

A related finding was that almost half of the reports did not fully address the root causes in the Corrective Actions or Rec-

ommendations. Somewhat surprisingly though, was the finding that a number of the reports that did *not* correctly identify and document a root cause, did properly address the unidentified root cause with the Corrective Actions—some could argue this was purely luck, but really highlights the fact that experienced personnel were involved in the entire process.

In evaluating reasons for these surprising results, it was found that there were several causes for the relatively low percentage of proper root cause identification and documentation.

1. Inconsistent understanding of the Root Cause concept.
 - investigations sought only one root cause;
 - process often stopped after identifying a Contributing Cause.
2. Tools were not used in a consistent or structured manner.
3. At times, Action Items addressed a Root Cause that was never "identified".

The assessment team, EHS management and the business groups were unpleasantly surprised by these findings. The Root Causes of this discovery needed to be determined, i.e. what was the cause for the disappointing results, *What Really Went Wrong*.

Focusing on the first finding, the team needed to understand why the Root Cause concept was being inconsistently applied. Participants from many of the different investigation teams were interviewed, with the finding that most were not aware of the proper definitions for Causal Factor and Root Cause, and therefore were operating on their own, differing understandings of these concepts. It was concluded that this occurred because prior training over the past 5–10 years had been carried out using a variety of courses and methodologies, each with different concepts of Root Cause. Additionally, various trainers presented the training without ensuring complete consistency among them.

The second finding indicated that not all investigation teams knew how to properly utilize the tools available. This indicated that the previous training had been less than adequate in "refresher" frequency. It appeared that the training had not been repeated with sufficient frequency to keep up with changes in the organizational structure and changes in the personnel fill-

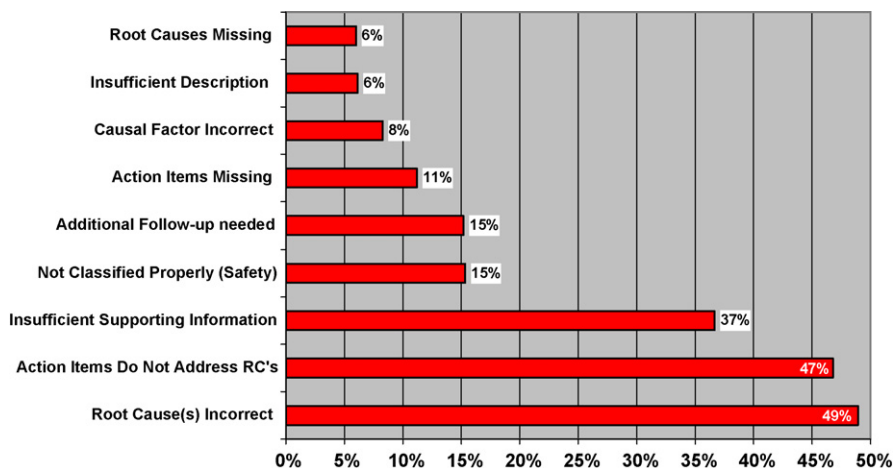


Fig. 1. Percentage of reports not meeting the standard for each criterion evaluated.

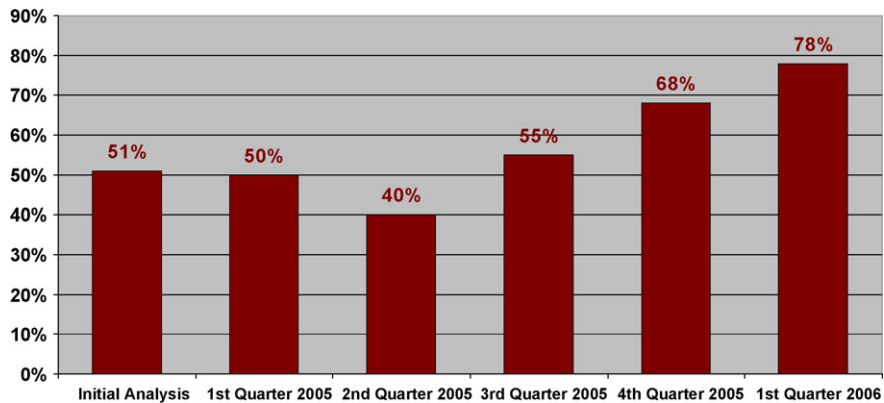


Fig. 2. Percentage of incident reports with Proper Root Cause Determination. *Note:* A 100% assessment of all correct root causes being identified is not possible based solely on a review of the incident report, but an effort is made to ensure that all significant root causes have been correctly identified based on the information included in the report.

ing those positions. A related finding indicated some locations selected investigation tools robust enough for the most complicated investigations, but few knew how to use them efficiently for simpler incidents, so the tools were sometimes not properly utilized.

The third cause focuses on the finding that many corrective actions properly addressed the root causes of the incident even though the root causes were never properly documented. This led to the determination that in some instances, the root cause was not being documented because the investigation team did not want to “blame” a particular person. In such examples, the root cause could be defined as being policies unintentionally lead to a culture of blame being assigned to a person instead of focusing on the lessons to be learned.

As with root causes in incident investigations, corrective actions must be sought to correct the existing situation and prevent the recurrence of that situation.

First, the cultural and awareness root causes were addressed in part by an article communicated across several media. An article entitled “The First Domino to Fall” explained the root cause concept and outlined the case for change, to raise awareness of the need to improve root cause determination. This message was also communicated to the operations management to promote the need for change.

The most significant corrective action, aimed at addressing the Knowledge and Skills issues, was a corporate-wide training effort developed to drive the knowledge and skills necessary for correct root cause determination down to the operations supervisor level and to reach the entire operations and EHS organizations. The training was developed and executed in a way to ensure communication of a consistent message and methodology. To support this training, a methodology was selected based on a Root Cause “Tree” that ensures the investigation continues drilling down until a root cause is reached. The methodology also leads to a standardization of root cause descriptions to improve the ability to trend incident cause data.

However, to ensure the effectiveness of the training, Key Performance Indicators (KPIs) were developed to monitor the progress, measuring the improvement in documented incident investigation reports.

The primary KPI used measured the Percentage of Investigation Reports documenting the Proper Root Causes for that incident. To measure this, a team of EHS specialists reviews all completed and “approved” incident reports each quarter, to determine, based on the information provided in the incident report itself, if the correct root causes have been identified.

The initial base line of 51% correct was found to be steady in early 2005. A consistency check across the team determining the KPI was made, after which the KPI value actually dropped to a low of 40%. Once training kicked off late in the second quarter of 2005, a steady improvement was noted in the percentage of incident reports that document the correct root cause(s) for each incident (see Fig. 2). Additionally, a strong correlation was noted in each quarter between those sites having completed the training and the percentage of correct root causes identified.

The progress has been very encouraging, but the process is not done. The final round of training for operations and EHS personnel must be completed, then successive rounds of training will focus on transportation related incidents for the Logistics and Emergency Response functions. Cognizance of organizational evolution or changes in personnel must also be in the forefront to ensure continuous improvement.

Finally, following the Plan, Do, Check, Act formula, a comprehensive review of the program will be performed at the end of the year to determine. . .

- (1) How well the original findings were addressed.
- (2) If any other areas for improvement were identified over the course of the training implementation, and
- (3) What additional measures are necessary to maintain the high level of awareness and skill developed through the training program.

All assessment results will be communicated within the EHS and Manufacturing communities along with any specific actions necessary for follow-up and continuous improvement.

3. Summary

This organization did not realize the room for improvement in the existing root cause determination program until a system

was implemented to be able to evaluate all incident reports on a corporate-wide level.

So the questions remaining are. . .

Do you have a way to evaluate incident reports on a broad, regional or corporate-wide basis? Do you investigate all types of incidents, including near misses?

Do you know how good the Root Cause Determination is in your company's incident investigations?

You may want to create an organizational memory and you may have a program in place to do that, to learn from your past mistakes, but do you know *What Really Went Wrong?*

References

- [1] T. Kletz, *Lessons from Disaster—How Organizations have No Memory and Accidents Recur*, Gulf Publishing Company, 1993.
- [2] T. Kletz, *What Went Wrong?—Case Histories of Process Plant Disasters*, third ed., Gulf Publishing Company, 1994.