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STANKE TASKOVSKI[1]
MARIJA HADŽI-NIKOLOVA[2]

[1]SASA Mine, Makedonska Kamenica, North Macedonia
[2]Faculty of Natural and Technical Sciences, Goce Delcev University Štip, North Macedonia

[1]s.taskovski@sasa.com.mk
[2]marija.hadzi-nikolova@ugd.edu.mk

WORKPLACE INCIDENT INVESTIGATIONS AS A TOOL FOR SAFETY IMPROVEMENT

Abstract: *The safety and health of employees is not only a legal obligation, but also an essential need for enhancing productivity and economic progress of every company. Every company aims to continually improve workplace safety by implementing a range of control tools and measures designed to improve safety conditions. Improving safety is an open process that never ends; there is always room for improvement. A key control measure is the timely reporting of incidents and conducting a thorough investigation of incidents or injuries and implementing effective corrective measures. All injuries at work and significant events or potentially significant events (including near miss incidents) should be investigated to identify and implement corrective and preventive measures, thereby reducing the likelihood of future occurrences.*

Keywords: incident notification, incident investigation report, preventive measures, corrective measures

ORCID iDs: Stanke Taskovski N/A
Marija Hadži-Nikolova https://orcid.org/0000-0003-1961-3838

INTRODUCTION

Timely and accurate reporting of work-related accidents, incidents, or potential incident conditions is an essential component of a successful Health and Safety Program.

Such reporting allows for a thorough investigation and the identification and implementation of effective corrective actions. Proper documentation of any investigation is essential for later use, if necessary. Furthermore, proper investigation, implementation of effective corrective actions and follow-up actions are key responsibilities of all responsible persons in a company. Incident reporting (including near misses) should be carried out as soon as possible. Additionally, each company should have a defined internal reporting that briefly describes:

- Date and time of the incident;
- Date and time of reporting the incident;
- Type of incident (incident/near miss);
- Work area where the incident occurred;
- Consequences of the incident (injury, loss of production, damage to equipment, environment, community, etc.);
- Description of the incident;
- Measures taken on site;
- Photographs (if possible).

After the reporting is completed, a thorough investigation of the incident is carried out to determine the causes of the incident.

A thorough investigation and analysis of work-related accidents and incidents is an essential part of health and safety management. The investigation should determine the underlying or root causes of the incident and identify preventive measures. There should be "Lessons Learned" from each investigation, i.e., what caused the incident and what we need to do to prevent it from happening again.

Conducting internal health and safety investigations provides a deeper understanding of the risks associated with specific work activities. Blaming individuals for an incident is extremely unproductive and ineffective. It also dispels the myth that incidents and accidents in some areas are inevitable and part of the work process. Well-designed risk control measures, combined with appropriate supervision, monitoring and effective management (i.e., risk management system), will ensure that work activities are safe. Health and safety investigations are an important tool in developing and refining" risk management system. An effective investigation requires a methodical, structured approach to information gathering, collation and analysis. The findings of the investigation should form an action plan to prevent the accident or incident from happening again and to "improve overall risk management". Findings will also indicate areas of risk assessment that need to be reviewed.

DEFINITION OF OCCUPATIONAL INCIDENTS/ACCIDENTS

Incident - occurrence arising out of, or in the course of, work that could or does result in injury and ill health

Note 1 to entry: An incident where injury and ill health occur is sometimes referred to as an "accident".

Note 2 to entry: An incident where no injury and ill health occurs, but has the potential to do so, may be referred to as a "near-miss", "near-hit" or "close call" (ISO 45001:2018(en)).

Note 3 to entry: Although there can be one or more nonconformities related to an incident, an incident can also occur where there is no nonconformity.

High Potential Incident – An incident that almost resulted in injury to a worker, damage to equipment, or an environmental incident.

First Aid (FA) – The first aid given in the event of an injury. Treatment can be provided by anyone trained in first aid or at a mine ambulance.

Medical Treatment Injury (MTI) – Assistance given in the event of an injury that requires treatment by a professional (doctor), but does not result in a lost-time accident.

Note: If an employee is taken to a hospital for an X-ray or consultation with a specialist and the scan shows no visible abnormalities and the employee returns to work the next day, the period of absence is considered a MTI.

Lost time injury (LTI) – An injury that occurs while at work that results in the inability to perform regular work duties on the following calendar day, including modification or limitation of work duties. In the LTI, both DI and FI are included, as well as other incidents that result in sick leave.

Disability Injury (DI) – A disability injury is an injury that results in the employee no longer being able to fully perform regular work tasks, performing either lighter or different work tasks.

Fatal Injury (FI) – Death of an employee as a direct result of an injury or illness at work.

Non-LTI Injuries – Includes injuries requiring first aid (FA), injuries requiring medical treatment (MTI) that do not require absence from work, as well as reports to the mine clinic for health issues that are and are not related to work (e.g., high blood pressure, etc.).

Risk: The level of risk is determined by a combination of the probability of a specific undesirable event occurring and the severity of the consequences (i.e., how often is it likely to occur, how many people could be affected, and how severe could the potential injury or health effects be?)

Risk control measures: Are precautions in place in the workplace to reduce the risk to a tolerable level?

Root cause: The initial event or failure from which all other causes or deficiencies arise. Root causes are generally failures in management, planning, or organization (Fact Sheet, 2016).

Underlying cause: the less obvious "systemic" or "organizational" cause of the occurrence of a negative event, e.g., checks on machines before start-up are not carried out by supervisors; the hazard is not properly addressed through an appropriate and sufficient risk assessment; production pressures are too great, etc.

Corrective action - action to eliminate the cause(s) of a nonconformity or an incident and to prevent recurrence.

THE CAUSES OF ADVERSE EVENTS

Adverse events have many causes. What may appear to be bad luck (being in the wrong place at the wrong time) can, on analysis, be seen as a chain of failures and errors that lead almost inevitably to the adverse event (this is often known as the Domino effect).

These causes can be classified as (HSE, 2004):

- immediate causes: the agent of injury or ill health (the blade, the substance, the dust, etc);
- underlying causes: unsafe acts and unsafe conditions (the guard removed, the ventilation switched off, etc);
- root causes: the failure from which all other failings grow, often remote in time and space from the adverse event (e.g., failure to identify training needs and assess competence, low priority given to risk assessment, etc).

Effective risk control measures must be implemented to address immediate, underlying, and root causes in order to prevent adverse events.

CHECKLIST FOR THE WORKPLACE INCIDENT INVESTIGATION PROCESS

To conduct a thorough incident investigation, it is essential to follow a proper checklist and ensure that all critical aspects of the investigation or incident analysis are addressed.

The checklist for the investigation process includes the following points:

- To determine an Investigation Team, i.e., those who will be involved in conducting the investigation;
- To collect documentation/information in the shortest possible time to prevent "spoilage" of the information;
- To interview the appropriate people to confirm the *FACTS* about the event and to discover the causative factors;
- To understand the *EXACT* details of the event, a timeline of events and conditions should be prepared;
- Determine which "protective mechanism" failed to prevent the event from occurring;
- Determine which factors - "human", "conditions" and "tasks" contributed to the incident;
- To determine which *PROCESS* (systems) can be improved to prevent recurrence;
- *CORRECTIVE ACTION* Determination Team;
- The outcome of the investigation is a top priority;
- Initiating *CORRECTIVE* and *PREVENTIVE* actions is a top priority.

Incident Cause Analysis

Incident Cause Analysis is a systematic process used to identify the underlying causes of incidents, going beyond the immediate events to understand the contributing factors. Figure 1 shows the steps for conducting an incident analysis. Insight into the causes is essential to prevent future (similar) accidents. Therefore, revealing all the causes leading up to an event of an accident is the basis of investigation and analysis. Accident causation models provide a theoretical basis for explaining how accidents at work occur (Reason, 1997). A well-known model used for accident analysis is the Swiss cheese model.

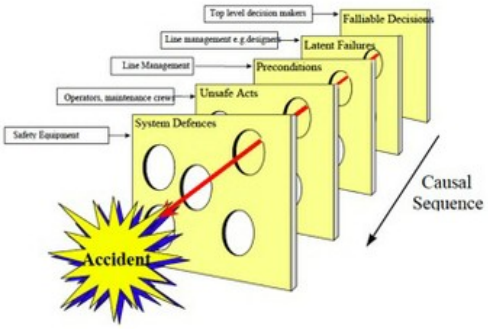

Figure 1. *Swiss cheese model (EU-OSHA, 2022)*

All work injuries and all significant events or potentially significant events (including near miss incidents) should be investigated so that corrective and preventive actions can be investigated, monitored and completed to prevent recurrence.

Analysis of the Human Factor as the Cause of the Incident

To thoroughly investigate an incident, it is important to begin by reviewing relevant personal records, such as work history, training documentation, time sheets, and medical information, as needed. Equally essential is identifying all individuals who may have knowledge related to the event and securing their statements promptly. Interviews should be conducted individually in a distraction-free environment to ensure accuracy and openness. Whenever possible, speaking with these individuals at the incident scene can provide valuable context and help verify details gathered during the investigation.

The following questions may be posed to interviewees to gather comprehensive and relevant information about the incident:

- Can you provide a full description of the work and conditions that led up to the event?
- Can you provide a full description of the sequence of events, from start to finish?
- Did you observe any unusual things before the event (sights, sounds)?
- What was their role in the sequence of events?
- What conditions influenced the event (weather, time, equipment, etc.)?
- How did people influence the event (activities, emergency response, etc.)?
- What is their opinion about what caused the event?
- How could it have been prevented?
- Did you give a list to other witnesses?.
- Were they under stress or due to a lack of time?
- How are they trained to do the job?

Analysis of the Conditions in the Work Environment as the Cause of the Incident

Examining the scene of the incident is crucial for gaining a clear understanding of the task being performed and the local environmental conditions at that moment. It is particularly important to recognize any sudden changes in the work environment, as these can significantly impact safety. Emphasis should be placed on the specific situation at the time of the incident rather than the usual or typical conditions, as this context provides critical insights into the factors that contributed to the event. It is important to determine:

- What were the weather conditions?
- Was a lack of cleanliness a problem?
- Was it too hot or too cold?
- Was noise a problem?
- Was there adequate lighting?
- Were there toxic gases, fumes, or dust?

In addition, it is important that when an incident occurs or a near-miss occurs, the conditions are not changed and the scene of the incident is immediately cordoned off so that a detailed investigation of the incident can be conducted.

Analysis of the Equipment as the Cause of the Incident

A careful inspection of the equipment involved in the incident is essential to understand its condition and any factors that may have contributed to the event. Attention should be given to any alterations or unusual signs, such as excessive strain, modifications, substitutions, distortions, or fractures. It is also important to identify potential design flaws, inappropriate components, or unclear labeling and markings. Ultimately, verifying that the equipment was suitable for the task at hand provides valuable insight into whether equipment-related factors played a role in the incident.

It is important to determine:

- Did an equipment failure occur?
- What caused the failure?
- Was the machine poorly designed?
- Are hazardous substances involved?
- Are they clearly identified?
- Was it possible to use a less hazardous substance and was one available?
- Were the raw materials substandard in any way?
- Should Personal Protective Equipment have been used?
- Was Personal Protective Equipment used?

- Were any safety devices removed from the machine?

Analysis of Procedures as the Cause of the Incident

A thorough review of the task includes examining the established work procedures and schedules to determine whether they may have contributed to the event. Additionally, it is important to evaluate the availability, suitability and use of these procedures, as well as the level of supervision required.

It is important to determine the following factors:

- Was a safe work procedure used?
- Are there written procedures?
- Was a Job Safety Analysis (JSA) prepared as part of the planning prior to the job?
- Has there been a change in conditions that made the normal procedure unsafe?
- Were appropriate tools and materials available?
- Were they used?
- Were lockouts used when necessary?
- Were safety devices in working order?
- Are workers adequately trained in the written procedures?
- Are the written procedures appropriate for the work tasks?

Analysis of the Organization as the Cause of the Incident

In this analysis, management has a legal responsibility for the safety of the workplace and the workforce. The role of supervisors and management must always be considered in the investigation of incidents.

- Are safety rules followed/understood by all employees?
- Are they enforced?
- Has there been adequate supervision?
- Have workers been trained for the job? When? Is the training still valid
- Have hazards been previously identified?
- Have procedures been developed to overcome hazards?
- Have unsafe conditions been corrected?
- Is the equipment regularly maintained?
- Are regular safety checks conducted?
- Are there any changes to equipment, environment, people or procedures?

ROOT CAUSE ANALYSIS IN INCIDENT INVESTIGATION

For root cause analysis in incident investigation, a tool known as a fishbone diagram, or cause and effect diagram (Ishikawa diagram, Figure 2), is often used in practice. It visually represents the problem as the “head” of a fish, and potential causes as “bones” branching off the “spine.”.

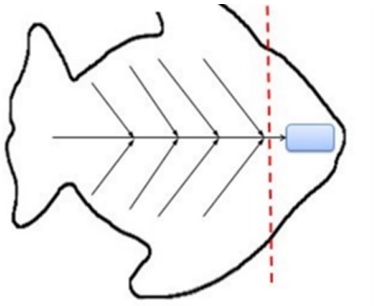

Figure 2. *The basic model of the Ishikawa diagram*

The Ishikawa diagram was popularized in the 1960s by Kaoru Ishikawa, who introduced quality management processes at Kawasaki shipyards, and in the process became one of the founders of modern management (Tague, 2014). It soon found widespread application in other industries, including risk management and occupational health and safety.

Fishbone diagrams visually represent various factors contributing to an issue, aiding in the identification of underlying causes. They are particularly useful for organizations that implement knowledge management. Collecting group ideas systematically can help management understand and diagnose the organization's problems. This method helps teams identify and analyze the root causes of incidents by brainstorming and categorizing potential causes (Sakdiyah, Eltivia, Afandi, 2022).

The following section explains how this method works, outlining its key steps processes (PetroSync, 2023):

1. Identify the problem: Start with the problem at the beginning of the fishbone diagram.
2. Brainstorm categories: Brainstorm and identify the main categories of potential causes (e.g., workforce, methods, materials, machines, measurement, environment).
3. Create the backbone: Draw a horizontal line like the backbone of a fishbone, connecting the problem to the categories.
4. Add the bones: Break away from the backbone to represent the categories of causes, forming the fishbones.
5. Brainstorm causes within each category: Brainstorm and list specific causes that contribute to each category.
6. Analyze and prioritize: Analyze the diagram, identify the most likely root causes, and prioritize them for action.
7. Implement solutions: Develop and implement solutions to address the identified root causes.

The following figure shows the practical application of the "fishbone" method for investigating the incident at the SASA Mine, Makedonska Kamenica, Republic of North Macedonia.

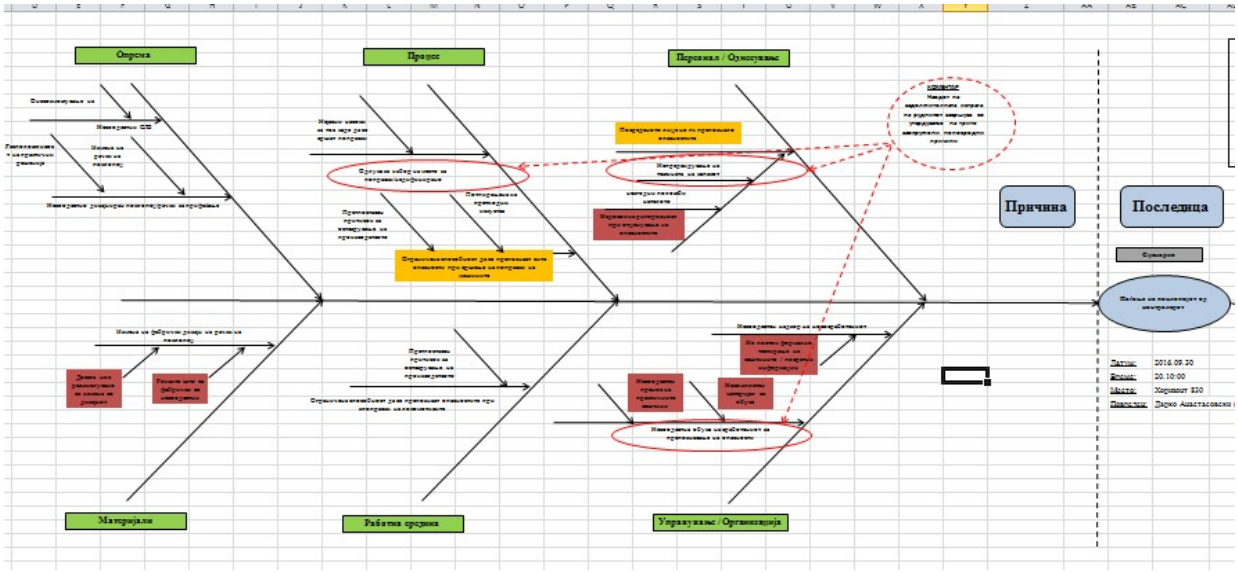

Figure 3. *"Fishbone" method with a practical example from an incident investigation* (Taskovski, 2024)

INCIDENT REGISTER

For an investigation to be effective, the control measures taken (preventive and corrective) should be completed in a timely manner. It is very important to keep records of all incident investigations as well as appropriate records of the planned preventive and corrective measures, i.e., to create an appropriate incident register.

A register should contain:

- Date of the incident;
- Brief description of the incident;
- Classification of the incident;
- Corrective action taken;
- Responsible person for completion;
- Date of completion;
- Fact of completion;
- Steps for the corrective action.

The incident register should also monitor the effectiveness of corrective measures, i.e. whether the measures taken are effective. Corrective measures are effective if the same or similar incident has not occurred in a certain period.

If a register is not kept and the completion of corrective measures is not monitored, the investigation into the incident would not be productive and would be just a waste of time.

Keeping the register makes it possible, if an incident occurs, to check whether previous incidents that have occurred are of the same or different type from the previous ones and a comparison can be made in relation to the control measures taken.

CONCLUSION

The main objective of the investigation is to prevent recurrence. Therefore, incident investigations should focus on the following:

Identifying immediate/direct causes that contribute to and are related to conditions, personal factors or activities;

Determining the underlying causes (root causes) for the above-mentioned;.

Identifying organizational, systemic or inherent deficiencies or failures;

Reviewing and analyzing the causes and deficiencies identified to determine corrective measures and improvement actions.

To ensure the integrity of the investigation, the scene of the incident should be cordoned off and not disturbed until a detailed inspection by an appropriate commission has been conducted, except when immediate action is required to safely remove individuals from the area.

The investigation should be completed thoroughly and by experts in the relevant field in order to determine the true causes of the incident, as well as to take appropriate measures to prevent recurrence.

Every workplace contains hazards; consequently, risk control measures are implemented to minimize those risks to an acceptable level and to help prevent accidents and health issues.

The fact that an adverse event occurred suggests that the existing risk control measures were inadequate.

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