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Avoiding workplace accidents: the importance of pre-job safety analyses

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ABSTRACT

Careful, thorough, individual and group pre-job safety analyses completed by knowledgeable and competent individuals can significantly reduce workplace incidents. Benefits include: decreased costs, improved productivity and morale of employees, and an increased perception by those outside of positive safety consciousness.

Pre-job safety analyses can be done either by a team of workers or by a solitary worker. In both cases these workers need to be trained in the completion of pre-job safety analyses. Supervisors must check to see that these analyses are completed competently.

The current study presents pre-job safety analyses, namely the Neil George Five Point Safety system and a construction field level risk assessment. Workers may be guided by one of these systems to complete a pre-job safety analysis but must also have access to safe work procedures, and equipment and area inspection reports.

Examples of accidents that were investigated during the author's 18 years as a Saskatchewan mine inspector will be discussed within the context of the above. The causes of the accidents will be explored with close reference to how pre-job safety analyses could have prevented their occurrence.

KEYWORDS: safety; incident; worker; management; supervision; pyramid; domino; tool; analysis; morale; five; field; mining; answering; construction

1. INTRODUCTION

Incidents occur at mine sites, with some resulting in serious injury. In order to reduce the number of incidents that occur, the entire workforce of the company should work together in various ways to provide a strong, integrated and constructive force. One way to involve the entire workforce is for the worker to conduct a pre-job safety analysis. Two means of pre-job safety analysis are the Neil George Five Point Safety System and Field Level Risk Assessment.

2. WORKPLACE INCIDENTS

Models developed using available data show that historically, serious injuries occur less often than incidents where nobody has suffered an injury. This is displayed in the pyramid model in Figure 1. The accident data put into this model was based on 1 753 498 accidents reported by 297 companies to a US insurance company; it was analysed by Frank Bird. The actual ratio varies between industries, circumstances, and the reporting of incidents. However, a large discrepancy between "close-calls" and "serious or disabling incidents" remains.

The incidents that occur with greater frequency have less damaging outcomes. There is a potential for the causes of incidents to produce outcomes of different severity. It is vitally important that incident investigations should be carried out in instances where there is an injury potential, not just those causing damage or injury. These investigations would find the causes of the incident occurring. This information could be used to help prevent similar incidences from being repeated.

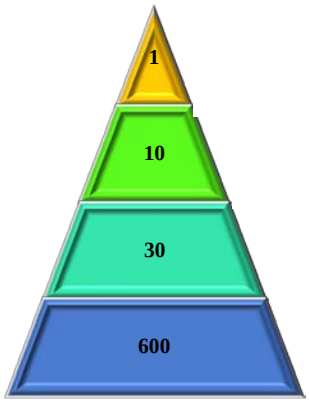

Figure 1: Bird's Pyramid Mode. (Stallenberg, 2008).

2.1 Preventing workplace incidents

Incidents occurring at mine sites range from harmless to one where workers are seriously injured. The more severe accidents occur less frequently. To work towards a safe work place, the mining company

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in which work is conducted must have a positive health and safety culture. This is one where the aim of all employees is to have no incidents occurring. In virtually all countries today, the workers of mining companies have the legislative right to refuse work that they believe poses a risk of injury to others or themselves.

An accident causation paradigm is referred to as the *Edward Adam's Domino Sequence for Accident Causation* which is shown in Figure 2. The term "Management Structure: defines the mining company's objectives, organization, and the operations. The terms "Management Behaviour" and "Supervisor Behaviour" capture operational factors. The term "Tactical Errors" describes unsafe acts and conditions. Accident/Incident represents all reported incidents including those where nobody was injured. Finally, Injury or Damage describes the outcome to persons or property.

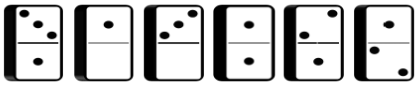

Figure 2: Edward Adam's Domino Sequence for Accident Causation (Strahlendorf, 2008).

Management and supervisors are responsible for ensuring that the tools are in place to minimise unsafe acts and conditions. A major responsibility of the employer is to ensure that the minesite and the work process are both safe. The workers are directly exposed to the unsafe acts and conditions; they should conduct a pre-job safety analysis at the workplace and work processes. As evident in the term, pre-job safety analyses should be conducted before beginning work.

Pre-job safety analyses may be conducted individually or as a group. Unsafe conditions of the work environment or work process should be noted and rectified to negate the risk to workers. The major benefit from this should be decreased accident frequency and their related costs. Production can be halted in order to investigate incidents that have occurred. Mining company employee morale would improve this tool was used, and incident frequency would decline. Finally, public perception of a mining company which is sincerely concerned about employee health and safety will be enhanced.

3. PRE-JOB SAFETY ANALYSIS

The primary aim of an accident investigation is to learn from the incident that is being investigated to find not only the causes but also how to eliminate the cause in the future. Management, Supervision, and Workers all have roles within their category of employment to identify aspects such as the safety of the workplace and equipment, safety controls initiated, and critical procedures necessary. An accountable pre-job safety analysis can identify potential accident causes and prevent them from surfacing before an incident occurs.

An adjustment of *Edward Adam's Domino Sequence For Accident Causation* depicts the partnership of employee groups that must work together to avoid Tactical Errors. This *Pre-Job Safety Analysis Domino Model* is shown in Figure 3.

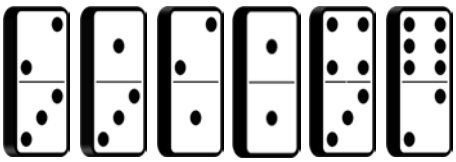

Figure 3: Pre-Job Safety Analysis Domino Model.

1. Management: Management must be involved to maximise the effectiveness of a pre-job safety analysis system. They decide which system to use and must ensure it is implemented and documented. They monitor it by checking regular summaries of the analyses. They can compare incidents that have occurred with reference to the points noted in pre-job safety analyses. Pre-job safety analyses are repetitive and workers can become complacent in their accurate and appropriate completion; frequent management monitoring should ensure proper attention is paid to them. In addition, the pre-job safety analyses completed by workers should be explored to see if there are any trends in unsafe conditions. It would be advisable to have a section on the pre-job safety analysis where workers can communicate safety improvement suggestions.

2. Supervision: Supervision must ensure workers are trained in how to complete pre-job safety analyses effectively. All pre-job safety analyses should be checked while the work shift is ongoing to

see whether they have been completed adequately and if not, further coaching must be given to those completing them. Positive feedback provided by supervisors for well-conducted pre-job safety analyses can be a powerful incentive to reinforce the importance of pre-job safety analyses. Management must then respond to these observations. This would help keep workers positively engaged in the health and safety process.

3. Worker: Workers are required to focus on pre-job safety analyses before beginning work. Management has given them a tool and requires them to use it to make their workplace safe. Effective supervision teaches workers how to use the tool to help them identify unsafe characteristics. The pre-job safety analysis is completed by checking the worksite, equipment and applicable work procedures. Any observations concerning the workplace, equipment, and work process is noted down. Any safety improvement suggestions should also be noted. To use this tool effectively, workers must be thoughtful and not simply "tick-boxes". Management and supervisor may disseminate the data accrued from past pre-job safety analyses if it is applicable to other workplaces; this data may be used effectively to support subsequent pre-job safety analyses.

If Management, Supervision, and Workers all follow their responsibilities for the pre-job safety analysis, the possibility of accidents/incidents occurring will be significantly reduced. If an incident should occur, the existence of a pre-job safety analysis may also decrease the severity of the incident. All levels of the workforce must be committed to pre-job safety analysis, communication must be maintained, and personal accountability to how accurately it is completed be kept.

3.1 Neil George Five Point Safety System

This first pre-job safety analysis system was developed by Neil George in 1942 for the Ontario mining industry. At the beginning of each shift the worker, in this case a miner, must inspect his worksite by using the Five Point Safety System, noting what was observed. This system is completed by the miner at the area where the work is being conducted. As the name suggests, miners must consider five points before beginning work. These points are:

1. Check the entrance to the place of work: The miner must check his surroundings as entry to the workplace is made. This includes travelling from the dry to the work place, and going between workplaces.

2. Are working place and equipment in good order: The miner checks the working place and equipment to ensure it is safe. Checking the working place and equipment may require checking specific checklists. If there are records detailing when the working place or equipment were inspected by a qualified professional, check to ensure the records are current.

3. Are people working safely: The miner must check that the required *Personal Protective Equipment* (PPE) is being worn. Is everyone following safe work procedure? Ensure that the correct procedures are being followed by the crew or a risk assessment is being completed if warranted.

4. Do an act of safety: The miner should note an act of safety accomplished by himself/herself. During the course of completing work, an instance will present itself where a safe act is required to do the job safely or prevent a hazard from presenting itself. It is a constant reminder for miners to think about safety.

5. Can, and will, miners continue to work properly: The miner must keep safe work in mind. Before beginning the task, consider what is necessary to complete the job safely in terms of personal protective equipment, materials, equipment, and procedures or risk assessment as the job progresses. The miner must check to see if all that is required to do the job safely can be accessed. If something new comes to light during the course of work and the means to do the job safely is not immediately available, consider what must be done to ensure that all workers remain safe.

The Neil George Five Point Safety System is a straightforward and structured means for miners to assess their workplace, equipment and work procedures. It is used at the workplace immediately before work tasks begin. It can be used at the beginning of shift and stand as a pertinent reminder of health and safety issues throughout the shift. A card is often carried by the miners with the five points noted down for them to consider. Columns for successive tasks to which the miners are assigned during their shift are sometimes present. It is a general card that does not have specifics and can therefore be used at different workplaces. Mine workplaces are dynamic and continually change. In order to complete the Five Point Safety System, it is often necessary to complete checklists and refer to maintenance log books to ensure they are current. They encourage independent thinking and real time engagement because the miners must check their workplace, equipment, and required workplace procedures and continue to do so throughout the shift.

3.2 Field Level Risk Assessments (FLRA)

This second system is used on many construction sites and involves teams of workers who work together to assess risks at the workplace. Instances

when this would be necessary include before beginning work, when a new worker joins the crew, when work procedures change due to site conditions or when new equipment is introduced, and when the activities of others in the area may pose a risk. The FLRA is completed by:

1. **Noting hazards to which workers are exposed:** As work is being conducted it is necessary to question what hazards are present to them and the surrounding workers.
2. **Assess the risk:** Note and assess the probability of the hazard causing an adverse outcome and the possible severity.
3. **Control those risks:** Note the means to control the risk by noting the hazards, the means to control the hazards, who will control them, and who will check if the controls are adequate.
4. **Follow up:** At this point, what follow-up is required after the job is completed. This would include reactivating controls that were suspended to conduct work and notifying any personnel with interest of the work being completed.

Some forms or checklists may be used in conjunction with the FLRA such as hot work permits, confined space entry, ground disturbance checklists, working at heights checklists, critical lift checklists, and mobile lift equipment checklists. These lists combine assessing and effectively controlling risks.

4. REAL LIFE EXAMPLES

Field Level Risk Assessments (FLRA) or the Neil George Five Point Safety System as applied to real life accidents:

4.1 Worker falling 20 metres

A worker fell 20 metres through a lifting well to the ground. He, along with the rest of his scaffold construction crew, were part of a team building a mill transfer tower which was 20 metres above ground level. He was a junior member of the crew. He had completed a field level risk assessment for the crew by himself from ground level and the entire crew signed it off even though they were not present at its completion. Although it had been noted that fall arrest was required, the locations and job tasks when the fall arrest should have been worn were not. The worker was passing construction material from 20 metres above ground level to the more senior members of the crew constructing the scaffold above. He was not wearing fall arrest. He had to collect some tubing from a collection area beside the lifting well. He went around the collection area to fetch tubing when he stepped into the open hole of the lifting well and fell 20 metres to the ground.

If the pre-job safety analysis had been completed properly, the questions that need answering in this example are:

1. What would have been revealed if the entire crew including more experienced members had done the risk assessment at the elevation where the work was carried out?
2. Would the open hole have been noticed if they were at the workplace 20 metres above ground?
3. If noticed, would the open hole have been covered or would they have been wearing fall arrest while working around it to prevent them from falling through the hole?

4.2 Load-haul-dump vehicle driving into open stope

A miner drove a *Load-Haul-Dump vehicle* (**LHD)** into an open stope. He started his shift working on the construction crew. During the shift, a supervisor assigned him to work on the production crew for the rest of the shift. The job to which he was assigned was to remove ore from a stope in the lower levels of the mine with an LHD. He was performing this task but it was hot and dusty deep in the mine. He drove the LHD to higher levels in the mine to look for dust masks. For some reason, he drove into the upper level of the stope from which he was removing ore. There was a sign that prohibited passage past the point beyond which the ore was being withdrawn from the stope from the level from where he was working. This sign was on a rope that was meant to stretch across the cross-cut; the rope was not connected across the cross-cut. He drove past this point. It is thought there was a crust of rock over the stope for which the ore was being withdrawn that he successfully drove over. When he drove over this crust while returning, the LHD went through this crust.

If the pre-job safety analysis had been completed properly, the questions that need answering in this example are:

1. Would the sign preventing entry on top of the stopes had been noticed even though it was not connected?
2. Would the miner have been aware of the reason the sign was present?
3. Should contact have been made with someone before driving anywhere near this stope?

4.3 Miner detonating drill hole

A surface driller drilled into a hole loaded with explosives, causing the explosives to detonate. The surface driller was assigned to clear drill holes of material that had sloughed into them by drilling from surface to an underground stope. These holes were loaded. The resulting explosion expelled the drill

string from the drill hole. Workers underground in the cross-cut that was driven into the open stope where this incident took place were flattened by percussion of the explosion.

If the pre-job safety analysis had been completed properly, the questions that need answering in this example are:

1. Would the driller have checked for evidence of the holes having been loaded?

2. Would the underground miners have checked what work was being conducted near the stope including any surface work?

4.4 Drill rig fire

Two workers inside a surface diamond drill rig were burned. While the drill was operating, a hose carrying hydraulic oil was transported detached from a nipple and sprayed the driller and helper with the hydraulic oil. It was an extremely cold day and the inside of the drill rig was being heated with an open flamed propane heater. This open flame set the workers alight.

If the pre-job safety analysis had been completed properly, the questions that need answering in this example are:

1. Would the competence of the connections have been tested?

2. Would the preventative maintenance records of the drill rig been checked and noted as not up-to-date?

3. Would open-flamed propane heaters inside a drill rig have been identified as unsafe?

5. CONCLUSION

Pre-job safety analyses are essential in helping to prevent incidents, which often have the potential to cause serious injuries. Incidents which have already occurred must be investigated to find their causes and thereby preventing a repetition.

For pre-job safety analyses systems to be effective, Management, Supervision, and Workers must all work together to make them operate effectively. Management must implement and document a system as well as monitor it to ensure it is working. Supervision must teach Workers how to complete pre-job analyses effectively and check to see that they are being done competently. The pivotal employees to make pre-job safety analyses effective are workers: they must complete them competently.

There is no doubt that competent pre-job safety analyses would have helped prevent the four serious mining incidents discussed here.

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