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Analysis of The Implementation of Occupational Safety Program Efforts to Improve Work Productivity with Fault Tree Analysis Approach

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Abstract – The implementation of the Occupational Safety program for manpower is an important supporting business in production activities. Each work safety program consists of several elements of the program and its supporters. In this study the measurement of work safety efforts and value of safe T, frequency level to declare the number of accidents that occurred every 1 million working hours in the current period. The declining level of accidents and the severity of accidents from year to year will increase the productivity of the workforce. Besides, also to know the improvement of health and safety systems in the company based on the analysis gained. As well as identifying the root causes of accidents by building Fault Tree Analysis models. The results of the measurement of the T-value (Nts) rate of accidents today have decreased against the rate of past accident frequencies. Seen from the analysis of occupational safety relationship with productivity that the fewer accidents occur, the smaller the lost business day and resulting in higher levels of productivity.

Keywords – Application of Occupational safety Program, Fault Tree Analysis, Productivity.

I. INTRODUCTION

Disposal of waste that is around a machine is very disruptive in the production process that can lead to fatal accidents. Then the amount of ventilation is less, so employees are less comfortable in working, feel such, and not passionate to do their activities (Ahmadi, 2019). Fewer illumination results in the eye the worker cannot see clearly at the time of the cutting process and causes the worker's fingers to be exposed Knife cut. Large-scale noise is mainly a wood-cleavage machine that can cause worker hearing impaired, and only a few workers use self-protection equipment (Astika, 2020).

The large number of losses suffered depends on the small degree of incidence (frequency) and severity (severity) of the accident (Bandono, 2019). Thus, accidents due to work will greatly affect the activities of the production process and the survival of the company or in other words, the accident that befalls the job is one factor that affects the productivity of work (Filippo, 1994).

II. MATERIALS AND METHODS

Safety is a safety-related machine, work tool, materials and processing process, the foundation of the workplace and the environment, and ways of doing the work. (Budiono, 1992), so that occupational safety and health is a means to prevent accidents, disability, and death as a result of a work accident. Protection of energy covering aspects that are sufficiently broad namely protection of safety, health, the moral care of the work of treatment following human dignity and moral religion (Kartono, 1994). While the measurement standard that has been approved by the International Labour Organization is to know the incidence rate or frequency rate and severity/safety rate (Herdiawan, 2019).

The steps we should work with are specifying:

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a. Frequency level

Frequency rate states the number of accidents that occur per million human working hours with the formula:

$$F = \frac{\text{n x 1.000.000}}{\text{N}}$$

Where: F = incidence rate of accident frequency

n = number of accidents incurred

N=number of employee working hours

b. Level of Severity or severity of work accident

To measure the impact of accidents, it should also calculate the accident weight number for a million working hours from the number of employee working hours (Krestiono, 2003)

$$\text{S} = \frac{\text{H x 1.000.000}}{\text{N}}$$

Where:

S = seferity level/accident Severity
H = total number of missing employee hours
N = number of employee working hours

c. Good T value

To compare the outcome of accidents of a work unit in the past and present, so that the level of impairment of accidents in the unit is known (Ravianto, 1996).

$$\text{Safe} - \text{T} - \text{Score (Sts)} = \frac{\text{F2} - \text{F1}}{\sqrt{\frac{\text{F1}}{\text{N}}}}$$

(Budiono; 1992)

Where:

Sts = value T Congratulations (dimensionless)
F1 = frequency rate of past work accidents
F2 = Frequency level of current work accidents
N = number of employee working hours

d. Fault Tree Analysis (FTA)

Fault Tree Analysis is a simple analysis of the error tree that can be described as an analytical technique. The fault tree is a graphic model that concerns various parallels and a combination of error pilot that will result in the occurrence of unwanted events that have been pre-defined (Suharjo, 2019).

Steps to build an FTA:

a. Defines accidents (Suharyo, 2017).

b. Learn the system by knowing equipment specifications, working environment, and operating procedures (Nugroho, 2019).

c. Develop an error tree.

3. Result and Discussion

Table 1. Number of labor production parts and working hours

Years	Number of employment (People)	Total working hours/ Month (People's hours)	Total number of hours Work (People's hours)
2005	110	19.250	231.000
2006	124	21.700	260.400
2007	145	25.375	304.500

Description: Number of working hours/month same.

The working hours are 8 hours starting from 08.00 – 16.00 WIB with 1 hour of rest time.

Table 2. Description of work accidents and the number of days lost

Months	Accident	Cause of employment accident	Work accident	Lost Day	Description
January	1	Lifting the burden too heavy so the load falls and the head is cracked	Wound head	3	1
	2		Sprained feet	6	1

		Slip			
Februa ry	1	Less careful – Heart in walkin g	Leg hurt	8	1
Maret	1	Wood-delayed legs	Leg Bones crack	20	1
April	1	Workin g while Joking so Thumb Expose d hamme r	Swollen fingers	2	1
Juni	1 2	Slip when Check Machin e Becaus e the floor is slipper y Eye often Dust intake (Wood grain)	The foot of the Eggshin e Eye irritatio n	5 10	1 2
Agustu s	1	Water Flush Coolin g generat or	Burns	3	1
Septe mber	1	Holdin g the door The oven room	Burns	2	1
		Still Hot without Gloves			
Novem ber	1	Dusty Room	Shortne ss of breath	30	5

Table 3. Description of work accidents and the number of days lost

Month s	Ac cid ent	Cause of employ ment acciden t	Work acciden t	Los t Da y	Descr iption
Januar y	1 2	Dehydr ation Droppe d due to slippery	Intensiv e Care Foot Differe ntials	5 7	1 1
Februa ry	1	Woode n Knock	Bruisin g in the head	3	1
April	1	Eye Dust Intake	Eyes irritatio n	20	3
Juli	1	Droppe d due to work in the grin	Fractur ed Hand bones	30	1
Agustu s	1	Downfa ll load while on lifting	Leg bruises	15	1
Oktobe r	1	Lifting weights too heavy	Bruisin g head and swollen legs	10	1
Jumlah				90	9

Table 4. Description of work accidents and the number of days lost

Months	Accident	Cause of employment accident	Work Accident	Lost Day	Description
Maret	1 2	Water Flush Cooling generator Eye often Dust intake (Woodgrain)	Burns on hand Eyes Irritation	7 10	1 2
Mei	1	Falling from stairs	Leg fracture	45	1
September	1	Hit by car	Collarbone rewriting	30	1
November	1	Overwriting goods	Bruising in the head	5	1
Jumlah				97	6

Based on the work accident data above, the number of working hours is lost from 2005 – 2007 as shown in the following Table 5. Estimated work for 7 hours/day

Table 5. The working hours lost

Years	Lost Day	Lost Hours
2005	106	742
2006	90	630
2007	97	679

The data is used to measure:

a. Rate of occupational accident frequency.

b. The level of severity or severity of work accidents (Suharyo, 2019).

c. T-Congratulations value measurement (Nts)

1) Measurement of frequency rate/incidence of defective injury.

To obtain a frequency rate/incidence of defective injuries, the formula used is as follows:

$$F = \frac{\text{n x 1.000.000}}{\text{N}} \qquad \text{(Budiono : 1992)}$$

Where:
F = incidence rate of accident frequency
n = number of accidents incurred
N = number of employee working hours

$$F\ (2005) = \frac{12 \text{ x } 1.000.000}{231.000}$$

$$= 51{,}948$$

The frequency levels in this period indicate that in one year, approximately 52 accidents that caused the wound have occurred for every one million hours of work. In the same way, the measuring rate of occupational accident frequency is as follows:

$$\text{F (2006)} = \frac{8 \text{ x } 1.000.000}{260.400}$$

$$= 38{,}961$$

$$F(2007) = \frac{6 \text{ x } 1.000.000}{304.500}$$

$$= 25{,}974$$

Table 6. Results of frequency measurement of occupational accidents

Years	Accident	F
2005	12	51,948
2006	8	38,961
2007	6	25,974

2) Measurement level severity/severity of disability injury.

$$\mathbf{S} = \frac{\text{H x } 1.000.000}{\text{N}} \qquad \text{(Budiono ; 1992)}$$

Where:
S = seferity Level/accident Severity
H = total number of missing employee hours
N = number of employee working hours

$$S\ (\ 2005\ ) = \frac{742\ x\ 1.000.000}{231.000}$$

$$= 3.212,121$$

$$S\ (\ 2006\ ) = \frac{630\ x\ 1.000.000}{260.400}$$

$$= 2.727,272$$

$$S\ (\ 2007\ ) = \frac{679\ x\ 1.000.000}{304.500}$$

$$= 2.939,393$$

Table 7. The severity of Level measurement results

Years	Number of working hours	Number of hours lost	S
2005	742	231.000	3.212,1
2006	680	260.400	2.727,2
2007	679	304.500	2.939,4

3. Measurement of Happy T values (Nts).

The F1 value is taken from the previous year and the value F2 is the value of the year to be measured.

Table 8. Data-Safe T value measurement data

Years	Number of working hours	F1	F2
2005	742	-	51,94
2006	680	51,94	38,96
2007	679	38,96	25,97

At this measurement, the formula that we use is:

$$\text{Safe} - \text{T} - \text{Score}\ (\ \text{Sts}\ ) = \frac{\text{F2} - \text{F1}}{\sqrt{\frac{\text{F1}}{\text{N}}}}$$

Where:

Sts = value of safe T (dimensionless)
F1 = frequency rate of past work accidents
F2 = Frequency level of current work accidents
N = number of employee working hours lost

$$\text{Safe} - \text{T} - \text{Score}\ (\ \text{Sts}\ ) = \frac{38,96 - 51,94}{\sqrt{\frac{51,94}{231.000}}}$$

$$= \mathbf{-\ 877,02}$$

$$\text{Safe} - \text{T} - \text{Score}\ (\ \text{Sts}\ ) = \frac{25,97 - 38,96}{\sqrt{\frac{38,96}{260.400}}}$$

$$= \mathbf{-\ 1.064,75}$$

This means that there is an increase in the performance of current occupational accident frequencies compared to the past (Susilo, 2020). Safe T Score is a number that has no dimensions. Safe T Score means positives show worsening conditions while negative numbers indicate improved state (Setiadji, 2019).

III. CONCLUSION

The result of measuring the frequency of work accidents is known that in the year 2005 with frequency 64.9. The year 2006 occurs with frequency 49.9. And in 2007 with a frequency of 36.1. The results of the measurement of the T-value (Nts) in 2006 are known as – 877.02 and in 2007 of – 1064.75. Then it can be concluded that in the year 2006 to 2007 the frequency value of the current accident has decreased against the value of the past frequency of accidents.

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