THE ANALYSIS OF HEALTH AND SAFETY ASPECTS BY USING HAZARD IDENTIFICATION AND RISK ASSESSMENT (HIRA) METHOD

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ABSTRACT

Company X is a producer of fodder machine's spare parts, along with its reparation. In the production activities carried out, there are some direct actions relating to engines and presenting hazard to workers. On 2013, 34 occupational accidents cases were suffered by workers in the production area. Begins with the identification of the point - the point which could lead to accidents, this study aims to determine the causes of accidents so that control measures can be carried out and the proposed improvements. Started with identification of points leading to accidents, this research was aimed to find out the causes in order to carry out controlling action, as well as propose improvements. The identification process was conducted by using Hazard Identification and Risk Assessment (HIRA) method. Based on the hazard identification process, 19 types of danger sources are obtained, whereas the most greatest risk is sandwiched-workers in hydraulic cutting machines and eye irritation due to lathe grams spark, each worth 7%. Based on risk level, there are 9 types of moderate risk hazard and 10 types of high risk hazard.

Keywords: *Occupational Health and Safety, HIRA, Risk Analysis*

1. INTRODUCTION

Human resources has an important role for the success of organization or company, because human life is sort of asset which needs to be maintained. It means that company's human resources is able to provide optimum contribution in achieving organization's objectives. One main thing should be concerned by company is Occupational Safety and Health (K3) system. In Indonesia, many Occupational Health and Safety (K3) problems are still frequently occured. A data from PT. Social Security (Persero) show that there were an average of 414 occupational accidents cases per day during 2007 to 2011, (Accessed from Occupational Accidents Data of PT.Jamsostek (Persero)). CV. Konstalindo is a producer of fodder machine's spare parts, along with its reparation. During production process, In the production activities carried out, there are some direct actions relating to engines and presenting hazard to workers

As many accidents cases occured, in accordance with Table 1, CV. Konstalindo must control potential accidents hazards in workplace environment. Therefore, this research is carried out by using a method which is a technique to identify potential hazard (hazard) of occupational accidents, namely HIRA (Hazard Idenfication Risk Assessment) method. This is a structured and systematic checking process of existed planning and process or operation to identify and evaluate problems in order to reduce accidents (Gokul and Shivasankaran, 2014).

Only a few methods use the principles of risk assessment (cause consequence-release-dispersion-effect) as the basis for their structure (Metrik, EHS) or apply some kind of model (e.g., for dispersion) to estimate a value related to the possible damage (HIRA). Such methods are preferable. (Koller et al 2001).

Here are some data of accident cases undergone by workers in production area during 2013:

Tabel 1 List of Accident Occurred in 2013

No	Type of Accident	Amount
1	Strucked down or sandwiched by raw materials	2 people
2	Electrocuted	3 people
3	Stumbled by work materials	2 people
4	Slipped by slippery floor	2 people
5	Hand scratched by machine	4 people

Tabel 1 List of Accident Occurred in 2013

No	Type of Accident	Amount
6	Hand blistered / burned	2 people
7	Sandwiched by Hydraulic Cutting Machine	1 people
8	Hand scratched by raw materials	4 people
9	Hand exposed by hammer	3 people
10	Hearing loss	1 people
11	Respiratory and eye disorders	2 people
12	Injured by splash of gram flake	5 people
13	Shoulder injury	3 people
Total		34 people

2. THEORETICAL BACKGROUND

Hazard is a situation that allows or potential for the occurrence of events such as injury, illness, death, damage or inability to perform operational functions have been assigned (Tarwaka, 2008)

Hazard is a state (energy, action, condition) which allow or cause injury, illness, death or damage to property including the keruskan environment, including in the definition of this danger is the environmental aspect (Aminuddin, 2011)

HIRA (Hazard Identification Risk Assessment) method is the initial stage of risk management. HIRA (Hazard Identification Risk Assessment) method is a structured and systematic checking process of existed planning and process or operation to identify and evaluate problems in order to reduce accidents (Gokul and Shivasankaran, 2014).

The concept of Idenfication Hazard Risk Assessment (HIRA) also used by Kumar and Kumar (2014) in order to identify and control hazards that occur in the foundry company in India, as well as the Department of Public Safety and Correctional Services Ontario Provincial HIRA use the concept in 2012 to prevent and reduce the hazards that occur in the Province of Ontario.

Hazard and operability analysis (HAZOP, Imperial Chemical Industries, 1974), fault tree analysis (Parmar and Lees, 1987) and failure mode and effect analysis (Lees, 1996) are examples of qualitative techniques. Khan and Abbasi (1998) introduced the hazard identification and ranking (HIRA) methodology as a systematic tool to be automated in a software in order to reduce expert time

Risk analysis requires knowledge of both the probability (frequency or likelihood of occurrence), and the consequence (impact, damage, or injury level) of the upset event. Risk assessment is the process used to determine how to manage the risk identified by the analysis (Legget, 2012)

According Gokul and Shivasankaran. (2014), as quoted from OHSAS 18001, the best way to reduce danger is to get rid of everything which have any potential hazard leading to work accident. The following is HIRA identification process by using UNSW Health and Safety (2008):

1. Hazard Identification

In this stage, a hazard Identification process was conducted to find out the potetntial danger points which leads to workplace accidents, from the beginning until the end of production process, in order to see all the irregularities occurred in the company

2. Risk Assessment

Risk analysis stage was done by defining the main sources and roots of accidents or process interruption.

The measures of risk analysis are:

1. Estimation of risk criterion
2. Determination of seriousness / severity level
3. Risk Cluster Matrix
4. Diagram of Risk Percentage

3. Risk Control

In this stage, a risk control analysis was conducted to find points which cause occupational hazard in CV. Konstalindo. This stage was aimed to transform uncertainties into benefits for the company, by preventing the occurrence of threats.

The last stage of controlling and improvement is classifying each hazard by degree of danger risk, including:

1. Extreme Risk Hazard
2. High Risk Hazard
3. Moderate Risk Hazard
4. Low Risk Hazard

3. RESEARCH METHOD

The research method used in this study is descriptive research. It describes amount of data which is analysed and compared

based on the ongoing fact, while the further action is trying to giving solution in form of improvement recommendations in order to obtain better results. This study focuses on the occupational health and safety management systems by using Hazard Identification and Risk Assessment (HIRA) method.

The identification processes by using HIRA are:

1. Hazard Identification
   Identifying any hazards in particular production area, from the beginning to the end of the process, by controlling any deviations
2. Risk Assessment
   Conducting a risk analysis of the identified hazard to see which one has the greatest risk.
3. Risk Controls
   Ranking the hazards based in risk analysis results and determining which one should be fixed soon.
   Analysis phase is conducted by defining the main sources and roots of accidents or process interruption. The steps are:
   a. Conducting an analysis of the main sources and roots of accidents or process interruption.
   b. Performing risk assessment analysis and using HAZOP worksheet to obtain appropriate improvement recommendations to be applied in the research object.
4. Risk Handling (Improvement Action, Procurement Recommendation of PPE, Improvement Proposal)
   In this stage, an analysis of improvement design was conducted to discover which one should be applied at the occupational hazards points in company's production area in order to minimize accidents.

4. RESULT AND DISCUSSION

Prior to identify hazard potential in CV. Konstalindo's production process, the manufacturing process should be known first. The process flows are:

1. Cutting, any A36 type steel plate sheets, with 2m x 1.5m large and 6mm in thickness, were cut into 33cm x 55cm.
2. Vertical scrap/smoothing, it is conducted on the long section of cut steel plate.
3. Horizontal scrap/smoothing, it is conducted on the long section of cut steel plate.
4. Cutting, any 33cm x 55cm steel sheet were cut back to 15cm x 50cm.
5. Lathing, the lathing process or re-smoothing process on steel plates' long and wide section were conducted.
6. Manual Pressing, performing the bent plate alignment, to make it precious, by hammering it manually.
7. Perforation, it was carried out using a hydraulic perforation machine.
8. Carbonizing process, a process of coating and increasing steel content by using specific formulations, heated in 1000 Celcius temperature degree for about 12 hours.
9. Cooling, the cooling or temperature neutralization process is carried out by using water.
10. Pressing, It was conducted by hydraulic press machine so carbonated plates have more value.
11. Inspection, a process of inspection or checking armored plates' quality was also conducted.
12. Packaging, a process where the armored plates were packaged into boxes.

After discovering CV. Konstalindo's production process, a *Hazard dan Risk identification* was conducted as following in table 2.

Before conducting ranking, it is necessary to formulate criterion of seriousness or risk ranking degree by considering risk criterion existing in Company X as follows:

1. Likelihood (L) is the possibility of accidents occurrence (Table 3).
2. Severity or Consequences (C) is the seriousness of the injury and working days loss (Table 4).

Table 2. Hazard and Risk Identification

Event	Hazard	Risk	Outcome
Steel Plates Removal	Steel Plate	Body Sandwiched	Abrasion
Roller Crumble Removal	*Roller Crumble*	Body Strucked Down	Swollen Feet
Machinery and Electrical Operation	Electrical Installation	Body Electrocuted	Limp Body
Steel Plates Removal	Lathe Machine	Stumbled by Machine's Feet	Feet Injury
Steel Plates Removal	Slippery Floor	Slipped by Slippery Floor	Waist Injury
Smoothing Process	Lathe Machine	Hand Grazed by Lathe	Grazed Hand
Smoothing Process	Vertical Scrap Machine	Hand Grazed by Scrap *Vertical* Machine	Grazed Hand
Smoothing Process	*Horizontal* Scrap Machine	Hand Grazed by Scrap *Horizontal* Machine	Grazed Hand
Carbonizing Process	Furnace	Hand Burned	Blistered Hand
Perforation Process	Hydraulic Cutting Machine	Sandwiched by Hydraulic Cutting Machine	Torn Fingers
Lathing Process	Lathe Machine	Hand Grazed by Steel Plate	Bleeding Hand
Lathing Process	Lathe Machine	Hand Grazed by *Roller Crumble*	Bleeding Hand
Manual Pressing Process	Hammer	Hand Exposed by Hammer	Swollen Hand
Machinery Operation	Lathe Machine, Scrap Machine	Hearing Loss	Hearing Disorders
Machinery Operation	Lathe Machine, Scrap Machine	Respiratory Disorders	Breathless
Machinery Operation	Lathe Machine, Scrap Machine	Eye Disorders	Eye Irritation
Lathing Process	Lathe Machine	Irritation and Eye Disorders	Swollen and irritated eyes
Steel Plates Removal	Steel Plate	Shoulder Burdened	Injured and Swollen Shoulder
Roller Crumble Removal	*Roller Crumble*	Shoulder Burdened	Injured and Swollen Shoulder

Table 3. Likelihood Criterion

Likelihood			
Level	Criteria	Description	
		Qualitative	Semi- Qualitative
1	Rarely Occured	Can be considered, but not only in extreme state	Less than once in ten years
2	Small Possiblity	Not yet happened, but usually occured at a time	Once-in-ten-year occurence
3	Possible	Should be happened, and maybe have been happened here/another place	One in five years or once a year
4	Great Possibility	Can be easily happened, may appear in the most common state	More than once in a year or month
5	Almost Definitely	It frequently happens and is expected to appear in the most common state	More than once in a month

(UNSW Health and Safety, 2008)

Table 4. Consequences Criterion

Consequences			
Level	Criteria	Description	
		Qualitative	Semi-Qualitative
1	Not Significat	It does not give any damage or injury to humans	No working days losing
2	Small	It cause minor injury, small losses, but does not influence work continuity	Still can work on the same day/shift
3	Moderate	It is resulted in severe injury which should be hospitalized. There is no permanent disability but lead to some finansial lossess	Losing less than three working days
4	Great	Causing severe injuries and permanent disability, as well as great finacial lossess which influences bussiness continuity.	Losing three or more working days
5	Disaster	Resulting in deaths and severe losses, which leads to permanent bussiness stopping	Losing working days forever

(UNSW Health and Safety, 2008)

Rating assessment of consequences and likelihood is presented in table 5 below:

Table 5. Rating of Consequence and Rating Likelihood

Hazard	Risk	Likelihood	Consequences
Steel Plate	Body Sandwiched	3	2
Roller Crumble	Body Strucked Down	3	2
Electrical Installation	Body Electrocuted	4	1
Lathe Machine	Stumbled by Machine's Feet	4	2
Slippery Floor	Slipped by Slippery Floor	4	2
Lathe Machine	Hand Grazed by Lathe	3	2
Vertical Scrap Machine	Hand Grazed by Scrap *Vertical* Machine	4	2
Horizontal Scrap Machine	Hand Grazed by Scrap *Horizontal* Machine	3	2
Furnace	Hand Burned	4	2
Hydraulic Cutting Machine	Sandwiched by Hydraulic Cutting Machine	3	3
Lathe Machine	Hand Grazed by Steel Plate	4	2
Lathe Machine	Hand Grazed by *Roller Crumble*	4	2
Hammer	Hand Exposed by Hammer	4	2
Lathe Machine, Scrap Machine	Hearing Loss	3	2
Lathe Machine, Scrap Machine	Respiratory Disorders	3	2
Lathe Machine, Scrap Machine	Eye Disorders	3	2
Lathe Machine	Irritation and Eye Disorders	5	2
Steel Plate	Shoulder Burdened	3	2
Roller Crumble	Shoulder Burdened	4	2

Risk Assessment is conducting by using Risk Matrix as presented in Figure 1.

Likelihood	Impact				
	Insignificant	Minor	Moderate	Major	Severe
Almost certain	Moderate	High	High	Extreme	Extreme
Likely	Moderate	Moderate	High	High	Extreme
Possible	Low	Moderate	Moderate	High	Extreme
Unlikely	Low	Moderate	Moderate	Moderate	High
Rare	Low	Low	Moderate	Moderate	High

Figure 1. Risk Assessment Matrix
(UNSW Health and Safety, 2008)

Risk of accidents discovered in CV. Konstalindo's production process are then classified into the matrix above. The classification can be seen in the following table:

Table 6. Matrix Ranking Rating

Scale		Consequences (Severity/Seriousness)				
		1	2	3	4	5
Likelihood (possibility)	5		Irritation and Eye Disorders			
	4	Body Electrocuted	Stumbled by Machine's Foot, Slipped by Slippery Road, Hand Scratched by Vertical Scrap Machine, Hand Burns, Hand Grazed by Steel Plate, Hand Grazed by *Roller Crumble*, Hand Exposed by Hammer, Shoulders Burdened by *Roller Crumble*			
	3		Sandwiched by Steel Plate, Strucked Down by Roller Crumble, Hand Grazed by Lathe, Hand Grazed by Horizontal Scarp Machine, Hearing Loss, Respiratory Disorders, Eye Disorders, Shoulder Burdened by Steel Plate	Sandwiched by Hydraulic Cutting Machine		
	2					
	1					

Based on the data in table matrix, risk scores and priorities can be calculated in order to take remedial action, whose results can be seen in Table 7 below:

Table 7. Risk Score Calculation

Hazard	Risk	Likelihood	Consequences	Risk Score
Steel Plate	Body Sandwiched	3	2	6
Roller Crumble	Body Strucked Down	3	2	6
Electrical Installation	Body Electrocuted	4	1	4
Lathe	Stumbled by Machine's Foot	4	2	8
Slippery Floor	Slipped by Slippery Floor	4	2	8
Lathe	Hand Scratched by Lathe	3	2	6
Vertical Scrap Machine	Hand Scratched by Scrap Vertical Machine	4	2	8
Horizontal Scrap Machine	Hand Grazed by Scrap *Horizontal* Machine	3	2	6
Furnaces	Hand Burned	4	2	8
Hydraulic Cutting Machine	Sandwiched by Hydraulic Cutting Machine	3	3	9
Lathe	Hand Grazed by Steel Plate	4	2	8
Lathe	Hand Grazed by *Roller Crumble*	4	2	8
Hammer	Hand Exposed by Hammer	4	2	8
Lathe, Scrap Machine	Hearing Loss	3	2	6
Lathe, Scrap Machine	Respiratory Disorders	3	2	6
Lathe, Scrap Machine	Eyesight Disorders	3	2	6
Lathe	Irritation and Eye Disorders	5	2	10
Steel Plate	Shoulder Burdened	3	2	6
Roller Crumble	Shoulder Burdened	4	2	8

Based on the data presented in Table 7, the percentage of each risk can be seen in Figure 3 below:

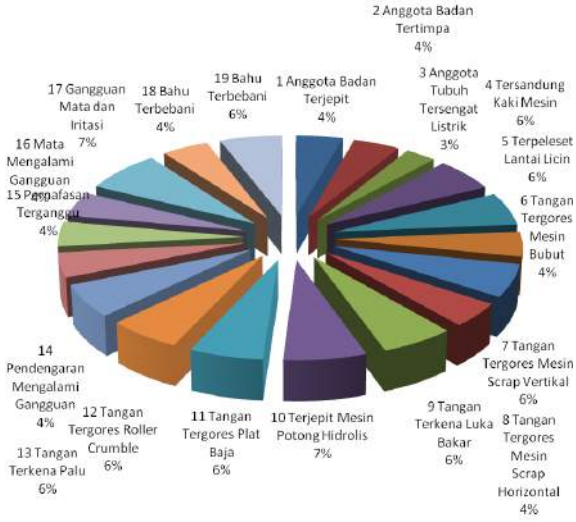

Figure 2. Risk Procentage

After discovering the percentage of each risk, the next action is calculating priority of each risk in accordance with priority classification presented in table below.

Table 8. Priority Index of Improvement Action

Hazard Level	Action
1-5	No need to act immediately, but keep inspected
6-10	Perform reparation in the next one year
11-15	Take action in the next three months.
16-20	Take reparation action within one month ahead.
21-25	Take action immediately/possible use restriction

The results of improvement actions priority for each risk above can be seen in Table 9. Once you know which risks are the most prioritized, the next step is to carry out 19 risk evaluation measures, where every event pose a potential hazard.

Table 9. Improvement Actions Priority

Hazard	Risk	Risk Score	Improvement Actions Priority
Steel Plate	Body Sandwiched	6	Perform reparation in the next one year
Roller Crumble	Body Strucked Down	6	Perform reparation in the next one year
Electrical Installation	Body Electrocuted	4	No need to act immediately, but keep inspected
Lathe	Stumbled by Machine's Foot	8	Perform reparation in the next one year
Slippery Floor	Slipped by Slippery Floor	8	Perform reparation in the next one year
Lathe	Hand Scratched by Lathe	6	Perform reparation in the next one year
Vertical Scrap Machine	Hand Scratched by Scrap Vertical Machine	8	Perform reparation in the next one year
Horizontal Scrap Machine	Hand Grazed by Scrap *Horizontal* Machine	6	Perform reparation in the next one year
Furnaces	Hand Burned	8	Perform reparation in the next one year
Hydraulic Cutting Machine	Sandwiched by Hydraulic Cutting Machine	9	Perform reparation in the next one year
Lathe	Hand Grazed by Steel Plate	8	Perform reparation in the next one year
Lathe	Hand Grazed by *Roller Crumble*	8	Perform reparation in the next one year
Hammer	Hand Exposed by Hammer	8	Perform reparation in the next one year
Lathe, Scrap Machine	Hearing Loss	6	Perform reparation in the next one year
Lathe, Scrap Machine	Respiratory Disorders	6	Perform reparation in the next one year
Lathe, Scrap Machine	Eyesight Disorders	6	Perform reparation in the next one year
Lathe	Irritation and Eye Disorders	10	Perform reparation in the next one year
Steel Plate	Shoulder Burdened	6	Perform reparation in the next one year
Roller Crumble	Shoulder Burdened	8	Perform reparation in the next one year

After identifying each risk above, some hazard prevention actions could be made, based on their risk level, namely:

1. Moderate Risk Hazard
   It includes Limb Electrocution, Limb Sandwiched in Steel Plate, Body Strucked Down by Roller Crumble, Hand Scratched by Lathe, Hand Grazed by Horizontal Scrap Machine, Suffering Hearing Disorders, Respiratory Disorders, Eye Disorders, and Shoulder Burdened by Steel Plate.
2. High Risk Hazard
   Some hazards which are considered high risk are Eye Iritation, Stumbled by Machine's Feet, Slipped by Slippery Floor, Hands Scratched by Scrap *Vertikal* Machine, Hand Burned, Hand Grazed by Steel Plate, Hand Scratched by *Roller Crumble,* Hand Exposed by Hammer, Shoulder burdened by *Roller Crumble*, and Sandwiched by Hydraulic Cutting Machine.

This point of improvement proposal using HAZOP Worksheet, which is a data discussion analysis describing more details about the causes, in order to find out the best action to overcome the problems.

Analysis of Improvements Proposal

1. Good working conditions, which are both comfortable and support workers to do their activities properly, including everything in workers' environment that may affect employess performance, as well as occupational safety. Therefore, such working conditions, consist of physical condition, psychological condition, and temporary condition of work environment, must be taken appropriately to ensure that workers feel comfortable at work for the sake of improving labor productivity.
2. Working procedure is a series of sequential working method, which is step by step and clearly shows the path or flow to be taken, where the work came from, where to pass, and when or where is the completion It could be supporting equipment, in terms of completion of works/tasks in certain field. Work procedures should be well-arranged in order to be carried out consistently, thereby improving work procedures can

create a interrelated sequence or work system to facilitate job management.

3. A training on the importance of Occupational Safety is a designed program giving provision to employees appointed by company to be able to apply the K3 in their workplace. The presence of K3 training is expected to give the understanding about things needed in K3 implementation in the workplace.
4. PPE Visual Display or poster, and the illustration of Occupational Health and Safety (K3) importance is a means to civilize safety campaign. Through the posters and displays, it is expected that public awareness of safe, comfortable and healthy work culture will be arised.. Do not forget to make it easy to read and do by workers.
5. Machine maintenance is to keep and raise the its efficiency, optimize the power to the desired result, and prevent sudden severe damage.
6. The significance of engine saving is to provide a cover on lathe to menghindari steer clear of workers from gram flake spark during smoothing process.
7. Providing non-conventional items-remover tools, such as manual hand truks.
8. Personal Protective Equipment (PPE) is the compulsory attribute must be used during working, in accordance to work hazards and risks level, to keep the workers's safety, as well as people aroung him.
9. Periodic inspections is a means to monitor health and safety aspects in CV.Konstalindo, periodic inspections carried out in accordance with the danger level of particular hazard. If the source of hazard has a moderate (S) risk level, then the inspection could be 1 time in 3 months, whereas for high-risk level (T), 1 time per month inspection should be performed. The periodic inspection is carried out according to the level of risk of each hazard occurred.

5. CONCLUSIONS

Based on the expected goals which fit the data and its processing results presented in the previous chapters, conclusions are made as follows:

1) The potential occupational accidents risks occurred in CV. Konstalindo's production area came from some sources, which has been classified into 13, include: Strucked Down and Sandwiched by Raw Materials, Electrocuted, Tripped by Materials, Slipped by slippery floor, Hands are Scratched by Machine, Hand Blisters / Burns, Sandwiched by Hydraulic Cutting Machine, Hand Scratched by Raw Materials, Hand Exposed by Hammers, Hearing Loss, Respiratory dan Eye Disoreders, Injured by Gram Flakes' Sparks, and Shoulder Injury. Among those, injury by gram flake's splash of lathe operation have the highest amount.
2) The Moderate Risk Hazard posed in CV Konstalindo's production area are Eye Iritation, Stumbled by Machine's Feet, Slipped by Slippery Floor, Hand Scratched by *Vertical* Scrap Machine*,* Hand Burned, Hands are Grazed by Steel Plate, Hand Scratched by *Roller Crumble,* Hand Exposed by Hammer, Shoulder burdened by *Roller Crumble*, and Sandwiched by Hydraulic Cutting Machine. The highest risk score is 10, fall on Eye Irritation which is caused by grame flakes' splash during lathe operation system.
3) After identifying the potential hazards, the overall recommendations are given to the company, they are:
    1. Improving unsafe working conditions
    2. Arranging good working procedures
    3. Conducting K3 training to workers
    4. Making a visual display/poster encouraging to always use APD
    5. Making sewer of stagnant water and oil
    6. Machine maintenance
    7. Preserving engines which causes grams spark
    8. Providing the non-conventional removal tools, namely: Manual Hand Truck
    9. Providing APD, namely:
        - *Safety Helmet*
        - *Safety Googgles*
        - *Safety Gloves*
        - *Masks*
        - *Safety Shoes*

- *Safety Vest Clothes*
- *Ear Safety*

10. Conducting periodic inspections

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