Job Safety Analysis in Production Floor of PT BD Based on Semi Quantitative AS/NZS4360 Method

I D Widodo¹, and N R A Dwinanda¹

¹Industrial Engineering Department, Universitas Islam Indonesia, Yogyakarta, Indonesia
E-mail: imamdjati@uii.ac.id

Abstract: Every industry must pay attention to the job safety of each employee by implementing good job safety effort to create a comfortable, healthy and prosperous work environment. It is related to the relationship of labor with work equipment, materials and processes, workplace foundations and ways of doing the work. This research was done in PT BD by implementing Job Safety analysis based on AS / NZS 4360. The analysis identifies 6 jobs that should be improved, namely, (1) Lifting the core (2) cutting mother core (3) The process of removing the email layer (4) Placing the results of the cutting core to the decoiler (5) Taking the cutting results for semi stacking and (6) Taking cutting results for semi wound. Some recommended actions are proposed such as improving the tool, developing SOP, better controlling procedure and improving operator (training).

1. Introduction

Every industry must pay attention to the job safety of each employee by some safety efforts. Work safety effort generally aim to protect the operator from accidents and protect the machine from damage, both during operation and during repair and maintenance activities. There are two biggest things that cause workplace accidents, such as unsafe worker behavior and unsafe environmental conditions. The frequency of work accidents and the occurrence of contamination of the product is very large if it does not pay attention to the two causes.

There are differences in the level and magnitude of workplace accidents between developed and developing countries. The rate of work accidents in developing countries reaches three to four times more fatal than developed countries [1]. Work safety is related to machines, working tools, materials, processes, workplace foundations, and the environment, as well as ways of doing work. Work safety targets all workplaces [2]. Therefore, companies should implement occupational safety and health efforts in the company as an effort to create a comfortable, healthy and prosperous work environment. This research was conducted in factory plan 1 PT BD. During a period of four years (2011-2015) the frequency of work accidents is 27%-29%. The company's biggest zero accident achievement was 6697 man hours.

The Job Safety Analysis (JSA) method will be used to analyze and reduce the risk of work accidents. This method is a method to look for risks and potentials that can be generated and overcome them against the possibility of workplace accidents that can occur by analyzing operator activities. Benefits of JSA are formalisation of work, accountability, worker participation, organisational learning, awareness, and...
loss prevention [3]. JSA was also applied in some fields such as construction[4], automation [5], mining [6] and shipyards [7].

2. Basic Theory

A. Occupational Health and Safety

Occupational Safety and Health can be described philosophically and scientifically [8]. Philosophically, it is a thought and effort to guarantee the integrity and perfection of both the physical and spiritual workforce, the work and culture towards a just and prosperous society. Whereas scientifically, occupational safety and health is a science and its application in an effort to prevent the possibility of accidents and diseases caused by work.

According to Dainur [9], Occupational Safety and Health is “safety related to the relationship of labor with work equipment, materials and processing processes, workplace foundations and ways of doing the work”. Sutrisno in Moenir [10] stated that work safety is a condition in the workplace / environment that can guarantee the maximum safety and health of people who are in the area / place, both the employee and non-employee of the work organization. Work safety is safety related to equipment, workplaces and the environment, as well as ways of doing work. Another opinion also expressed by Taslimin [11] is that occupational safety and health involve all elements involved in work activities involving subjects (people who do work), objects (material), ie objects or items being worked on, tools - tools used in the work and involve the environment.

From some of the definitions and concepts above, the researcher concludes that application and work safety is a way to apply oneself or organize oneself on a job in order to work safely and healthily both physically and spiritually related to the work process and work environment.

The aim of Occupational Safety and Health is essentially to protect workers from work-related accidents.

Sutrisno and Ruswandi [12] stated that the purpose of occupational safety and health is to achieve employee safety at work and after work.

Suma’mur [13] stated that the aim of Occupational Health Safety is to protect operators for their safety rights in doing work for the welfare of life and increase production and work productivity, to ensure the safety of others who are in the workplace environment and the source of production is maintained and used efficiently.

B. Risk management

Risk management must be part of the organizational culture. Organizations or companies that manage risk effectively and efficiently are more likely to achieve their objectives and do so at a lower overall cost (AS / NZS 4360, 2004) [14]. The risk management process can be seen from the standards set by AS / NZS 4360: 2004, the flow of the process can be seen from Figure 1. In identifying risks in occupational safety and health, the JSA (Job Safety Analysis) technique is used, ie before the activity starts, it is necessary to conduct a risk analysis study to find out what the magnitude and potential hazards are caused during the activity [15].

3. Methodology

The object used in this study is the operator and operator activities in the core section relating to Occupational Safety and Health, namely the hazards and risks contained in the operator’s work process. In this study, the data used are safety data, the possibility of accidents that occur, the consequences, and the risks that exist in the core section. The data collection methods used in this study are observation and interviews with expert informants/experts. This data includes data on the type of danger, the type of injury caused, the risk of danger, and susceptibility when the injury occurs.

The study was conducted in several stages:

1. At this first stage, JSA is used to look for risks of work accidents that might occur, what might be the cause and control efforts that have been made by the company in minimizing and preventing work accidents.
2. A risk analysis is performed using a semi-quantitative analysis method based on AS/NZS 4360: 2004 risk management standards to determine the consequences, exposure, and likelihood of work accidents on the operator. From the results of the semi-quantitative analysis, then the data is processed to find out how much risk the operator has using the formula: Scoring is done as an interpretation of the value of risk (Value of Risk = Consequences (C) × Exposure (E) × Probability (L)). Based on the results and discussion of risk analysis, the authors can then provide recommendations for companies in managing safety and health for workers with the principle of hierarchy of control.

3. The conclusions and recommendations stage contains the conclusions and suggestions of the authors of the company in accordance with the focus of the issues raised based on the OHS risk analysis of the operator.

4. Results And Discussion
The method for hazard identification is carried out using Job Safety Analysis (JSA). In the implementation of JSA, the authors take the data directly by observing the Core section of the plant production department PT. BD and interviews with the operators concerned. Observations are recorded on the Job Safety Analysis form based on AS / NZS 4360 (2004) Risk Management. Safety risks were analyzed based on 13 identified work details (Table 1). The risk identification and score determination is obtained through direct observation at the work location and interviews with experts which in this case are the operator and the head of the team at the core section. Risk analysis is carried out using a semi-quantitative risk analysis method which includes identification of risks, determining the value of consequences (consequences), likelihood, and exposure of each stage of work in the core section which is then used to determine the level of risk based on AS / NZS standards 4360: 2004, which will be described in Table 1. Based on the score, Six jobs/work need to be analysed. They are (1) cutting the mother core (2) Lifting the core (3) The process of removing the email layer (4) Placing the results of the cutting core to the decoiler (5) Taking the cutting results for semy stacking and (6) Taking cutting results for semi wound. Some identified conditions and facts of job/work that have high are:

1. The work that has the highest risk value is the Core Cutting operator with details of the work cutting the mother core as indicated by a risk value of 300. This indicates that the work is included in the priority 1 category, so it is necessary to handle risk until the risk value is more acceptable. Based on September's work accident data, the core cutting operator suffered a hand accident wedged by a
sharing core machine. The victim's finger entered the machine and was cut 1 cm. Barrier to avoid being exposed to the blade that is on the sharing core machine looks loose so that the victim's finger can easily enter. In addition it is needed an improvement on the engine pedal which sometimes moves on its own. This incident occurred on 18 September at 01.00 (night shift). During the incident, the operator was cutting the cover seat, with a thickness of 0.6 mm with a maximum cutting thickness of 5 mm.

Table 1. Accident Risk Assessment

| Job/work                                           | Risk                                                                 | Basic Level* | Risk Value | Risk Level  |
|----------------------------------------------------|----------------------------------------------------------------------|--------------|------------|-------------|
| Lifting the core                                   | Scratched on the blunt end of the core and crushed by the core       | C E L        | 5 6 6      | 180         | Priority 1  |
| Cutting the mother core                            | Cut off the core sharing machine, exposed to engine noise            | C E L        | 5 6 10     | 300         | Priority 1  |
| Placing the results of the cutting core to the decoiler | Hit by Core                                                          | C E L        | 5 3 2      | 30          | Priority 3  |
| Taking the cutting results for semy stacking       | Scratched edge blunt                                                | C E L        | 5 3 3      | 45          | Priority 3  |
| Stacking process for silicone steel                | Hit by silicone steel                                               | C E L        | 5 2 0.5    | 5           | Acceptable  |
| Placing stacking core result into decoiler         | Hit by silicone steel, awkward posture                              | C E L        | 5 2 1      | 10          | Acceptable  |
| Taking the cutting results for semy wound           | Scratched edge blunt                                                | C E L        | 5 3 3      | 45          | Priority 3  |
| The process of wound / making a pile of silicone steel (prisma) | Hit by silicone steel                                               | C E L        | 5 2 0.5    | 5           | Acceptable  |
| Placement of the wound core results to the decoiler | Hit by silicone steel, awkward posture                              | C E L        | 5 2 1      | 10          | Acceptable  |
| The process of removing the email                  | Contact with flammable chemicals                                     | C E L        | 1 2 3      | 90          | Substantial |
| Assemble cables between high / low voltage coil    | Scratched cable wire assembly                                        | C E L        | 5 3 1      | 15          | Acceptable  |
| Do assembly with tic core welding                  | Exposed to ultraviolet light and sparks                              | C E L        | 5 2 1      | 10          | Acceptable  |
| Perform copper welding and connector welding       | Contact with hot objects and smoke                                   | C E L        | 5 2 1      | 10          | Acceptable  |

* AS/NZS 4360 Standard

The next day, the operator can re-enter so that a restart for zero accident can be prevented. Accidents occur due to several factors, namely the unsafe action factor of the operator who is less focused on his work, besides that it is necessary to do engine rejuvenation by repairing machines that are no longer safe to use.

2. Other work that has a high risk analysis value is the Core Cutting operator with details of the work lifting the mother core with a score of 180. The score is included in the priority 1 category, which means that it requires control as soon as possible. The process of lifting the mother core requires special expertise for the operator in running the crane, so it takes seriousness in lifting the core. Based on the analysis results, core cutting operators have the highest potential danger in each of their activities. Accidents can occur due to the work of core cutting operators are still limited in the number of PPE safety shoes and helmets so that some operators are seen not to use them. This undisciplined operator can cause work accidents.

3. The next job with a high risk analysis value is the HV&LV Wiring operator with details of the work eliminating the email layer with a score of 90. The score falls into the substantial category which means it requires corrective action. In the process of removing the enamel layer on the wire is carried out by the operator in direct contact with sulfuric acid chemicals through a high temperature combustion process. Direct contact with chemicals and exposure to high temperatures can endanger the operator if the operator does not use Personal Protective Equipment (PPE) correctly. Masks also
need to be used so that exposure to heat does not affect the face and does not suck chemicals, but from the workers themselves are still not disciplined in using masks because they feel their work is safe and fine. In addition, it also requires leather gloves for operators to avoid being exposed to hazardous chemicals.

4. Other jobs have risk analysis values that fall into the priority 3 and acceptable categories. Operators sometimes are seen not using complete PPE so that they can cause work accidents. The company does not need to take any corrective actions other than providing continuous supervision so as not to increase the risk of work accidents that may occur in the future.

The last stage of risk assessment is about developing work accident analysis solutions as structured tools based on risk events that have been obtained from the risk identification stage. Risk assessment actions are carried out according to risk events that require improvement to reduce work safety risks, starting from the highest to the lowest risk value. Actions of control over existing hazards must be carried out in accordance with the principle of control hierarchy according to AS / NZS 4360: 2004 as in Table 2.

### Table 2. Risk control

| Job/work                        | Risk            | Risk Value | Risk Level | Current Condition | Causes                                                                 | Control Description                                                                 |
|---------------------------------|-----------------|------------|------------|-------------------|------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Cutting the mother core         | Cut off the core sharing machine, exposed to engine noise | 300        | Priority 1  | Wear gloves, safety shoes, safety helmet | Unsafe act, the operator is out of focus, there is noise from the cutting machine | Engineering: Repairing the loose blade barrier on the sharing machine to make it safer |
|                                 |                 |            |            |                   |                                                                        | Administrative: Supervision of SOP implementation, operator occupational health safety training, installing warning signs |
|                                 |                 |            |            |                   |                                                                        | PPE: Additional PPE is the ear plug |
| Lifting the core                | Scratched on the blunt end of the core and crushed by the core | 180        | Priority 1  | Wear gloves, safety shoes, safety helmet | Do not use PPE and the appropriate tools | Administrative: Supervision of SOP implementation, material handling training, installing warning signs |
| The process of removing the email| Contact with flammable chemicals | 90         | Substantial | Wear gloves, safety shoes, safety helmet | Do not use PPE gloves | Training: Job safety analysis training on a regular basis, work procedure training |

In Table 2, Some risk control descriptions are recommended based on semi Quantitative AS / NZS 4360: 2004. The focus of researchers in analyzing corrective actions is only for the risk level that is higher than 20. Meanwhile, at acceptable level (risk level <20), corrective action is not necessary and the company can only carry out continuous supervision so the risk of work accidents might not occur in the future.

The application of occupational health and safety on the production floor is actually quite good. The Occupational Health and Safety Organizing Team has installed warning signs that are installed in every corner of the factory. However, one of the main factors is the frequent occurrence of work accidents at PT. BD originated from the operator error itself in the form of unsafe act. Companies need a scheduling for controlling or periodic monitoring of operator performance to avoid human errors. In addition, regular training is needed to increase the expertise and insight of operators on the importance of work
safety. In this case, overall the company needs to further promote order and availability of PPE for operators, especially in the core section. From the head of Committee for the Development of Occupational Safety and Health at PT. BD also should appeal and explain the importance of occupational health safety implementation and the use of PPE for operator safety.

5. Conclusion

The following are the conclusions of the research carried out:

1. The main danger with priority risk level 1 contained in the core section is that the operator can be cut off by the core sharing machine and exposed to engine noise in the process of cutting the mother core, and scratched by the blunt end of the core during the core lifting process, both can be said to be a main hazard because it has the highest risk value of 180-350.

2. One job/activity (process of removing the email layer) has substantial risk. The recommendation is that beside wear gloves, safety shoes, safety helmet, operators should be trained by Job safety analysis training on a regular basis, work procedure.

Reference

[1] Asl M M 2017 Uni. J. of Man. 5(7), 355-363
[2] Santoso G 2004 Manajemen Keselamatan dan Kesehatan Kerja (Jakarta: Prestasi Pustaka)
[3] Albrechtsen E Solberg I Svensli E 2019 Safety Science 113 425–437
[4] Zhang S Boukamp F Teize J 2015 Autom. Constr 52 29–41.
[5] Gopinath V Johansen K 2016 Proc. CIRP 44 199–203
[6] Morrish C 2017 Int. J. Min. Sci. Technol 27 (4) 635–664
[7] Zheng W Shuai J Shan K 2017 Saf. Sci. 93 9–15.
[8] Situmorang, C. 2003 Mengikuti Prosedur Menjaga Keselamatan Dan Kesehatan Kerja www.google.com/http://modul.tedebandung.com/industry (October, 2018)
[9] Dainur 1995 Materi-materi Pokok Ilmu Kesehatan Masyarakat (Jakarta: Widya).
[10] Moenir 1993 Mengikuti Prosedur Menjaga Kesehatan dan Keselamatan Kerja (Jakarta: Departemen Pendidikan Nasional).
[11] Taslimin H A 1993 Keselamatan Dan Kesehatan Kerja (Jakarta: Erlangga)
[12] Sutrisno and Ruswandhi R 2007 Prosedur Keamaanan, Keselelaman dan Kesehatan Kerja (Jakarta: Yudistira)
[13] Suma’mur 1981 Keselamatan Kerja dan Pencegahan Kecelakaan.(Jakarta: CV Haji Masagung)
[14] Australian/New Zealand Standart. 2004 OHS Risk Management Handbook (Australia : Standarts Australia International Ltd.)
[15] Ramli S 2010 Pedoman Praktis Manajemen Risiko Dalam Perspektif K3 (Jakarta : Dian Rakyat)