Design of Standard Operational Procedures of Flip and Lifting Material Processes

B I Ardinata¹ and N Fajrah²

¹,²Industrial Engineering Program, Universitas Putera Batam, Kepulauan Riau, Indonesia
Email: bakhrudinirfanardi@gmail.com

Abstract. The manufacturing industry is inseparable from the process of lifting material using a crane. The demands of the machining process require the material to be flipped and lifting material. In many companies, flip and lifting material is a high-risk process, because the material has a big load so can be potential to work accident. Mostly, the operator of the crane does the flip material process based on their experience, so that each operator has a different way. The design of SOP aims to equate the procedure and to reduce the HARC score so that the process becomes safer and controlled. The approach that the researchers used was the RIE project. Based on the design of SOP, founded that SOP for flip and lifting material is highly recommended for the operator of a crane, so the operator can work safely. Based on the validation process with the HSE Expert, the SOP is declared as a suitable guide for the operator in conducting flip and lifting material. Therefore, the HARC score decreased from 6 to 4. It means the process of flip and lifting material is safer and still needs continuous improvement with the SOP to the next improvement with different conditions.

1. Introduction
Indonesia is country industry manufacturing oil and gas is included in the heavy metal industry which cannot be separated from the process of lifting the material on any production activities. This is a concern because bearing in mind the load of material that is quite large namely 1-3 tons and the shape of the complex material, making it quite difficult to determine the centre of gravity of the material in order to maintain balance when the lifting and flip material is carried out as well as the risk that material falling at a upon happen swing that could harm the operators working (at risk). According to [1] factors that can cause the lifting process to fail are poor planning, failure of equipment, human resources that do not meet the requirements of natural factors (weather, natural disasters and others).

Today, the process of lifting material and flip material is carried out on the shop floor by a machinist (CNC machine operator). Besides operating CNC machines, another task of a machinist is to set-up materials. Flip material is absolutely necessary because of the limitations of CNC machines in doing material work, so the material must be reversed (flip).

Work standards or processes are very important in the process of lifting material and flip material. This is because the process has a high risk of work accidents. Some of the potential risks of work accidents are loose material, workers hit by material, sling break up and other risks of work accidents. This condition requires the existence of Standard Operational Procedures (SOP) process of lifting material or flips material.
Based on these problems, this research needs to be carried out, so the aims of this research is designing standard operational procedures for the flip material process with concern for the safety of the operator. It is namely the Standard Operational Procedures (SOP) of the material lifting process. Standard Operating Procedures (SOP) for the material lifting process are expected to assist workers in carrying out the process of lifting material or flip material. Standard Operating Procedures (SOP) of the material lifting process are expected to indirectly minimize the potential risk of work accidents for operators.

2. Methods
The population of this study is all types of products produced. The products produced are as follows:

| No | Part Name |
|----|------------|
| 1  | BODY, 30 SLIPLOCK X DIVERTER DC PIN CONN (2111 lb.) |
| 2  | BODY, HSG, SOLIDrill, 13-5 / 8 OEC 10K HUB (2114 lb.) |
| 3  | BODY, FASTCLAMP NO. 18 (21-1 / 4 2K) (1212 lb.) |
| 4  | BODY, TBG HD SPL, MTB, 13-5 / 8 NPM, CANH (1752 lb.) |
| 5  | BODY, CSG HSG, SPECIAL S-3,21-1 / 4 OEC 2K (3620 lb.) |
| 6  | BODY, 20 SLIPLOCK X DIVERTER DC PIN CONN (2162 lb.), |
| 7  | BODY, 30 SLIPLOCK X DIVERTER DC PIN CONN (2111 lb.) |

(Source: Research Data, 2020)

The sampling technique used in this research is purposive sampling. Purposive sampling was chosen because the sample was taken based on the problem conditions in the field. This method uses criteria that have been selected by researchers in selecting samples. For this study, a sample of that material BODY CSG HSG, SPECIAL S-3, 21-1/4 OEC 2 K with a weight of 3620 lb.

The data collection techniques in this study are:

- Observation
  Observation is a data collection technique by making observations directly to the field.
- Interview
  Interviews were conducted with workers at HMCM1-A work station.

The method of conducting data analysis in this study is the Action Plan improvement, carried out by carrying out the procedure of the Rapid Improvement Event (RIE).

- Develop Project Charter, the process to define project initiation
- Make Base Line Data Analysis, the process to find out the level of risk
- Improvement Action Plan
- Improvement Actual Implementation
- Improvement Control

According to [2] Rapid Improvement Event (RIE) is a customer-focused method, based on problem solving and process improvement.

3. Result and discussion

3.1 Project Initiation
Project initiation as an initial stage of this research which aims to collect research data. As for the RIE approach, which is indicated by the existence of a project charter. Project charter is used to fulfil 8 process elements during this research carried out in accordance with RIE standards. The following is a charter project that has been carried out based on the company’s RIE format standards. Project initiation
is important to show that the results of this project are in accordance with field conditions in the company.

3.2 Risk Identification
Risk identification is carried out in accordance with baseline data analysis. Baseline data analysis that measures the level of risk using the HARC application, gathering documentation and field interviews. Baseline data analysis is the second step in the approach used by RIE. The following is a baseline data analysis that researchers have done.

3.2.1 HARC application
Hazard Analysis and Risk Control (HARC) is an analysis to identify hazards and risks in company activities, especially work in workshops where there is always a risk of accidents and therefore HARC will be able to identify hazards that may occur in routine or non-routine activities [3]. The following is the HARC application to show the level of medium risk and an ALARP (As Low as Reasonably Practicable) demonstration must be conducted before proceeding with the analysis of lifting material (flip material).

![HARC Application](image)

**Figure 1. HARC Application**

3.2.2 Interview and Observation Results. The following are the results of field observations and field interviews with workers carrying out the Lifting / Flip Material process. Observations were made on 3 machinists at the same workstation but at different times

3.3 Determination of Risk Level
Determination of the level of risk using baseline data analysis and HARC applications. To get a HARC score it is necessary to calculate using a risk matrix calculation. The following is a risk matrix calculation with a score of 6
Figure 2. Risk matrix calculation

3.4 Calculation of Center of Gravity (CoG)

The third step in the approach used is the Improvement Action Plan. Improvement Action Plan in the form of Center of Gravity calculations. The following is a picture of the sample material along with the calculation of CoG analysis.

Section 1:
\[ X_1 = 12 \text{ inch} \; ; \; Y_1 = 26 \text{ inch} \]
\[ A_1 = 20 \text{inx} \times 4\text{in} = 80\text{in}^2 \]
Section 2:
\[ X_2 = 12 \text{ inch} ; \ Y_2 = 16 \text{ inch} \]
\[ A_2 = 24\text{inx} \times 16\text{in} = 384\text{in}^2 \]

Section 3:
\[ X_3 = 12 \text{ inch} ; \ Y_3 = 4 \text{ inch} \]
\[ A_3 = 18\text{in} \times 8\text{in} = 144\text{in}^2 \]

\[ X_0 = \frac{A_1 \ X_1 + A_2 \ X_2 + A_3 \ X_3}{A_1 + A_2 + A_3} = \frac{80(12) + 384(12) + 144(12)}{80 + 384 + 144} = \frac{7296}{608} = 12 \text{ inch} \]

\[ Y_0 = \frac{A_1 \ Y_1 + A_2 \ Y_2 + A_3 \ Y_3}{A_1 + A_2 + A_3} = \frac{80(26) + 384(16) + 144(4)}{80 + 384 + 144} = \frac{8800}{608} = 14.473 \text{ inch} \]

3.5 The Design of SOP

Based on the calculating of the CoG, so we find out of the design of SOP. Important procedures are in place for an organization so that everything can be done uniformly [4]. In the end the procedure will be a guideline for an organization in determining what activities must be carried out to carry out a particular function [5]. While the understanding of procedures is a clerical sequence, usually involving several people in a department or more, which are made to ensure uniform handling of company transactions that occur repeatedly. Meanwhile according to [6] the procedure is a sequence of work that involves several people in one section arranged to ensure uniform treatment of company transactions. The fourth step in the approach used is the Improvement Actual Implementation. Actual Improvement Implementation in the form of SOP draft.

3.6 Validation of SOP Design Results

The fifth step in the approach used is Improvement Control. Improvement Control is validating the SOP design that will be carried out by three practitioners, namely Lifting Champion, Black Belt, and HSE Expert and 1 academician.

3.7 Implementation of SOP Design Results

Results of the draft SOP was implemented in the process lifting material to be able to measure the value of the level of risk by using application HARC. Here are the results of the application of the draft SOP HARC process lifting material. HARC application results show the value of the risk level becomes low on the implementation of the SOP on the process lifting material which had previously been at the level of medium.

3.8 Analysis and Discussion

Based on the results of filling the HARC application to obtain a HARC score it is necessary to understand how to fill the HARC application so that it displays the output in the form of a risk level analysis. When the risk of accidents has been identified, engineering can be done or ALARP (As Low as Reasonably Practicable) [7]. The result of the HARC score before using the SOP of the material lifting process is a score of 6 which indicates the level of risk is in the medium position that is medium risk. Based on these values, there needs to be improvement, one of which is by designing SOP. Meanwhile according to [6] the procedure is a sequence of work that involves several people in one section arranged to ensure uniform treatment of company transactions.

The SOP design is obtained by analysing the condition of the material during the material lifting process. Analysis of material conditions was carried out using CoG analysis. Based on the calculation
COG obtained points from the COG on the material, so that the knot of the tie webbing sling should be at the point of COG that the material can be balanced on the lifting process [8].

Good Standard Operational Procedures need control from management. According to there is a need for officers to ratify an SOP [9]. Therefore, this SOP needs to be validated by experts, namely to the Lifting Champion, Black Belt and HSE Manager, as well as by academics who have competencies relevant to this research. Based on the results of the validation by the experts it was stated that the SOP that was designed was valid and fulfilled the concepts and rules of the related processes and Health and Safety standards [10].

4. Conclusion

Based on the results of research conducted using the RIE approach and CoG analysis, SOP designs can be obtained that can be used in the flip and lifting material process. The results of the SOP design can minimize the potential risk of work accidents in the material lifting process. This is indicated by the value of the level of risk after the implementation of the SOP design results fell to 4, namely low risk. It means the process of flip and lifting material is safer and still needs continuous improvement with the SOP to the next improvement with different conditions.

Acknowledgement

The author would like to thanks Mr. Hisam, Mr. Erik and Mr. Yuni as the expert for support me doing this project and thanks to Machinist Lifting Process so that this research could be completed.

References

[1] P Hartono and Trijeti 2015 Studi Analisis Penggunaan Alat Berat (Crane) Sebagai Alat Angkat Untuk Instalasi Equipment Deodorizer di Proyek CPO Plant *Jurnal Konstruksi* 7(1) pp 39-52
[2] E Baqueiro 2017 *RIE* (Rapid Improvement Event) Training CS
[3] Supriyadi 2015 Identifikasi Bahaya dan Penilaian Risiko K3 pada Tindakan Perawatan & Perbaikan Menggunakan Metode HIRARC (Hazard Identification and Risk Assessment Risk Control) pada PT. X in *SEMINAR NASIONAL RISET TERAPAN 2015* Serang Raya
[4] I P Hartatik 2014 *Buku Pintar Membuat SOP* (Yogyakarta: Flash Books)
[5] F Feggy T Windu and M Nelisa 2017 *Jurnal Ilmu Informasi Perpustakaan dan Kearsipan* 6(1) pp 170-178
[6] G Cole and P Kelly 2011 *Management Theory and Practice: 7th Edition* (London: Thomson)
[7] A Wijaya, T W Panjaitan and H C Palit 2015 *Jurnal Titra* 3(1) pp 29-34
[8] I H and S Association 2020 *Hoisting and Rigging Safety Manual* (Canada: Infrastructure Health and Safety Association)
[9] A Sailendra and E Swaesti 2015 *Langkah-Langkah Praktis Membuat SOP (Standard Operating Procedures)* (Yogyakarta : Idea Publishing)
[10] F Rahmawati 2019 *The Indonesian Journal of Occupational Safety and Health* 8(2) pp 198-205