MORT WorkSheet or how to make MORT analysis easy

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Abstract

The article is devoted to incident investigation, specifically to one of its aspects: the satisfactory identification of root causes. Management Oversight and Risk Tree (MORT) technique is exploited as a tool that helps to fulfill the task. However, since the application of traditional MORT diagrams was not considered satisfactory, a new software tool MORT WorkSheet was developed to make the MORT analysis easier. The article explains what led to the development of the software tool, how the tool works, and what results it is able to provide. An incident example is used in the article that illustrates how the new tool is applied during the investigation and how the results of its application look. Final comparison shows how different the obtained results may be with support of the MORT WorkSheet from the results of conventional incident investigation.
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1. Introduction

Recently, we studied a set of incident investigation reports from the seventies and eighties.

The article [3] describes an incident analysis process that we decided to follow. The process is divided into the four following steps:

(1) data collection;
(2) causal factor charting;
(3) root cause identification;
(4) recommendation generation and implementation.

The second step produces a graphic representation of the incident chronology and is finalized by the identification of causal factors, i.e. partial events for which the root cause identification should be performed. The third step utilizes a decision diagram, which is referred to in the article [3] as the Root Cause Map, in order to identify the underlying reasons for each causal factor.

We decided to use the Management Oversight and Risk Tree (MORT) diagram as the Root Cause Map.

The Management Oversight and Risk Tree is relatively old. It has been referred to as a respected tool already in the Lees's encyclopedia [1]. However, it is difficult to use. Obviously, many people have tried to create computer tools in order to make the MORT analysis easier. Usually, the attempts to computerize MORT are based on the fact that its structure is the structure of a fault tree so an FTA tool is used as a base for the computerized MORT analysis (this idea is expressed in the guidelines [2]). However, there is a pitfall to this: transfers in the MORT diagram do not have the same meaning as transfers in the standard FTA. In MORT, their meaning is only that the structure of the parts of the tree is identical but not that the parts of the tree are identical. Probably here is the reason why we have not indicated any MORT computerized tool representing complete MORT diagram without substantial simplifications. We are presenting here and offering to readers a MORT analysis tool that is based on the transcription of the diagram into the environment of spreadsheet. This transcription helped to create a MORT WorkSheet tool that is simple to use and that does not simplify the original structure of the MORT diagram. Our MORT WorkSheet is available from the webpage

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2. MORT analysis

The Management Oversight and Risk Tree is an analytical procedure for determining causes and contributing factors [4]. The original MORT program for assuring safety was written up by W.G. Johnson [5]. Included in this program was a method for investigating incidents that relied on a logic tree diagram. The MORT diagram served as a graphical index to Johnson's text, which was in excess of 500 pages. In order to help the investigators, the Noordwijk Risk Initiative Foundation distilled the original text into a forty-two-page question set in a manual [4]. The manual [4] is intended to be used with the MORT diagram [6]. We decided to use the sources [4,6] as a general guide to the investigative use of the MORT method.

As it was noted in the introduction, the MORT diagram is used in the article as the Root Cause Map in order to identify the underlying reasons for each causal factor produced by the causal factor charting. The MORT diagram is suitable for this purpose since it fulfills the two following conditions. First, it is a decisive diagram that serves to describe connections between an incident and individual features of the process safety management system. Second, according to [4] it is to be applied to key episodes in the incident sequence of events. Comparison of the terms key episodes in [4] and causal factors in [3] leads to the conclusion that the key episodes and the causal factors are identical.

MORT analysis is applied to the episodes/causal factors identified. Each episode/causal factor is characterized as a vulnerable target exposed to an agent of harm in the absence of an adequate barrier [4].

The manual [4] describes the MORT process as a dialogue between the generic questions of MORT and the situation that is under investigation. The questions are asked in a particular sequence. The MORT diagram acts as a prompt list that alerts the analyst to concentrate on the issues that are revealed through the process.

The MORT diagram itself represents an extensive graph that uses the conventions of Fault Tree Analysis. To make the process easier to review, the manual [4] recommends that the analyst uses one printed copy of the MORT diagram for one episode and colors it as he proceeds with his/her work. Customary color-code are the following: red, to indicate a problem; green, to highlight a satisfactory relevant issue; and blue, to indicate where there is not enough information to properly assess an issue.

Table 1 shows how the root cause identification procedure should look using the MORT diagram.

3. Drawbacks of the MORT analysis

The available MORT diagram [6] is extensive but not excessively so; it contains about 350 basic events. However, this relatively low number is a result of multiple uses of transfers in the diagram. If there were no transfers, the number of basic events would be above 2000. The diagram would be extremely

Table 1
Root cause identification procedure using the MORT diagram

1. Identify key episodes of the incident
2. For each of the key episodes:
    2.1. Determine the vulnerable target, the agent of harm, and the absent barrier
    2.2 Take a printed copy of the MORT diagram, passage through all its branches in the established sequence
    2.3 At each of the branches:
        2.3.1 Ask the relevant generic questions of MORT
        2.3.2 Color the branch using the customary color-code
    2.4 Review the blue parts of diagram after the whole diagram is colored. For each of the blue branches of the diagram:
        2.4.1 Provide supplementary information
        2.4.2 Make color of the branch red or green
3. Red part of a colored MORT diagram printed copy represents root causes of relevant episode. Set of red parts of the colored MORT diagrams represents multiple root causes of the incident

unpractical without any transfers —its printed copy would be very large, hardly legible and unsuitable for printing, copying and archiving.

The disadvantages of the transfers become visible as soon as we try to accomplish step 2.3 of the above procedure. Due to the transfers, we have to pass through many parts of the diagram repeatedly and this results in repeated coloring of relevant branches. Of course, the colors assigned to different individual passages through a specific part of the diagram may be varied. However, it may be difficult to keep track of what colors belong to each of the individual passages. Reviews according to step 2.4 may make the matter even more complex.

Obviously, the application of the procedure copes with drawbacks of the available MORT diagram. Its printed form makes the use of transfers necessary that further leads to the uncomfortable work not assuring the highest quality of results. It is therefore difficult to assure transparent color marking of diagram branches, to make an echo check of coloring and to control the completeness of the analysis. Documentation of results (filled diagram) may be unambiguous and is not easy to read. Archiving and retrieval of old results is impractical and their comparison with new ones is difficult.

4. Focus of the article

The incident analysis was transformed into three consecutive tasks: drawing a chart, applying a diagram and creating a table.
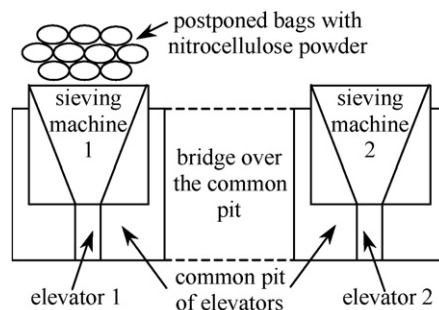

Fig. 1. Plot of the equipment involved in the incident.