

# *Occupational Safety And Health Analysis To Increase Work Productivity With A Fault Tree Analysis Approach In Cv Xyz*

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**Abstract** – The industrial activity carried out by CV XYZ includes the conversion of coffee beans into coffee grounds. There have been 10 cases of work accidents at CV XYZ in 2020, including eye irritation and slipping, and 8 cases in 2021, including pinched fingers and falling from a height. With fault tree analysis, this study aims to identify the level of frequency, severity, Safe-T-Score, productivity, and underlying causes of workplace accidents. The calculation of the number of work accidents used in this study was frequency, which states that accidents happen every 1,000,000 working hours, severity, which states the loss of working days every 1,000,000 working hours, and Safe T Score, which compares the outcomes of the accident frequency rate. To determine the accident's cause, FTA analyzes the failure tree. According to the study's findings, there were 102.96 accidents per 1,000,000 working hours in 2021 as opposed to 128.70 accidents in 2020, indicating a decreasing trend in accident frequency over time. The severity rate decreased from 2020 to 2021, falling from 283.14 days lost per 1,000,000 hours to 231.66 days. As a result, the severity of accidents is getting less severe each year. The 2021 Safe-T-Score result is -632.45, indicating an improvement from the prior year in the incidence of work accidents. In 2020, the level of work productivity was 0.9980, and in 2021, it was 0.9983. Therefore, the degree of job productivity rises between 2020 and 2021. A discipliner of occupational accidents is produced by FTA analysis, which takes into account unsafe environmental conditions and human behavior.

**Keywords** – Fault Tree Analysis (FTA), Occupational Safety and Health, Productivity.

## I. INTRODUCTION

The number of workplace accidents in Indonesia is a highly concerning figure. In reality, Indonesia is ranked 52nd out of 53 nations for having inadequate Occupational Safety and Health (K3) management, according to a study by the World Agency International Labour Organization (ILO). Even if there is a workplace accident, the expenses to the organization would be quite

high [1].

The year with the most occupational accident cases between 2011 and 2014 was 2013, with 35,917 instances (2011: 9,891, 2012: 21,735, and 2014: 24,910). 2011 had the most cases of occupational accidents in the provinces of Banten, Central Kalimantan, and East Java. Jambi, Maluku, and Central Sulawesi Provinces were all in 2012. The provinces of Aceh, North Sulawesi, and Jambi were present in 2013. The provinces of South Sulawesi, Riau, and Bali were present in 2014. [2].

According to ILO research, 2.2 million people per year pass away from illnesses or accidents related to their jobs, or an average of 6,000 people per day, or one person every 15 seconds. [3].

Occupational Safety and Health (K3) is a program developed by employees and employers in an effort to prevent the emergence of accidents and occupational diseases by identifying factors that may cause accidents and occupational diseases as well as proactive steps to take in the event of accidents and occupational diseases. The objectives of occupational safety and health are to increase production, improve job efficiency, and reduce health expenditures. When workers are in good physical, mental, and social health, they can exert themselves to the fullest extent possible at work, resulting in high performance and increased productivity. [4].

In order to reduce the level of work productivity of its employees, CV XYZ, a manufacturing company, processes coffee beans into coffee grounds. This process cannot be separated from the possibility of work accidents due to a number of factors and conditions, including the environment, people, and machines.

So far CV XYZ is trying to prevent, reduce occupational accidents and occupational diseases that in fact still occur work accidents. Based on company data obtained by researchers in 2020 there were 10 cases of work accidents such as, eye irritation, slipping and in 2021 there were 8 cases of work accidents such as pinched fingers and falling from a height. Based on this problem, this research aims to find out the number of accidents, the ups and downs of work productivity and find out the root of the accidents that occur

## **II. METHODS**

### **A. Place and Object of Research**

The research was carried out at the CV XYZ company located at: Jl.Takengon Pondok Baru, Kp. Makmur Sentosa Kec. Bandar, Bener Meriah Aceh-Indonesia Regency. The object under study is a work accident that has occurred in the corporate environment of CV XYZ.

#### **Data Collection**

- Data on the number of work accidents
- Data on types of work accidents
- Employee working hours data
- Data on the number of days lost due to accidents
- Data on the number of employees or labor

### **B. Research Operational Variables**

#### **1.Independent variables.**

Free variables are variables in research that influence and become the cause of changes or the emergence of subsequent variables. The free variables in this study are occupational safety and health.

#### **2.Dependent variables.**

Bound variables are those that are influenced or result from free variables. The bound variable in this study is work productivity.

C. Data Processing Analysis Model

1. Data processing based on quantitative data.

The steps that must be worked out in quantitative data processing are to determine:

a. Calculation of the number of hours worked.

The method of calculating the number of working hours is as follows:

Total number of employee hours worked in a year – the number of worker absences in a year.

b. The degree of frequency / frequency of work accidents.

With the formula, the frequency level expresses the number of accidents that occur per million hours of human work. [7]:

$$F = \frac{n \times 1.000.000}{N}$$

Where:

F = Accident frequency rate

n = Number of accidents that occurred

N = Number of hours worked by employees

c. The severity or severity of work accidents

The severity level expresses the number of working days lost by a million hours of a worker, with the formula [7]:

$$S = \frac{H \times 1.000.000}{N}$$

Where:

S = Seferity/severity of the accident

H = Total number of employee lost hours

N = Number of hours worked by employees

The number of hours lost includes:

The number of days lost due to temporary complete impairment as a result of the date (including days off during which the worker is unable to work).

The number of permanent total disability and death.

To calculate the number of working hours used in the calculation of frequency / frequency and seferity / severity is the total working hours of employees in a year / month minus the number of worker attendance in a year / month [8].

d. Secure T Value

To compare the results of the accident rate of a work unit in the past and present, so that it can be known the rate of decrease in accidents in the unit, a T Survivor value is used which is based on a statistical quality control test. The method used is the "t" test or Student Test with the formula [7] :

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

Where:

STS = Secure T value (dimensionless)

F1 = Frequency Rate of past work accidents

F2 = Current Frequency Rate of work accidents

N = Number of hours worked by employees

According to Bennet Silalahi, this interpretation is :

- 1.The STS value is between +2 and -2, with the frequency of work accidents showing no significant/meaningful change.
  - 2.The STS value is above +2, meaning that the frequency of work accidents in the present has decreased against past achievements or shows worsening conditions.
  - 3.The STS value is below -2, meaning that there is an increase in the achievement of the frequency of work accidents in the present when compared with the past or showing that the situation is improving.
- e. Determining the value of productivity.

How to determine the value of productivity is:

Number of hours worked in a year – with the number of hours lost due to work accidents ÷ the number of hours worked in a year.

2. Data processing based on qualitative data.

Data processing based on qualitative data is carried out using the Fault Tree Analysis (FTA) method based on work accident data that occurs in the company, where this FTA method describes the root of every work accident that occurs so that the cause of each accident that occurs can be known.

**III. RESULT AND DISCUSSION**

A. Data Collection

Employee Working Hours

Working hours/day are 8 hours starting at 08.30 WIB – 16.30 WIB with a break of 1 hour (12.00 WIB – 13.00 WIB). Except Friday (12.00 WIB – 13.30 WIB).

Number of Workers

The number of workers in CV XYZ from 2020 to 2021 is fixed and can be seen as follows:

Year 2020 = 37

Year 2021 = 37

Number of Work Accidents

The number of work accidents that occurred in CV XYZ in 2020-2021 can be seen in Table 1. as follows:

Table 1. Number of Work Accidents/CV Month. XYZ in 2020-2021

Year	Number of Accidents	Bulan											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2020	10	2	1	1	0	1	2	0	0	0	3	0	0
2021	8	0	1	1	2	0	1	1	1	0	0	1	0

Source : CV. XYZ

B. Number of Workers and Working Hours

The following is data on the number of workers and the number of hours worked in CV XYZ for 2020-2021 as shown in Table 2. next:

Table 2. Number of Workers and Number of Working Hours/month CV XYZ 2020-2021

Year	Number of Workers (people)	Number of Working Hours - Worker/Month (hours)	Number of Working Hours – Worker/ Year (hours)
2020	37	6.475	77.700
2021	37	6.475	77.700

Source : CV. XYZ

Information:

- The number of working days in a month is 25 days
- The number of hours worked by employees in a day is 7 hours starting from 08.30-16.30
- with a break of 1 hour.

C. C. Number of Lost Working Hours

The following is the number of employee hours lost due to work accidents can be seen in Table 3. as follows:

Table 3. Recapitulation of the Number of Employee Hours Lost in 2020-2021

Year	The Number of Accidents	Number of Lost Workdays (days)	Number of Lost Working Hours (hours)
2020	10	22	154
2021	8	18	126

Source : CV. XYZ

D. Analysis of Data Processing Results.

Analysis of the Frequency Level of Work Accidents

Based on the results of the measurements above, it can be seen that the frequency level of accidents in 2020 is 128.70 times an accident occurs every one million hours of work of people. In 2021, it shows that the frequency of accidents is 102.96 accidents every one million hours of work. Based on the comparison of these figures, it is clear that in 2020-2021 the frequency of accidents is reduced or getting lower. It can be described as Figure 1. as follows:

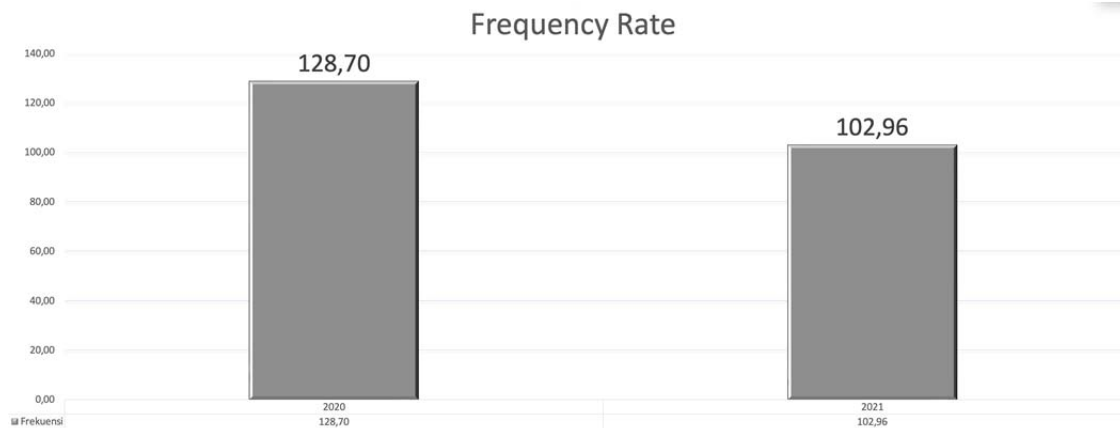


Figure 1. Accident Frequency Rate Diagram

Analyze the severity of work accidents.

From the results of measuring the severity of accidents above in 2020, the loss of working days due to work accidents

that occurred was 283.14 days lost every one million hours worked. And in 2021 the loss of working days due to work accidents that occurred was 231.66 days lost every one million hours worked. Based on these values, it can be seen that the severity of the accident has decreased. It can be described as Figure 2. Sabagai follows:

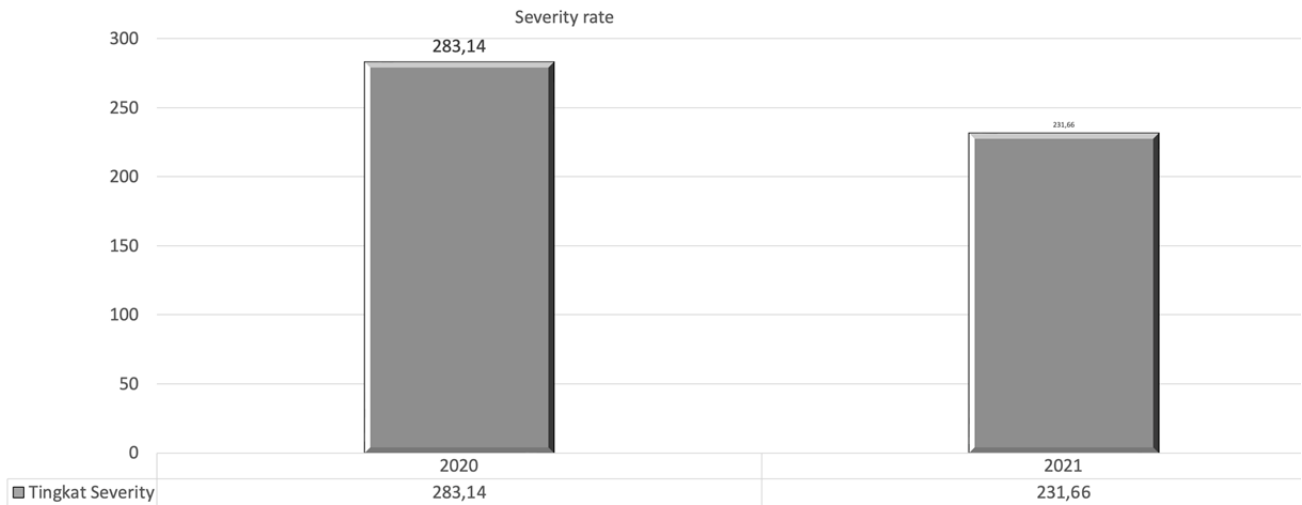


Figure 2. Accident severity diagram

### Safe T T Score (STS) Analysis

From the STS Measurement Results for 2 years, STS was obtained in 2021 of -632.45. This shows that the frequency of work accidents indicates an improved situation, in other words, there is a decrease in the presentation of accidents. It can be described as Figure 3. as follows:

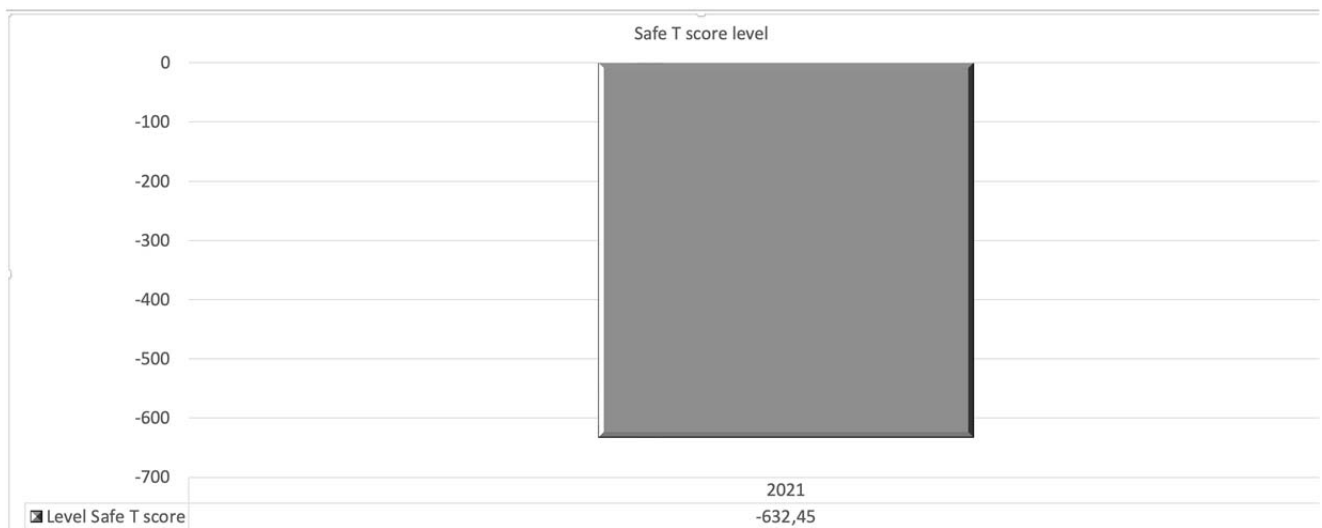


Figure 3. Safe-T-Score Level Diagram

### Analysis of the Effect of Work Accidents on Productivity

Based on the above data, the result of work productivity in 2020 is 0.9980 and in 2021 it is 0.9983. The level of work productivity has increased. This is because work accidents greatly affect work productivity if accidents are high and lost hours are high, it will cause productivity to fall and if there are smaller accidents and lost hours, the higher the productivity will be. It can be described as Figure 4. as follows:

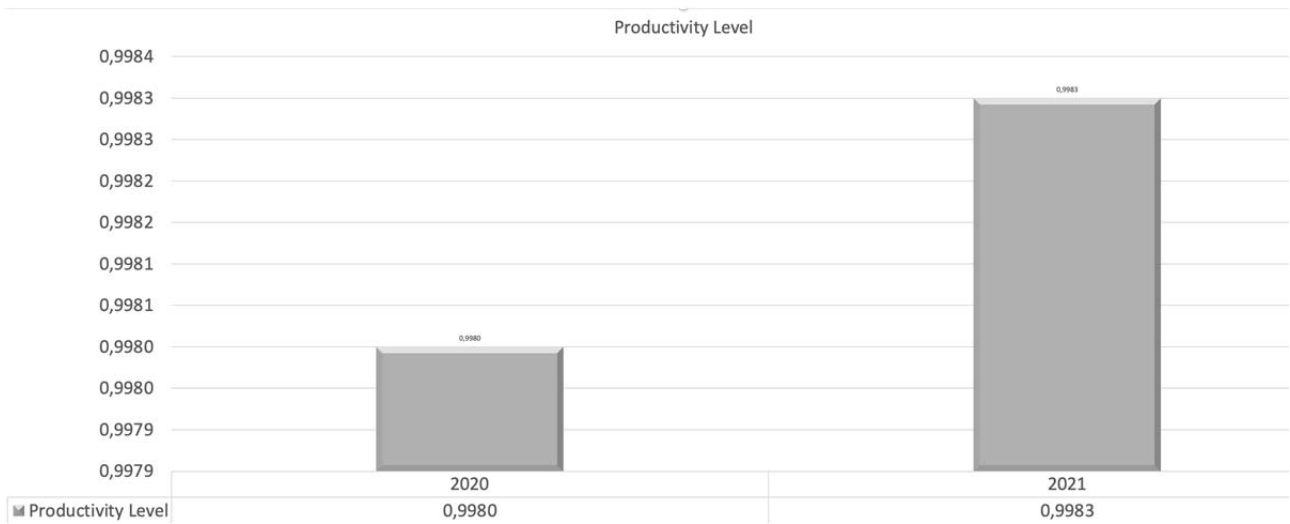


Figure 4. Productivity Level Diagram

Fault Tree Analysis

The following is a Fault Tree Analysis of eye irritation can be seen in Figure 5. the following:

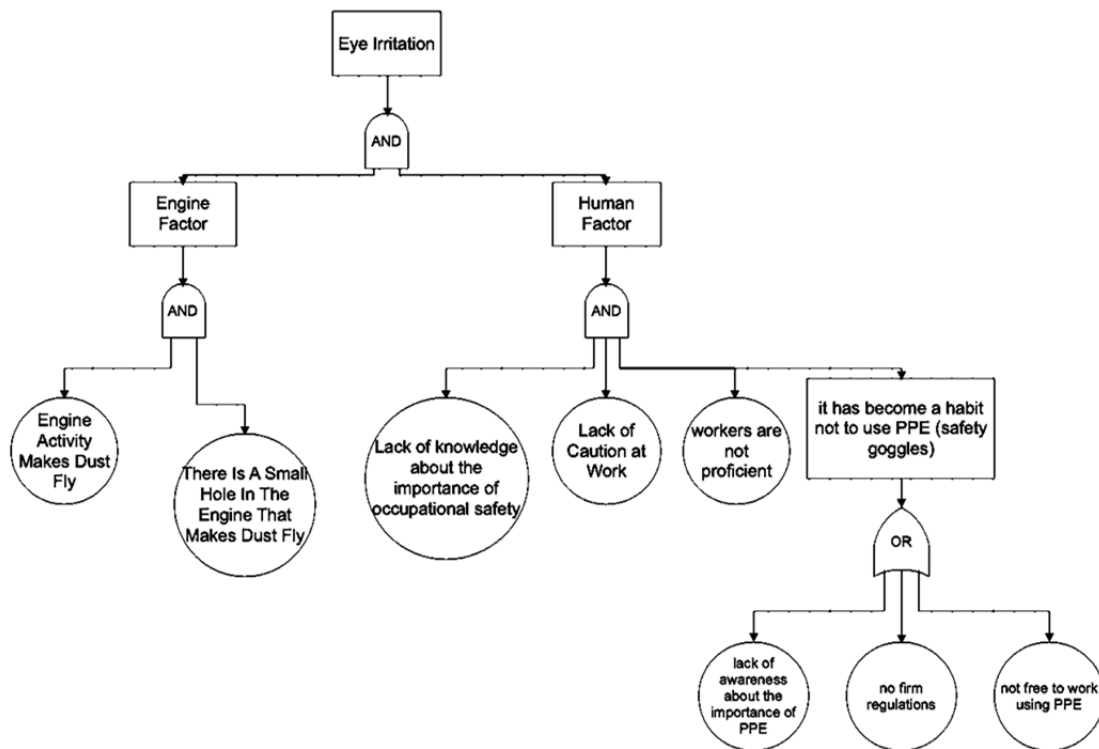


Figure 5. Fault Tree Analysis of eye irritation

The following is a Fault Tree Analysis of respiratory disorders can be seen in Figure 6. the following:

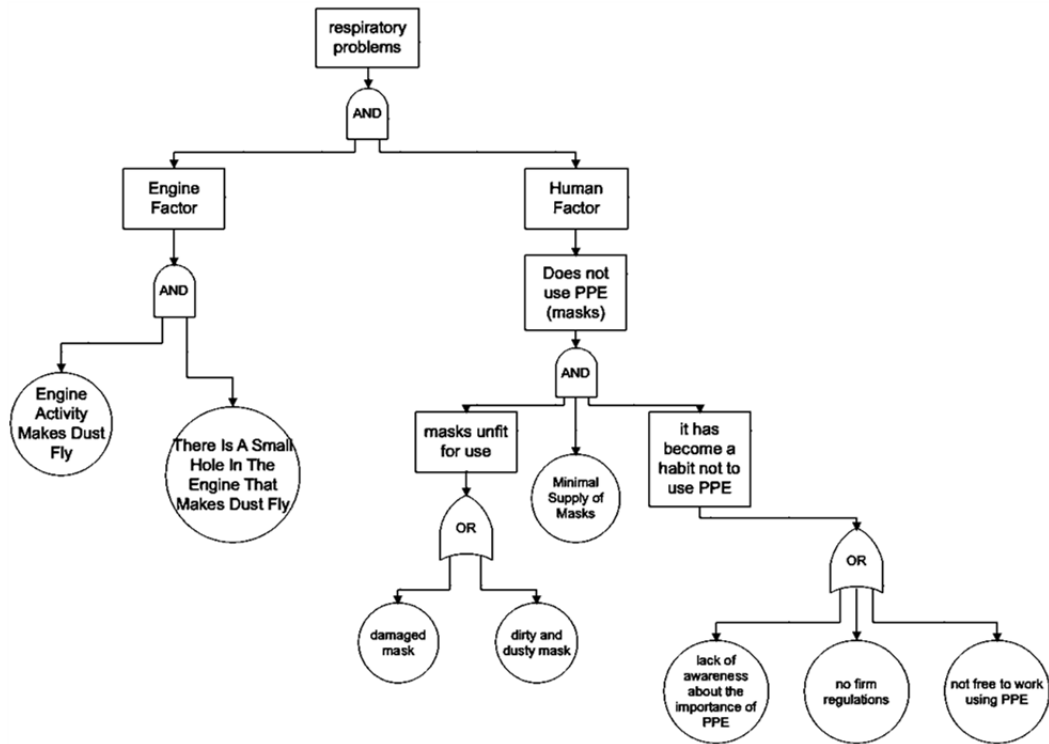


Figure 6 Fault Tree Analysis of respiratory disorders

The following is a slip Fault Tree Analysis can be seen in Figure 7. the following:

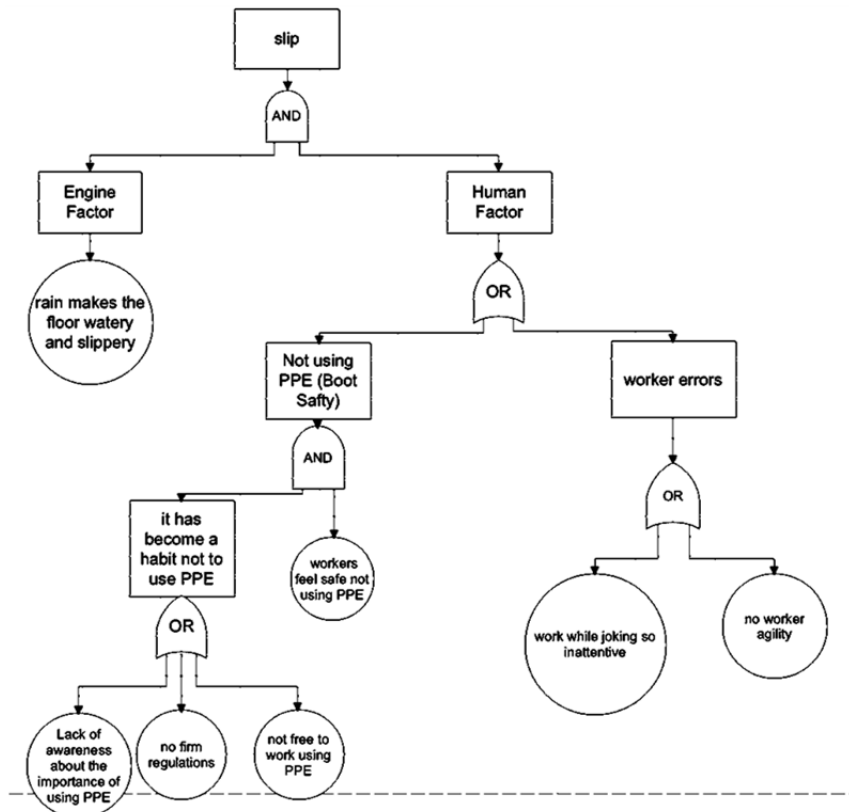


Figure 7 Fault Tree Analysis slip



The following is a Fault Tree Analysis of tripping and falling can be seen in Figure 8. the following:

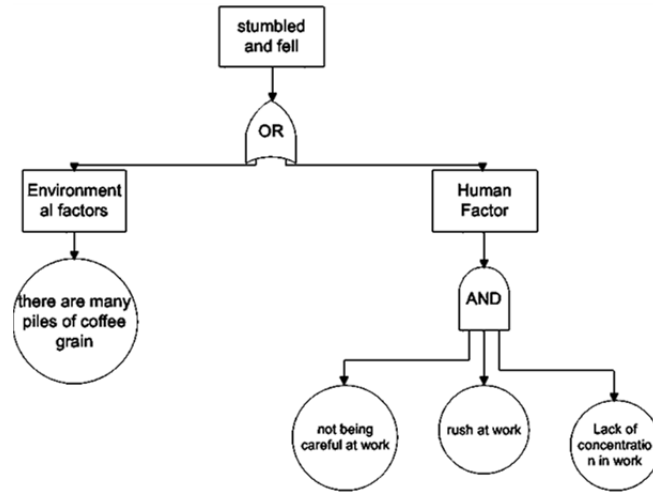


Figure 8 Fault Tree Analysis tripping and falling

The following is a Fault Tree Analysis of falling from a height can be seen in Figure 9. the following:

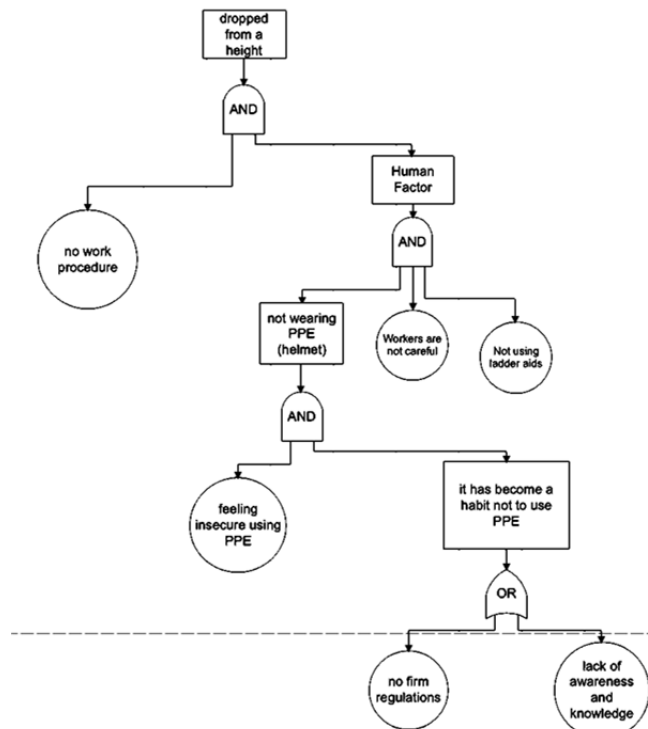


Figure 9. Fault Tree Analysis dropped from a height

The following is a Fault Tree Analysis of pinched fingers can be seen in Figure 10. the following:

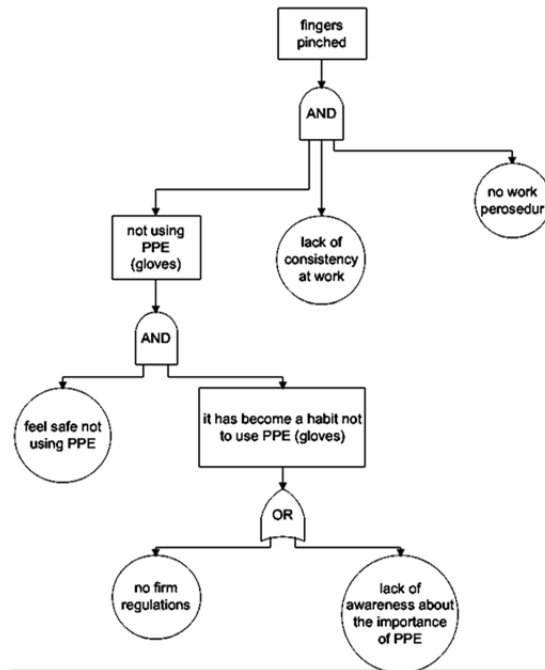


Figure 10. Fault Tree Analysis pinched fingers

#### IV. CONCLUSION

Based on the results of the discussion of the analysis of the application of occupational safety and health in an effort to increase work productivity with the Fault Tree Analysis approach at CV XYZ to the problems that have been analyzed, it is concluded as follows:

1. The results of measuring the frequency of work accidents (F) in 2020 and 2021 decreased by 128.70 to 102.96. The results of measuring the severity or severity of work accidents (S) in 2020 and 2021 there was a decrease in accident severity by 283.14 to 231.66 and the measurement results of the T Selamat (Nts) value in 2021 were -632.45. This shows that the frequency of work accidents shows an improved situation, in other words, there is a decrease in the presentation of accidents.
2. The calculation results show that the level of work productivity in 2020 is 0.9980 and in 2021 it is 0.9983. The level of work productivity has increased, this is because work accidents greatly affect work productivity if accidents are high and lost hours are high, it will cause productivity to decrease and if there are smaller accidents and hours lost, the higher the productivity will be.
3. The root cause of accidents that have occurred in CV XYZ is seen from two aspects, namely human actions that do not meet safety (Unsafe Human Action) and unsafe environmental conditions (Unsafe Conditions).

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