Effectiveness of Web-Based Near Miss Reporting Program on Preventing Occupational Accident

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Abstract—Hundreds of thousand occupational accident still happened in Indonesia during 2018 and 195 cases happened in two biggest shoe factories at Karawang, this study will analyze the effectiveness of web-based near miss reporting program on preventing accident. The design of this study is case control, factory with web-based near miss reporting program will be case and control from factory that use paper-based near miss reporting system. The result showed factory implementing near miss reporting program with web-based have 78.04% smaller recordable accident rate and 4.15% higher on decreasing recordable accident rate in three years, compared to paper-based reporting system. Nowadays technology and internet make people easier to do the daily activity, including near miss reporting. Near miss report is one of the method for early detection of the hazards that can cause an accident.

Keywords: web-based, near miss, report, accident, prevention

1. INTRODUCTION

More than one hundred thousand occupational accidents occur in Indonesia during 2018, this number means that every hour of work occurs 12 cases of accidents. 195 cases of accidents occurred in the two largest footwear factory in Karawang Regency. According to James Reason, human factors, perceptions of risk and behavior of workers have an important role in the occurrence of occupational accidents [1]. According to Heinrich, the accident pyramid he created can be interpreted that every major accident has many minor accidents and more accidents that damage property or accidents that do not cause injury [2]. The accident pyramid is one of the bases used by the two companies to reduce the number of work accidents, namely by detecting and reporting near miss events. Identifying and investigating near miss is a key element to find and controlling the risks before it harm workers and property damage [3]. Near-miss reporting and analysis provides an additional metric for assessing worker safety performance [4]. Each company uses a different method to do near miss reporting, PT A uses a web-based reporting system and PT B uses a hazard card (manual) system. Both systems were implemented simultaneously in 2016 at both companies to reduce the number of accidents. Occupational accident data shows a decrease in accident rates, but which system is more effective at reducing accidents? This research was conducted to see the effectiveness of the near miss reporting system, so it can be used as a consideration for other institutions to develop accident reduction programs.

II. METHOD

The method used in this study is case control with purposive sampling, PT A becomes the case and PT B becomes control. The inclusion criteria are implement near miss program, same accident data analysis, and same factory code of conduct. Observations were carried out for three years start from 2016 to 2018. Standard 29 CFR No. 1904 issued by OSHA [5] used for record the data and classify the accidents. Accident data is analyzed using the OSHA Incident Rate formula [6], the formula on (1).

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\text{Number of incident} \times \frac{200000}{\text{Number of working hour in one year}} = \text{Incident Rate}
\]

Equation 1. OSHA Incident Rate Formula

The number 200,000 in the formula represents the number of hours 100 employees who work 40 hours per week, 50 weeks per year, this formula is used to calculate the incident rate for 1 year. Both companies carry out the same program with different methods. PT A uses a web-based reporting system, by facilitating each work section with a set of computer devices that easily accessed by workers. This computer is equipped with an application for the near miss reporting platform, near miss that is inputted into the application will be immediately received by the HSE team via email and notification on the application. PT B uses a paper-based system, which uses a card provided in each work section complete with boxes for cards that have been filled and will be taken by the HSE team every week.
Fig. 1. The flow process of the near miss reporting uses web-based system at PT A

Fig. 2. The flow process of the near miss reporting uses a paper-based system at PT B

III. RESULT

Table I – VI is an accident and near miss data obtained during 3 years of observation in PT A and PT B.

### TABLE I. PT A ACCIDENT DATA IN 2016

| Data Validation | JAN   | FEB   | MAR   | APR   | MAY   | JUN   | JUL   | AUG   | SEP   | OCT   | NOV   | DEC   | Total |
|-----------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Hours Worked    | 2936340 | 2512366 | 2461550 | 1666369 | 2244046 | 2872954 | 2904696 | 2594676 | 2716632 | 2833902 | 2830098 | 2726213 | 31299841 |
| Lost Time Illnesses | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| Lost Time Injuries | 0     | 3     | 1     | 2     | 0     | 4     | 2     | 2     | 0     | 3     | 2     | 4     | 23    |
| Lost work days   | 0     | 3     | 1     | 8     | 0     | 11    | 15    | 4     | 0     | 31    | 3     | 15    | 91    |
| Near Misses      | 26    | 34    | 26    | 152   | 158   | 38    | 179   | 246   | 423   | 358   | 614   | 2315  |
| Recordable Illnesses | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| Recordable Injuries | 3     | 9     | 7     | 5     | 4     | 10    | 2     | 5     | 5     | 6     | 6     | 6     | 67    |
| Turnover Illnesses | 0     | 0     | 0     | 1     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| Turnover Injuries | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |

### TABLE II. PT B ACCIDENT DATA IN 2016

| Data Validation | JAN   | FEB   | MAR   | APR   | MAY   | JUN   | JUL   | AUG   | SEP   | OCT   | NOV   | DEC   | Total |
|-----------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Hours Worked    | 1338673 | 1328891 | 1337895 | 1329892 | 1328190 | 1302178 | 1290098 | 1325796 | 1335012 | 1325407 | 1322682 | 1335907 | 15900621 |
| Lost Time Illnesses | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| Lost Time Injuries | 1     | 2     | 1     | 3     | 1     | 2     | 0     | 1     | 2     | 0     | 0     | 2     | 15    |
| Lost work days   | 4     | 13    | 3     | 2     | 2     | 32    | 30    | 34    | 8     | 0     | 0     | 6     | 134   |
| Near Misses      | 10    | 8     | 12    | 11    | 11    | 16    | 10    | 9     | 13    | 12    | 15    | 16    | 143   |
| Recordable Illnesses | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| Recordable Injuries | 11    | 9     | 9     | 11    | 7     | 8     | 11    | 6     | 14    | 11    | 8     | 10    | 115   |
| Turnover Illnesses | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| Turnover Injuries | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
### TABLE III. PT A ACCIDENT DATA IN 2017

| Data Validation | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | 2017 Total |
|-----------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----------|
| Hours Worked    | 2516514 | 2421104 | 2682376 | 2413752 | 2303759 | 1796523 | 2384077 | 2393472 | 2058150 | 2329122 | 2283777 | 1980950 | 27563574 |
| Lost Time Illnesses | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Lost Time Injuries | 1 | 0 | 1 | 2 | 1 | 0 | 0 | 1 | 0 | 3 | 1 | 3 | 13 |
| Lost work days | 30 | 0 | 16 | 6 | 1 | 0 | 0 | 21 | 0 | 5 | 1 | 9 | 89 |
| Near Misses | 525 | 504 | 370 | 393 | 374 | 338 | 509 | 803 | 581 | 659 | 720 | 525 | 6301 |
| Recordable Illnesses | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Recordable Injuries | 4 | 4 | 3 | 5 | 3 | 5 | 2 | 2 | 1 | 4 | 2 | 3 | 38 |
| Turnover Illnesses | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Turnover Injuries | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

### TABLE IV. PT B ACCIDENT DATA IN 2017

| Data Validation | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | 2017 Total |
|-----------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----------|
| Hours Worked    | 1285352 | 1262687 | 1265469 | 1300012 | 1265781 | 1239978 | 1222178 | 1255469 | 1276521 | 1277851 | 1298734 | 1291162 | 15241194 |
| Lost Time Illnesses | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Lost Time Injuries | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 4 | 34 |
| Lost work days | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 19 | 21 |
| Near Misses | 15 | 28 | 16 | 13 | 8 | 11 | 19 | 15 | 18 | 14 | 21 | 17 | 195 |
| Recordable Illnesses | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Recordable Injuries | 4 | 10 | 8 | 7 | 12 | 6 | 5 | 5 | 18 | 10 | 12 | 9 | 106 |
| Turnover Illnesses | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Turnover Injuries | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

### TABLE V. PT A ACCIDENT DATA IN 2018

| Data Validation | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | 2018 Total |
|-----------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----------|
| Hours Worked    | 2284101 | 2006657 | 2209145 | 2130170 | 2129831 | 1396042 | 2332330 | 2255391 | 2301823 | 2649557 | 2599607 | 2510215 | 26804866 |
| Lost Time Illnesses | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Lost Time Injuries | 4 | 0 | 1 | 1 | 0 | 0 | 2 | 2 | 1 | 3 | 1 | 0 | 15 |
| Lost work days | 6 | 0 | 2 | 40 | 0 | 0 | 2 | 23 | 1 | 32 | 12 | 0 | 118 |
| Near Misses | 682 | 554 | 766 | 579 | 466 | 186 | 398 | 523 | 408 | 437 | 392 | 401 | 5792 |
| Recordable Illnesses | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Recordable Injuries | 6 | 1 | 5 | 2 | 2 | 2 | 2 | 2 | 2 | 4 | 1 | 2 | 31 |
| Turnover Illnesses | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Turnover Injuries | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
TABLE VI. PT B ACCIDENT DATA IN 2018

| Data Validation | JAN  | FEB  | MAR  | APR  | MAY  | JUN  | JUL  | AUG  | SEP  | OCT  | NOV  | DEC  |
|-----------------|------|------|------|------|------|------|------|------|------|------|------|------|
| Hours Worked    | 1148921 | 1147642 | 1146721 | 1149762 | 1120779 | 653081 | 691078 | 755098 | 761262 | 767089 | 789200 | 11289164 |
| Lost Time Illnesses | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Lost Time Injuries | 0 | 1 | 0 | 1 | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 6 |
| Lost work days  | 0 | 7 | 0 | 3 | 27 | 0 | 0 | 16 | 0 | 0 | 0 | 53 |
| Near Misses     | 18 | 22 | 25 | 20 | 21 | 24 | 20 | 21 | 19 | 21 | 26 | 19 |
| Recordable Illnesses | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Recordable Injuries | 5 | 9 | 7 | 11 | 11 | 2 | 4 | 3 | 6 | 6 | 6 | 1 |
| Turnover Illnesses | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Turnover Injuries | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

IV. DISCUSSION

A common assumption that currently underlies safety analysis approaches in industrial and high-hazard organizations is that the reporting of near-miss events can contribute towards accident prevention. Specifically, when information on near miss events is available, managers can analyze it, identify risk factors, and then act to reduce the risk, thereby preventing more severe accidents from occurring. To be effective, such an analysis must be grounded in an objective evaluation of the event, the outcome, and the severity of the alternative outcome’s consequences [7]. A near miss has many of the ingredients of unsafe behaviors and unsafe conditions of a real accident sequence with the exception of a few missing ones, thereby preventing a near-miss incident for further escalating and leading to the accident and its dire consequences [8].

Based on occupational accident data obtained for 3 years, companies that use web-based for near miss reporting have an accident rate of 78.04% lower than companies that use paper for near miss reporting. In addition to the lower accident rate, the decrease in accidents in companies that use web-based for near miss reporting is 4.15% higher compared to companies that use paper for near miss reporting.

For 3 years PT A reduced the incident rate by 45.97%, in 2016 the incident rate was 0.43 and dropped to 0.23 in 2018. Whereas the PT B incident rate dropped by 13.04%, in 2016 the incident rate was 1.46 and in 2018 it fell to 1.26. Fig 3 show the recordable accident rate for both company.

Gathering near miss, determining causes, correction and communicate the hazards can help reduce and decrease incidents and injury rates [9]. Both companies use different ways to do near miss reporting. Companies that use web-based in near miss reporting can capture 91.43% more near miss than companies that use paper to do near miss reporting, like showing in the fig 4. The use of a web-based reporting system makes it easy for workers to report the near miss that found in the work area. In addition to the ease of accessing media reporting, web-based system usage also speeds up the reported follow-up process from near miss.
The method applied in near miss reporting is manual when compared to online methods, making the response to follow up on near miss causes longer, and this is an opportunity for an accident to occur. Companies that use web-based system can receive reports shortly after near miss occurs or is found, so that the person in charge of the area can immediately take corrective action. Fast corrective actions can reduce the chance of an accident. Companies that use cards for reporting take one week to find out the cause of near miss, and it is possible for the same accident occur during the waiting period between workers reporting near miss through the box and the time the card is taken by the person in charge of the program.

The person in charge of the program can receive notification emails when there are near miss reported by workers via email. Furthermore, the person in charge of the program continues to the person in charge of the area to follow up on the near miss found. The notification email shown in the fig. 5.

Near miss that found not only communicated between the person in charge of the area and the person in charge of the program. But all workers can access and find the status of near miss found, like shown in fig 7.

Website development may be a challenge for workers [10]. Initially there were concerns regarding the use of web-based reporting systems that would be difficult to implement, but for 3 years there was an increase in the number of near miss reported. Most workers do not feel that this report is too difficult, does not take longer than making a written report. The display of information received is more visually attractive, easier to read and more interactive than written reports [11].

In companies that use paper near miss report, it takes longer to make improvements. Fig 8 shown the sample paper form and the box for collecting near miss. Near miss report cards are collected by the person in charge of the program once a week, then distributed using e-mail to each person in charge of the area to be followed up. Accidents can occur between the times the report is collected until the report is collected, because of near miss causes that have not been followed up.
Companies use this system with consideration, it is easy to use even for people who don't understand technology. But in reality, this reporting system is not widely used by workers. So only small number of near miss are reported, and are not effective for preventing accidents.

Both of these programs are also one of the methods used to involve workers to form safety ownership. Because the best safety process that leads to protection is all a process that involves workers who have direct contact with the hazard [9].

Near miss reporting is a means to prevent accidents. Near miss is reported to be a source of information that can be used to carry out accident prevention programs. Near miss related to unsafe conditions, such as the absence of safety guarding on a rotating machine can be the basis for carrying out the machine guarding installation programs on all rotating machines.

Another challenge that exists in running near miss reporting programs is the near miss event which sometimes has no supporting evidence [3], according to the definition where near miss does not cause damage to either injury or property damage. Although the impact is limited, near miss provides insight into the potential of the worst conditions and business disruptions that will occur. Therefore, overcoming near miss on time and correctly can prevent the danger of developing into an accident [12]. The little thing found in the indirect near miss report turned out to be an accident, but this could be the trigger of a major accident in the future.

Near miss reporting program not only for preventing the accident, but also part of worker participation. Worker participation helps in developing effective ways of protecting workers. By getting involved in an issue at the planning stage, workers are more likely to identify the reasons for taking a particular action, help find practical solutions, and comply with the end result. If workers are given the opportunity to participate in shaping safe work systems, then they can advise, suggest, and request improvements helping to develop measures to prevent occupational accidents and ill-health in a timely and cost effective manner [13].

V. CONCLUSION

Near miss reporting is a tool that can be used to prevent occupational accident. This is in accordance with decreasing a number of occupational accident data that occurred in both company during the study. Method that is more effective to use is a web-based near miss reporting system, because it is easily accessible and a faster response to follow-up. In addition, workers can easily access related information that has been approved and their follow-up status. The use of traditional methods such as near miss cards does not mean that they are not good and cannot be applied, except that this method is less efficient for the time of follow-up, so it still requires opportunities to correct the accident.

REFERENCES

[1] A. Saracino, M. Curcuruto, G. Antonioni, M. G. Mariani, D. Guglielmi, and G. Spadoni, “Proactivity-and-consequence-based safety incentive (PCBSI) developed with a fuzzy approach to reduce occupational accidents,” Saf. Sci., vol. 79, pp. 175–183, 2015.
[2] Erik Hollnagel, Safety-I and Safety-II, Burlington, USA: Ashgate Publishing Company, 2014.
[3] M. Williamsen, “Near-miss reporting: A missing link in safety culture,” Prof. Saf., vol. 58, no. 5, pp. 46–50, 2013.
[4] X. Shen, S. M. Asce, E. Marks, D. Ph, and A. M. Asce, “Near-Miss Information Visualization Tool in BIM for Construction Safety,” vol. 142, no. 4, pp. 1–10, 2016.
[5] OSHA, “Regulations (Standards - 29 CFR) No 1904,” 2012 .
[6] OSHA, “Clarification on how the formula is used by OSHA to calculate incident rates,” 2016 .
[7] M. Winkler, Y. Perlman, and S. Westreich, “Reporting near-miss safety events : Impacts and decision-making analysis,” Saf. Sci., vol. 117, no. September 2018, pp. 365–374, 2019.
[8] J. H. Saleh, E. A. Saltmarsh, and F. M. Favar, “Accident precursors , near misses , and warning signs : Critical review and formal definitions within the framework of Discrete Event Systems,” vol. 114, pp. 148-154, 2013.
[9] D. Borbidge, “Employee Behavior: 9 ways to implement positive change,” John, p. 60, 2006.
[10] N. Brown, “Updating assessment styles: Website development rather than report writing for project based learning courses,” Adv. Eng. Educ., vol. 6, no. 2, pp. 1–17, 2017.
[11] S. A. Brown, A. A. Garcia, J. A. Zuluiga, and K. A. Lewis, “Effectiveness of workplace diabetes prevention programs: A systematic review of the evidence,” Patient Educ. Couns., vol. 101, no. 6, pp. 1036–1050, 2018.
[12] A. Muermann and U. Oktem, “The Near-Miss Management of Operational Risk,” 2002.
[13] E. for H. and S. at W. Agency, “Worker Participation in Occupational Safety and Health,” 2012.