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Hazard identification as an effective tool for evaluating hazardous processes

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Abstract

Background: As the number of Pelletization of iron ore factories in India grows, so will the number of environmental and health consequences related to the workplace. As a result, knowing the dangerous process is essential for developing effective control measures. HIRAC ("Hazard Identification, Risk Assessment, and Control Measures") is a useful Occupational Health Assessment technique.

Objective: The study's goal was to identify all potential risks at various workplaces in Conduct a professional health assessment of risk in the "iron ore pelletizing factories", compute the high- risk rating using the hazard or risk matrix, and also compare the rating of risk after and before control actions.

Materials and Methods: A cross-sectional study was conducted in Pelletization of iron ore factories in India, Odisha, from January to October 2020. Inspection of the workplace, employee responses to potential hazards in their workplace, review of early incident analysis, material safety information sheet, injury or first aid record, "department procedure manual", job recommendation or instructions, "standard operating procedure" also employee health records were all used to collect data for the survey.

Results: There were a total of 120 dangers discovered. The net result at the 0.0001 level of significance, the paired sample t-outcome test's reveal that "before taking control measures", mean high-risk rating changes (Mean =11.15, Standard Deviation = 7.1) and "after taking control measures" (Mean = 4.1, Standard deviation D = 3.4) (t value = 12.6428, n = 120, df = 119, P<0.0001, ninety five percent CI for the mean difference that is (5.34 to 7.32). After applying control measures, risk reduction was roughly 7.05 points lower on average.

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Conclusion: When control measures were implemented, hazards with a rating of high-risk or higher were decreased to a stage that is regarded as acceptable "As Low as Reasonably Practicable" , minimizing the risk of disease or damage in the job area.

Keywords: Control measures, hazardous process, risk assessment, hazard identification.

1.0 Introduction

After Russia, Brazil, and Australia, India has the fourth biggest iron ore resources in the world. India's feasible hematite deposits were 9919 million tonnes, and its "recoverable magnetite reserves" were 3546 million tonnes, according to a survey undertaken In April 2020, the "Indian Bureau of Mines" (IBM) will release a report.

Beneficiation methods

It must be used to meet iron ore demand since good quality iron ore reserves are rapidly decreasing. To employ concentrates as feed material, agglomeration processes such as sintering/pelletization must be applied to the steel plants.

Pelletization plants are beneficial to the fines and convert useless low-grade fines into a blast furnace feed that is easy to consume. The current pelletization production capacity in the eastern area is 40.7 MMT, which will grow to 52.7 MMT in the near future after the authorization of roughly nine units in numerous commissioning stages. As the number of pelletization factories grows, so will the number of environmental and **health problems**.

The detection, elimination, assessment, and/or Hazards in the workplace are under control is an important aspect of any Occupational Health and Safety programme.Risk assessment of risk is the establishing process if the risks posed by a hazard are acceptable while also considering the effectiveness of such existing controls. Although it is tough to eliminate all dangers, the aiml is to decrease the most serious and high-risk hazards assessment to the least risk level possible in order to protect workers.

Hazardous process is defined as follows in Section 2 (cb) of the Indian Factories Act, 1948:

"Hazardous process"

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It refers to any activity or process in connection with a factory included in the primarily Schedule that, unless additional precautions are taken, could result in the raw materials, intermediate and finished products, by-products, wastes, or effluents: Cause serious harm to the health of those involved in or linked with the activity, or As a result, the general environment is polluted. A “hazard" is a condition or a source that may result in human disease or injury, environmental damage, property damage, or an amalgam of these. Hazard identification entails determining the unfavourable circumstances that contribute to the occurrence of the hazard, and the process through which those unfavourable conditions may occur. Risk or hazard is a two-dimensional notion that includes the possibility of a negative consequence as well as uncertainty about the incidence, magnitude or timing of that negative result. There is no risk if either attribute is missing.

Identification of Hazards and Risk Assessment

It is a technique for defining and describing risks by determining their probability, severity, and frequency, also assessing negative consequences for example injuries and potential losses. An assessment of risk that offers the factual foundation for the planned activities of the strategy to decrease losses from identified dangers. Risk assessment is divided into four components by the “ISO Risk Management” Guidelines and Principles: risk evaluation, risk treatment, risk identification and risk analysis. The first stage, **identification of risk,** is accomplished through listing all potential hazards as well as their implications. Local assessments of risk must give enough data for the authority to detect and prioritise relevant reduction activities to mitigate also losses caused by identified hazards.

The method of using measures to least the risk linked with a risk is called hazard **control.**

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2.0 Research and methodology

The various steps of the process are depicted in the diagram below [**Figure 1]**.

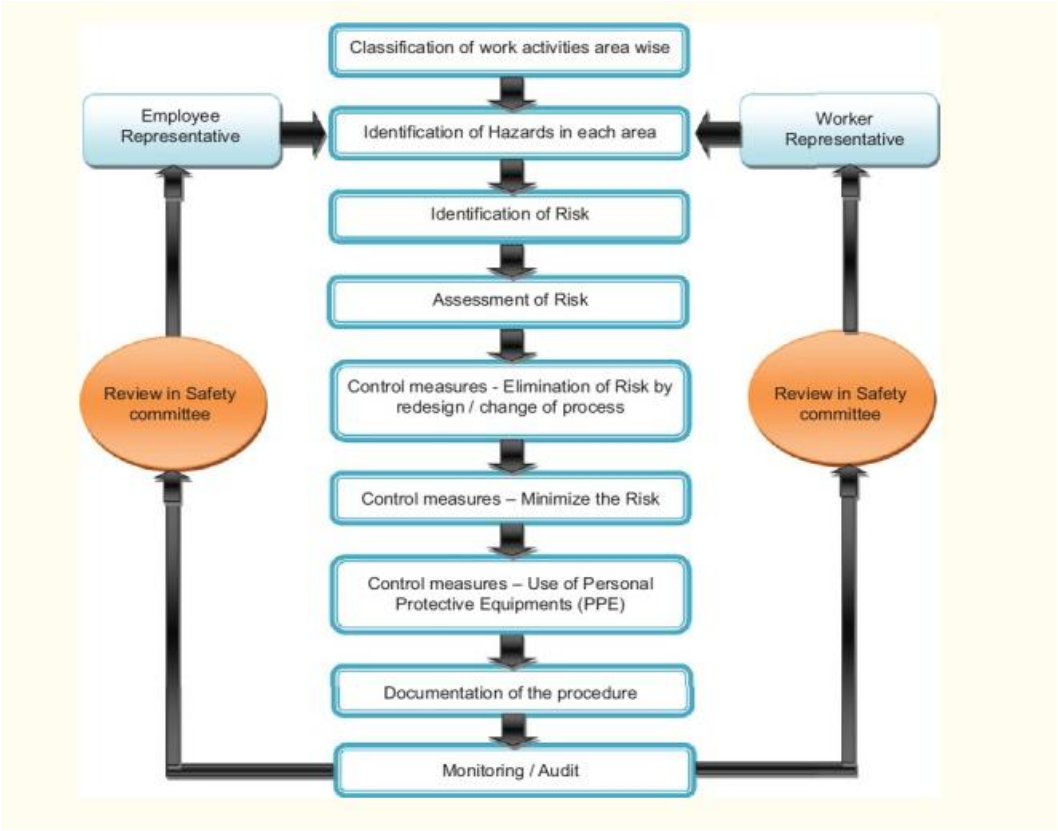

Figure 1: Flowchart of risk assessment, control measures and hazard identification approach

2.1 Research approach

A **systematic approach** to measuring and describing the hazards connected with hazardous chemicals, actions, processes, or occurrences is known as risk assessment.

Any "self-contained" systematic procedure that is carried out as a section of an assessment of risk. – means that any operation It can also be put to use as a helper build a probabilities distribution for health or environmental repercussions – is referred to as a risk assessment method.

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2.2 Population and sample

Hazards of chemical exposure

A hazard of chemical exposure is one which is supported by evidence of chronic (delayed) or acute (immediate) effects of health in an "exposed population". Therefore The dose (how much), duration and frequency of exposure (how long and how often), and mode of exposure (how and where a material enters or leaves the body), whether through the respiratory system (inhalation), the skin, or some other channel, all influence exposure (absorption),the gastrointestinal system (ingestion) or through the skin (percutaneous injection) (accidental needle stick). The resulting health effects can be temporary, cumulative or permanent; local (at the location of initial chemical contact), or systemic (after absorption, perhaps biotransformation and distribution, at a location remote from first encounter with a material).

Exposure

It is defined as the amount or concentration of a specified agent (biological, electrical, chemical, physical or electromagnetic field (EMF),) that also reaches a system, subpopulation or target organism at a particular frequency only for a set period of time.

Hazard identification

It is the process of determining the type and nature of negative consequences that an agent, procedure, or piece of equipment has the potential to induce in an organism, system, or (sub) population.

For users and institutions to modify and adapt for its operations, the following sample checklists and risk assessment tools are provided. A quick introduction; target audience; applicability and application of the checklist;

- Checklist for Laboratory Safety in the Past
- Matrix for Hazard Risk Assessment in the Laboratory
- Matrix for Risk Assessment of Laboratory Processes
- Checklist only for a Laboratory method Risk Assessment Using a harmful Chemical
- Tool for Assessing Chemical Hazards in High-Risk Environments

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2.3 Research tools

The five various types of danger assessment instruments that can be utilized. The following is a brief description of the five tools:

1. In research laboratories, control banding chemicals are used: Hazards are classified into one of several categories, allowing for the implementation of general control measures appropriate for those categories.

2. Job hazard analysis: A systematic strategy for documenting the hazards and work steps connected with each other step.

3. Analyze "what-if" scenarios: A method that asks a set of questions to assist you discover potential problems.

4. Checklists: This strategy is more practical because it aids researchers in remembering all of the measures they must take.

5. "Standard operating procedures" (SOPs) are developed in a structured manner: A strategy for analyzing many areas of analysis work that leads to the creation of the SOPs.

2.4 Data collection method

The research was divisional in nature and used "**semi-quantitative"** data or information collection techniques. Inspection of the work environment, interaction with employees about potential hazards, review of the "department procedure manual", job instructions, "standard operating procedure", and incident data report provided primary data, whereas secondary information was gathered using "Material Safety Data Sheets" (MSDS),injury or first aid register, employee health records, literatures and journals provided secondary data.

2.5 Statistical analysis

Statistical analysis includes calculating the mean value of a set of data in a given sample used only for observational research. Hypothesis testing is a technique for drawing conclusions about a population under investigation. The null hypothesis states that the statistics mean value will be 0. The paired "t-test" is used when two collections of data or information are being examined and is employed as a sort of hypothesis testing. In a paired t-test, the data are

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reliant on each other since each value from the first sample is matched with a value from the second. The difference in the means of both datasets was used to make the inference.

The website GraphPad was also used for statistical analysis. The significance level was set at P 0.05[**Table 1]**.

	n	mean	standard deviation	standard error mean
Before control measures	120	11.15	7.1	0.65
After control measures	120	4.1	3.4	0.31
Difference	120	7.05	3.7	0.34

95% confidence interval for mean difference :(5.34-7.32). Mean difference T-test: zero(vs. not=00 t-test value: degree of freedom (df): 119. The two tailed p<0.0001. By conventional criteria, this difference is considered to be extremely statistically significant.

Table 1: "After control measures", there is a reduction in risk.

The net result at the 0.0001 level of significance, the paired sample t-outcome test's reveal that "before taking control measures", mean high-risk rating changes (Mean =11.15, Standard Deviation = 7.1) and "after taking control measures" (Mean = 4.1, Standard deviation D = 3.4) (t value = 12.6428, n = 120, df = 119, P<0.0001, ninety fife percent CI for the mean difference that is (5.34 to 7.32). After applying control measures, risk reduction was roughly 7.05 points lower on average.

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3.0 Result

This plant had 120 dangers, all of which were identified and analyzed. They've been divided into five distinct groups [**Table 2 and Figure 2]**.

Mechanical	42.54%
Electrical	18.40%
Fire and explosion	16.67%
Heat disorders	3.74%
Radiation	2.88%
Noise	3.74%
Vibration	2.88%
Dusts, chemicals and toxic substance	19.26%
Biological	4.61%
Agronomical	4.61%
Psychosocial	2.88%

Table 2 : The frequency of various dangers

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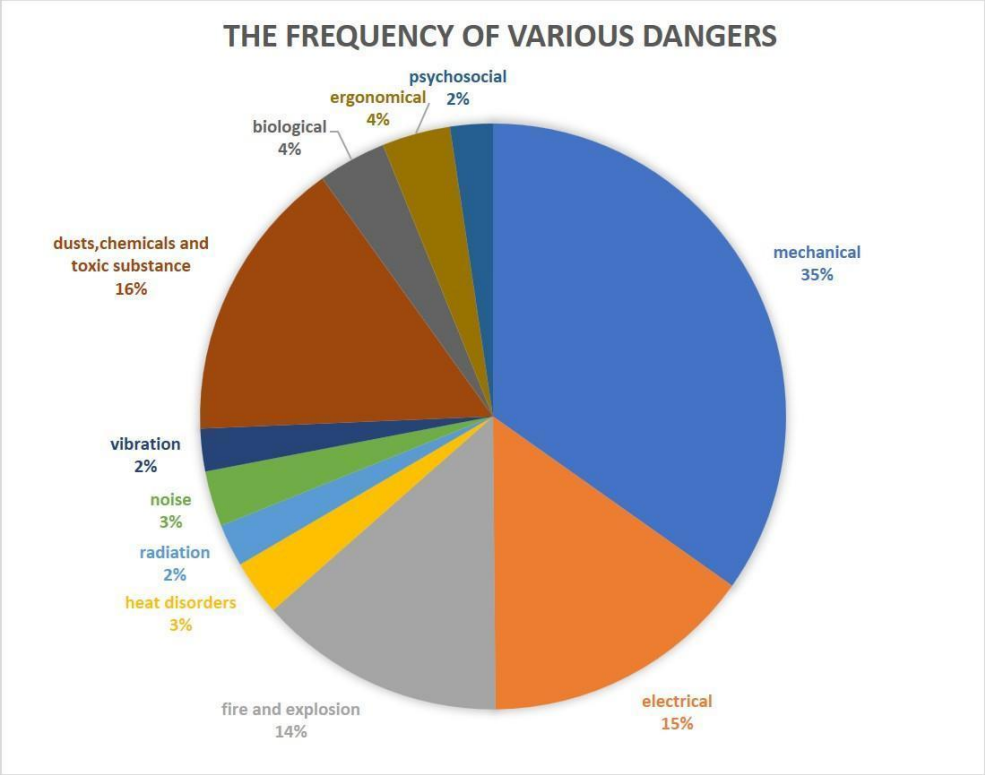

Figure 2: In the iron ore pelletizing sector, the frequency of various dangers

The following table lists the key hazards, risk assessments, and risk reduction after implementing appropriate control measures **[Table 3]**.

Steps in the process	effectiveness
Completely eliminate the risk hazard	100%
Measures of engineering control: establish a hurdle between the hazard and the person.	70 to 90%
Regulations, laws, and processes are all examples of administration.	10 to 50%
Personal protective tools are provided.	20%

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Table3: Control measures and their efficacy

risk	description	action
16 to25	extreme	Immediate action to control the hazard as detailed in the hierarchy of control. Actions taken must be documented on the risk assessment from including date for completion
11 to 15	high	Immediate action to control the hazard as detailed in the hierarchy of control. Actions taken must be documented on the risk assessment from including date for completion
6 to 10	medium	Planned approach to controlling the hazard and applies temporary measure if required. Actions taken must be documented on the risk assessment from including date for completion
1 to 5	low	it may be considered as acceptable and further reduction may not be necessary. However, if the risk can be resolved quickly and efficiently, control measures should be implemented and recorded

Table 4: Control measures that are based on a risk assessment

For risk management, the given procedures were also taken [Table 4 and Figure 3]:

- Hazards that are critical or high-risk require immediate treatment.
- Temporary remedies that worked before permanent fixes could be implemented
- Long-term remedies for dangers that can lead to long-term sickness
- Long-term solutions for the hazards that have the most serious implications
- Workers need to be trained on the risks that still exist and how to deal with them.
- Regular checks to see if the control measures are still in place.

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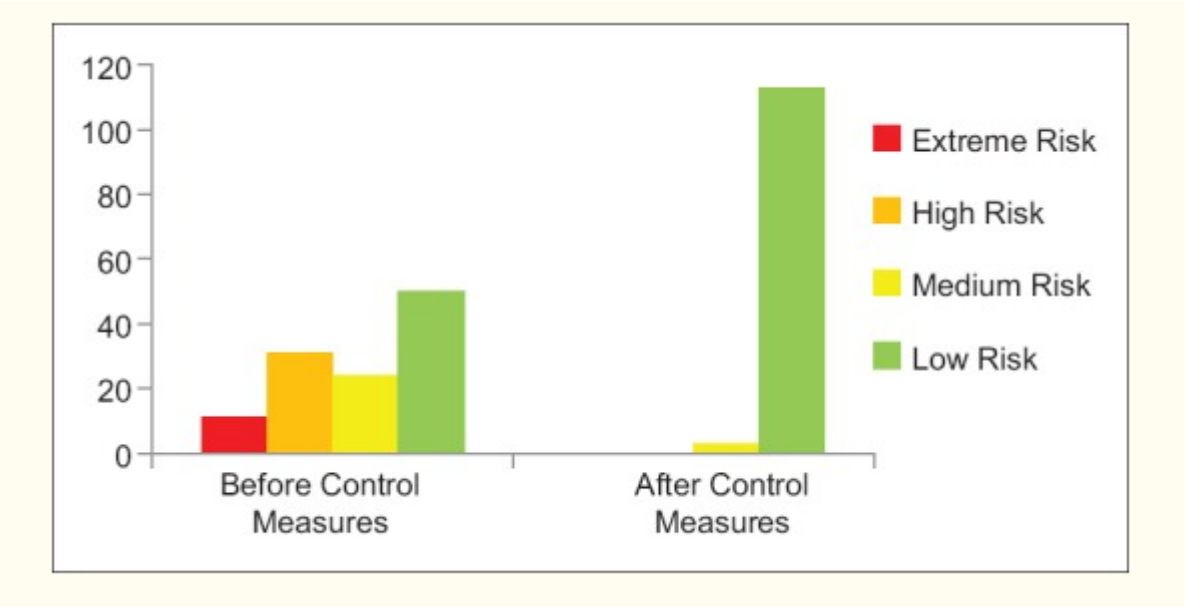

Figure 3 : After control efforts, high-risk and extreme ratings were reduced to acceptable high risk ratings.

3.1 Discussion

In this divisional investigation, it was discovered that by implementing "control measures hazards" with a rating of high-risk and above might be lowered to an ALARP level. The investigation implies that conducting a regular Risk Assessment, Control Measures and Hazard Identification study can help lower the risk of damage or disease in any manufacturing industry.

The department of the environment, safety, and health is the foundation of such manufacturing companies. The HSE department is closely linked to different departments for example engineering services, human resources,commercial, and manufacturing [**Figure 4]**.

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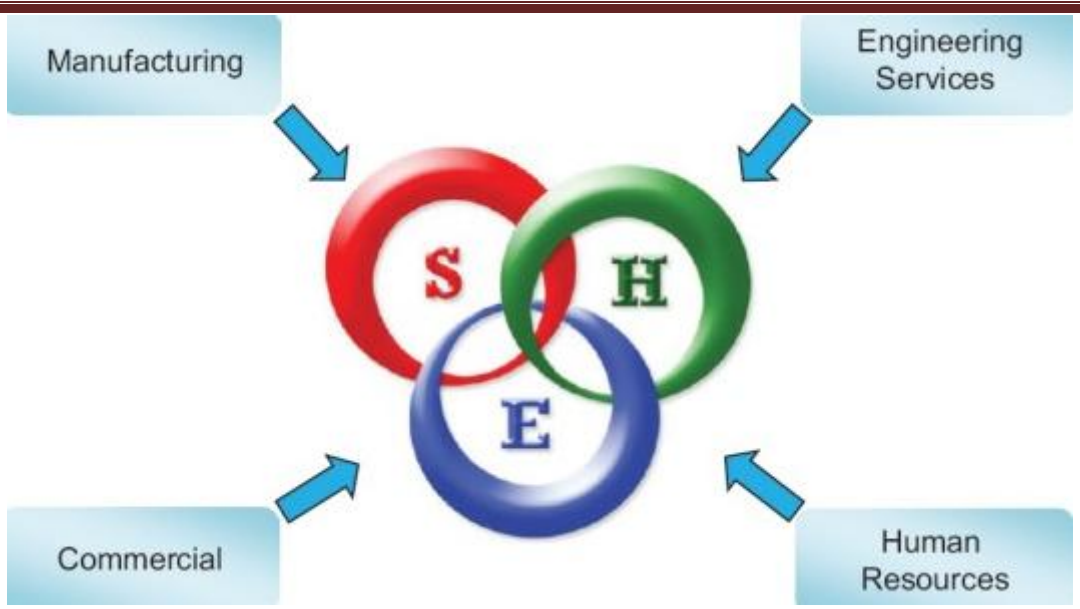

Figure4: Integrity of the Department of the Environment, Safety, and Health with different departments

Through monthly Safety Committee meetings, the Environment, Safety, and Healthdepartment performs a number of normal functions, including detecting hazards, risk assessment studies, and management methods.

It is critical to know that less workplace health and safety costs money, particularly in these trying times. Moreover, case studies represent that effective Health management and Occupational Safety is associated with an organization's developed profitability and performance. [Aerts et al., 2018; Zhou et al., 2018; Fadeel et al., 2018; Tarafdar and Sinha, 2019; World Health Organization, 2020] [Aerts et al., 2018;

4.0 Conclusion

Defining and assessing dangers is the first step in protecting workers from occupational diseases and ensuring a safe workplace. All manufacturing businesses should conduct HIRAC studies on a regular basis. This aids in the achievement of two goals: first, identifying high-risk and critical hazards that must be handled on a priority basis, and second, reducing risk to an ALARP level by implementing control measures as soon as possible. When control measures were implemented, hazards with a critical rating or higher were lowered to a degree that is regarded as acceptable "As Low as Reasonably Practicable" (ALARP), minimizing the risk of damage or disease in the workplace. The net result at the 0.0001 level of significance,

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5.0 Implication of the study

The following issues must be addressed in the risk assessment for occupational health:

- The risks posed by the processes engaged in various activities
- Failure of controls: a "semi-quantitative" assessment of the potential safety and health consequences
- Administrative and Engineering controls appropriate to the dangers and also their interrelationships, for example the deployment of applicable detection technologies to offer previous release warning.

6.0 Recommendation

Hazard Identification and Assessment

Failure to identify or acknowledge hazards that are present or could have been expected is one of the "root causes" of workplace injuries, illnesses, and events. A proactive, continuing procedure to identify and assess such dangers is a crucial component of any good safety and health programme.

Employers and workers must identify and analyse hazards in the following ways:

- Collect and analyse data on the hazards that exist or are anticipated to exist in the workplace.
- Perform frequent and initial job area inspections to identify such new or reoccurring dangers.
- Determine the underlying dangers, their causes, and safety and health programme flaws by investigating injuries, illnesses, incidents, and close calls/near misses.
- Identify trends in injuries, illnesses, and risks reported by grouping comparable episodes together.

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- Consider the dangers that come with emergency or out-of-the-ordinary scenarios.
- Determine the severity and likelihood of events for each identified danger, then prioritise corrective measures based on this information.

Some dangers, such as tripping hazards and housekeeping, can and should be addressed as soon as they are discovered. Fixing risks on the spot highlights the significance of safety and health while also providing an opportunity for safety leadership. See "Hazard Prevention and Control" for further information about repairing other risks discovered using the methods provided here.

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