

How to really learn from incidents?

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Abstract

The underlying causes of incidents need to be identified. This is broadly agreed in the industry. However, the practice is different. Many companies are struggling with it. Different problems arise in investigating organisational, underlying root causes from incidents. This is illustrated in this paper on the basis of two worked out incident cases with the use of the Tripod method [1]. It is concluded that the added value of a thorough analysis of the underlying causes and latent failures in an organization is such that this should become common practice in the industry, both for labor related and process safety incidents. Arguments used against it (time consuming, difficult etc.) can easily be overcome. It requires however Management commitment and knowledge/ experience in this type of analysis.

1. Introduction

For everyone who is involved in improving safety by learning from incidents it is clear. All handbooks and publications stress the need to learn lessons on an organisational level. The underlying causes need to be found, the deepest root causes to be identified. The logics behind this are clear. Many companies have defined a policy about this. As a result, nowadays many companies are struggling with it.

The paper is written and presented from a background of large experience in incident investigations in different sectors in the industry, mainly the Chemical and Process industry. In practice, the following problems arise in investigating organisational, underlying root causes with incidents:

- This type of analysis are seen as complicated and time consuming and are therefore often restricted to 'serious incidents'. However: this is not a good selection criterion (only): the organisational problems can/ should (also) be identified from less serious incidents, or even from near misses. Why wait to learn from serious incidents only, if you can learn the same lessons from near misses? An example will be given of a recent fatal accidental explosion in a chemical company (investigated by the author) and a near miss a few months before (not investigated).
- The selection of incidents to be investigated thoroughly need to be based on different criteria:
 - o Serious incidents and potential serious incidents
 - o Variety of type of incidents: select labor safety related incidents and process safety related incidents. It should be noted that often labor related incidents are investigated. Process safety related cases should be based on near misses, unexpected process parameter excursions etc.
 - o The number of deep rooted, organisational analysis studies need to be limited. From a practical point of view, but also from a conceptual point of view. With too many analysis studies, the same organisational factors will be addressed.

Example: if you are not good in maintenance management (e.g. large back log), than this problem will be addressed in a number of maintenance related incidents. It will start to be repeated as long as it is not rectified. The time factor to work on organisational factor improvement is often 1-2 year.

- Put a target to perform at least 5 -10 (depending on activity and size) of this type of root cause analysis studies. The knowledge and 'routine' will remain present with the expert facilitators in the company.

An important aspect and difficulty in the organisational analysis studies is the commitment of management to make themselves vulnerable and to accept discussion about the management in the incident investigation team. This is often a reason that not all organisational factors can be addressed and that not all lessons are learned.

Last but not least: The facilitation of this type of incident analysis studies requires certain knowledge and capabilities which are different from the regular analysis studies which use to be done in the industry. In practice, this aspect is limiting the quality of the lessons we can learn to a large extent. Training and guidance is necessary.

Below, two case studies are used to illustrate the importance of identifying organisational factors and to show the difference between labor safety related and process safety related factors mentioned. The latter in relation to the requirement to investigate near misses.

1. Case study One: Labor Safety, Work permit related incidents

We have found remarkable resemblances between the underlying factors in our accident analysis studies for completely different sectors and activities [2].

The accidents/ incidents that have been investigated are different in nature: fall from height, high voltage contact and electrocution, damaging underground pipelines, fire and more. The accidents differ, but the nature of the underlying factors that caused the accidents show remarkable resemblances.

The analyses of the incidents/ accidents have been performed with different methods, but mainly the Tripod method is used. In this paper, the results are shown in a condensed form to show the commonalities between the way these type of accidents are caused.

The following safety measures are basically important instruments (Lines Of Defence - LOD) to prevent these type of accidents to occur. These LOD's nevertheless do not always get the necessary attention. It will be shown that improving a few aspects of the preparation of the work activities can lead to a significant lower chance of occurrence of these accidents and/or the adverse consequences, knowing the common underlying aspects.

Safety Measures

The type of Safety Measures obviously depends on the type of activities and the type of hazards. For the purpose of this paper we have chosen four 'standard' measures for the mentioned construction and maintenance activities in the (process) industry):

- The performance of a Risk Inventarisation for the specific work activities. This is a general work safety requirement (by law). This can have the form of an Job Safety Analysis and/or Task Risk Analysis. For larger projects, a Safety and Health Plan need to be made, including the risk inventarisation and measures taken.

- The assurance of a safe workplace by means of safe constructions and/or by removing the hazard from the installation (e.g. high voltage, hazardous material under pressure in a pipe).
- Work permit: Before the work can start, often a work permit is necessary to make sure that also the hazards for the rest of the installations are taken into account and to record who is at work where in the plant.
- The use of the relevant Personal Protection Equipment (PPE).

Results of the accident analysis studies¹

Figure 1 shows a Tripod accident analysis structure constructed from common elements from several accident analysis studies. This Tripod tree is therefore a useful 'checklist' and starting point for the type of activities that we are discussing here: working at height, working with high voltage, working on pipes with hazardous material etc.

The figure contains the four mentioned Safety Measures. These are shown as 'broken' barriers². Correct application and implementation of these barriers should have been able to prevent the accidents to occur. It should be realized that these barriers are for the purpose of this paper somewhat generalized. In practice, the broken barrier will be more specific showing the problem area. We will not discuss the PPE barrier here, it is shown that this barrier was effective (which of course is not always the case). The failure of the other three barriers is discussed below.

Failure of the barriers

Procedure to make sure that the installation is safe (Lockout/ Tagout)

This concern to make sure that the electrical power is removed, that the pipes are free of pressure and inert, etc. In a company, normally standard procedures exist for this. The immediate cause of failure of this barrier is trivial: it is just the fact that these procedures are not always completely followed. Or are not complete or not (completely) understood.

Risk Inventarisaton and Safety and Health Plan (Dutch: RI&E, V&G plan)

The immediate cause failure of this barrier is that fact that the quality of this obligatory barrier is often too low. The main problem is that the seemingly generic nature of the work ('working at height') has induced generic risk analysis results (e.g. a TRA for working at height in general). In using these, this barrier is ineffective and in fact *counterproductive* to its purpose: to take specific safety measures for the specific job.

¹ Performed with the use of the Tripod beta method. Description : www.safety-sc.com

² The barrier concept more and more became the standard in thinking about safety and safety measures. In the framework of the Post Seveso (BRZO) regulations, the Dutch regulator use the concept of Lines of Defence (LOD), internationally also the name of Layer of Protection (in LOPA) is used. SIL Classified Safety instrumentation also need to be seen as a barrier.

Work permit

The problem with the functioning of this barrier can be compared with the one discussed above. The risk studies required are not present or are of a too generic nature.

Analysis of the underlying, organisational factors

Figure 1 shows the underlying factors for the barrier failures (left hand boxes)

Learning lessons and improvements on these level will lead to important progress towards higher safety levels. Below we mention some representative preconditions and latent failures which have been found in our accident analysis studies. See figure 1.

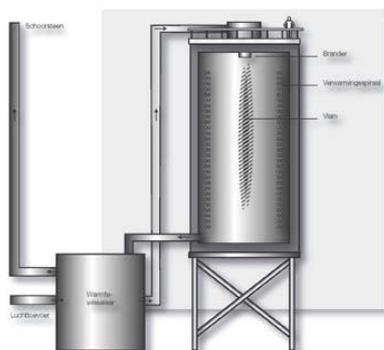
Organisational factors

- Safety perception and behavior different at different levels in the company (Safety culture problem).
- Practice and procedures: 2 worlds.
- Not enough personnel with required knowledge/ experience.
- Almost continuous company reorganisations, creating blind spots in SHE.
- Project management in the company is not focused enough (or too late) at work safety.
- System for responsibility and supervision is not clear.

2. Case Study Two: Process Safety incident, Explosion in gas fired furnace 2003.

The explosion occurred in a chemical company in the Netherlands. It occurred during the startup of a furnace (see figure 2). Regretfully, three people on top of the furnace did not survive the explosion. The incident could occur because the start-up procedure was not completely followed. The fuel gas ESD valves remained open (in override) and gas was sent to the furnace under unsafe conditions.

Figure 2: The gas fired furnace with air preheater



The company investigated the incident thoroughly and made the information publicly available for the purpose of broader learning in the industry. In the investigation, the underlying, organisational factors have been determined. Two months before the incident, exactly the same circumstances occurred but fortunately, no explosion occurred. This can be considered as a near miss and should also have been investigated thoroughly. In that case, the same lessons could have been learned and the same recommendations could have been given.

Organisational factors

The Tripod incident analysis have been performed. A simplified result is given in figure 3. It shows two broken barriers : the work instruction of start up of the furnace (was not followed) and the furnace safety system (was in override). The analysis shows the underlying, latent failures in the organisation (boxes at the left):

- System of responsibilities not clear and deviating from actual practice
- Risk communication is not adequate
- No system that secures the quality of work instructions
- Systematic supervision on compliance is not in place
- Culture of learning from incidents is not adequate
- Difference between the paper world (procedures etc.) and reality

It is clear that these factors could have been addressed in the earlier near miss. If you want to learn from incidents: investigate near misses.

Procedures and work instructions

From experience, it is known that the lack of compliance with procedures and instructions is an important factor. In this incident, we investigated circumstances (preconditions) of the lack of compliance. These were (see figure 3):

- The work instructions were not fully correct and were difficult to comply with
- Insufficient supervision on compliance.

An important result of this analysis in the process industry was an increased awareness of the importance of compliance with the company's rules, procedures and instructions. It was also concluded that the system of learning from incidents need to be improved.

Conclusions

Case study 1:

From analysis of construction and maintenance work related accidents it has been shown that several common underlying factors do exist. The accidents that have been investigated are different in nature: fall from height, high voltage contact and electrocution, damaging underground pipelines, fire and more. The accidents differ, but the nature of the underlying factors that caused the accidents show remarkable resemblances.

Main underlying factors:

The risks of the *specific* activities are not, or not well enough, identified. The nature of the risk analysis studies is too generic. It means that more attention needs to be paid to the risks of the actual job (location, specific circumstances etc.) The use of generic TRA tables only is not sufficient.

It can be stated that not all (near) incidents that are work permit related need to be thoroughly investigated. It has been shown that these type of incidents have common underlying factors which need to be addressed in the management system.

Case study 2:

Process safety incidents are different in nature: they are (very) rare and if they occur they are mostly very serious. The need to investigate near misses is therefore very important. By removing the organisational factors found in the near miss incident, a range of future incidents that are rooted in the same factors will be removed.

References

[1] Incident investigation, including Tripod. C.M. Pietersen; SSC publication.

[2] Dominant underlying factors of work related accidents, 3rd International Conference 'Working on Safety' September 2006. workingonsafety.net. C.M. Pietersen

Figure 1 Tripod analysis of work permit related incidents

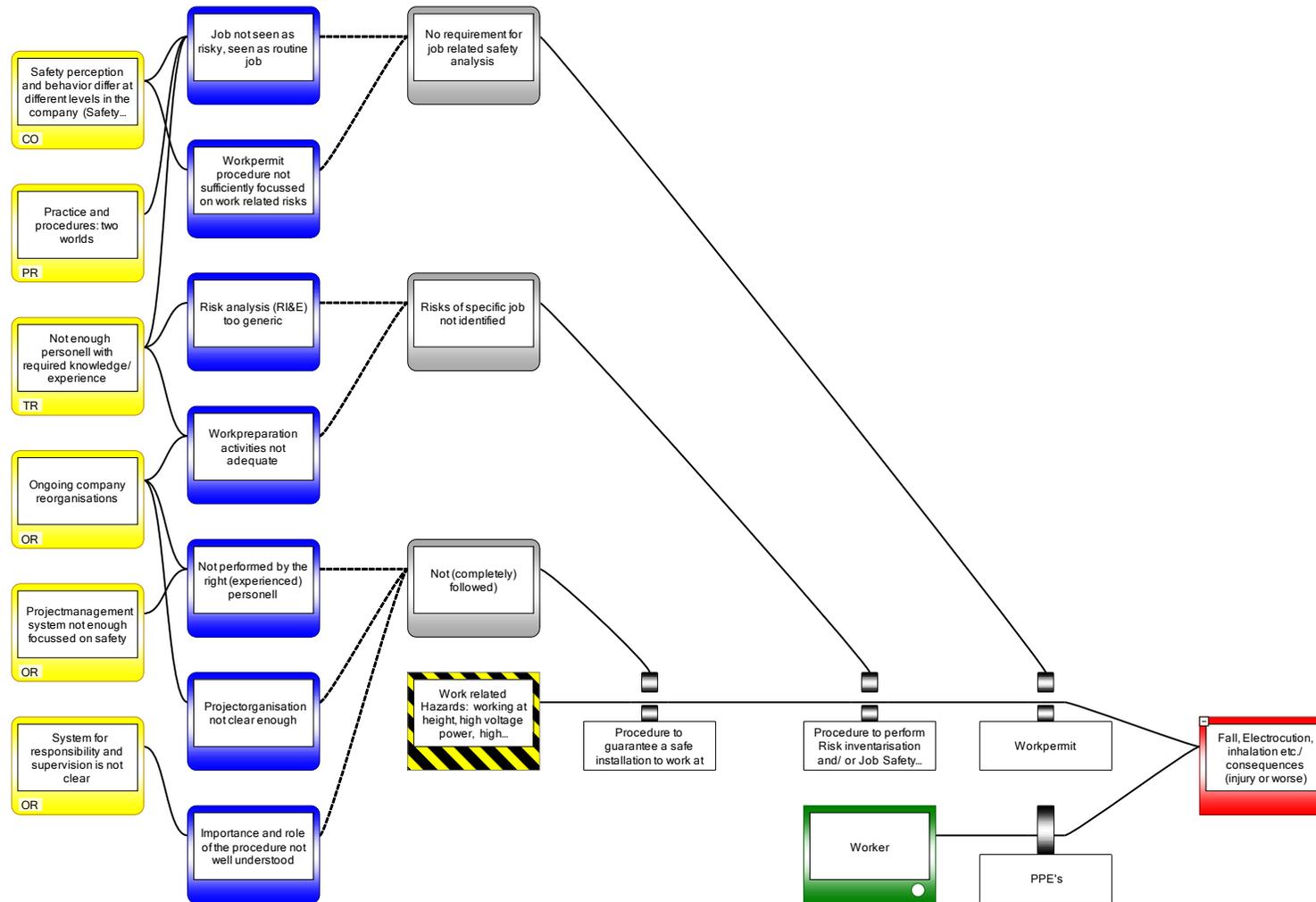


Figure 3 Tripod analysis of an explosion in a furnace

