Hazard Identification & Quantitative Risk Assessment

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Abstract- *There are a number of statistical distributions that are fundamental to the work of reliability. In this work, we will apply the theory of the weibull distribution to the collected event data. The weibull distribution is used to perform safety analyzes because details of events derived from historical data are used to predict patterns followed by future events and past events. The weibull distribution is often used in reliability work to insert error data because it is flexible enough to handle decreasing, constant, and increasing failure rates. Probability is represented by the area under the density function curve, which is calculated as an integral, and thus the median of the continuous distribution is the point on the real number line, where exactly half of the area lies to the left. The method of continuous probability distribution is the point where the probability density function reaches its maximum value.*

Keywords- Reliability, Weibull distribution, safety analysis

I. INTRODUCTION

Manufacturing industries lie in the core of industrial growth for any nation. Ensuring the safety of steel manufacturing industries is the biggest challenge facing national technocrats and professional in handling, transporting and storing bulk hazardous materials. Hazardous material characteristics in the form of flammability, toxicity and reactivity reinforce the presence of hazard in all parts of the steel industries.Over the last 20 years, there has been a growing awareness of the problems associated with industrial growth and technological development. The existence of the problem in the form of danger is due to a combination of several factors. The technological development of the industries is still rapid and large-scale. The causes of accidents are the hazards in the steel manufacturing industries. An accident occurs when the hazard becomes an adverse event. Therefore, identifying and eliminating hazards from the work system is essential. The identification of hazards during workplace operations, processes and activities provides a solid basis for conducting a system safety assessment.

Strict safety testing is adopted around the world to ensure the safety of the manufacturing industry. The basic objectives of the work include the following points: (c) Ensure an understanding of the causes by analyzing the time between events in each event category. Critically examine the manufacturing the steel and subsystem for hazard identification and assessment.

A branch of manufacturing and trade based on the production, processing, or manufacture of products consisting of raw materials and commodities. This includes all food, chemicals, textiles, machinery and equipment. This subheading includes all refined metals and minerals derived from extracted ores. This includes all timber, wood and pulp products.

Hazard identification is an essential part of the workplace safety process. This document is useful for them employers who do not have the time, expertise or knowledge to complete the process. They simplify one thing which identify hazards, record them, assess the level of risks they present and propose solutions their control.

Hazard identification is the process of identifying all hazards in the workplace. No specified method for grouping accidental injuries and disease hazards. This is the process of examining the workspace and work to be carried out in order to identify all the hazards involved in the work or at the workplace. Identification of the hazards and assessments in any undertaking and the extent of the risks involved, taking into account possible precautions .Definition of risk assessment

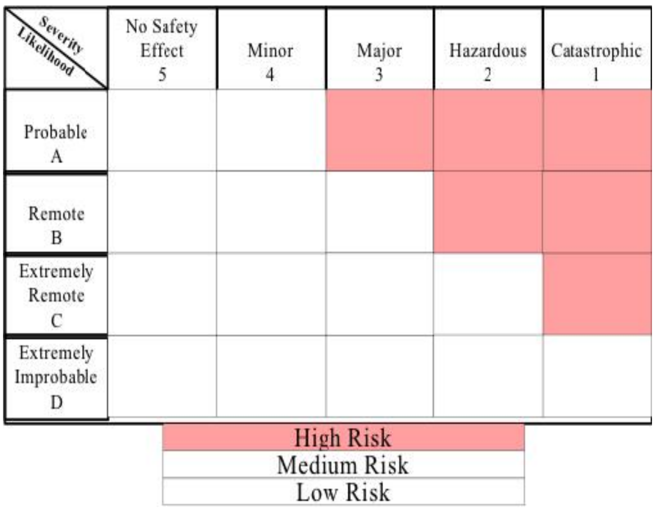

Fig.1 Risk Acceptability Matrix

A quantitative or qualitative estimate of the risk associated with a well-defined situation and a recognized hazard.

- Qualitative: An object probability estimate based on known risk information used the conditions are taken in to account.
- Quantitative: This type is based on subjective, personal judgment, with general data risk.

The two types of risk assessment (qualitative and quantitative) are not mutually exclusive. Quality evaluations are easier to carry out and are also required for legal purposes. If there are jobs, whose hazards and risks are similar in different workplaces or physical areas may be a general risk assessment made.

Some logical steps need to be taken when carrying out a risk assessment

- Identify the hazard.
- Measure the level of damage.
- Assess the risks from the hazards and decide if the existing precautions are appropriate or moving it must be done.
- Make a note of the findings.
- Inform your colleagues about your results.
- Review your assessment from time to time and adjust if necessary. The risk assessment is also defined as the following explanation:
- Danger is anything that can cause damage, such as chemicals, electricity, working from a ladder, etc. Risk is the high or low chance that someone and other hazards may be harmed together Indicating how severe the damage may be.

The security risk management effectively, managers of the program to provide a suitable, he is guilty, and the craftsmen qualified engineers are appointed in program offices and business organizations to manage the system security program. Ensure that system security managers are integrated into the organizational structure so that they have the authority and organizational flexibility to perform effectively. Ensure that all known hazards and associated risks are identified, documented, and followed as program policies so that decision makers are aware of the risks involved when the system becomes operational. Requires a security risk assessment to be presented as part of the program review and at decision milestones.

II. METHODOLOGY

This section presents the proposed methodology, adopted in the proposed work.

The development of the function of hazard ratio and probability density is based on eight-year event data collected by the author. The Weibull analysis was performed to learn from the analysis of aggregate event data. obtained different documented data at different workplaces at two steel manufacturing industries The most commonly used distinction between accidents and incidents is that accidents have a specific outcome, while events have no outcome, such as injuries, damage, fire, and Slips, trips and falls on the same level, Falls from height; Unguarded machinery; Falling objects; Engulfment; Working in confined spaces leakage in an organization. An accident includes any undesirable condition that causes health, property damage, property damage, plant products, loss of production, and increased liability. The event includes any unwanted circumstances that could cause an accident; it is preferable to think of events as part of a single, much larger group of unwanted events that lead to an accident.

III. DATA COLLECTION

Two steelmaking industries in Indore wire taken into account in this work, and the author completed one month and two weeks of vocational training in this steel industry to collect data on accidents and incidents. Within these sectors, the main sources of data on accidents and incidents in vocational training are accident reports, accident / incident records, accident notifications and investigation reports. These steel manufacturing industries management systems follow the timeline of the accident and the author has identified the following source to accomplish this: an online system that can be evaluated by all EHS professionals and, if sufficiently serious, report to the competent public authority, which is the Director of Industrial Health and Safety of the State. (e) The EHS specialist investigating the accident shall send a report to those involved in the outcome of the investigation and the action to be taken.

Vocational training follows three main steps in the collection of accident and incident data in the steel industry. The first step is a critical examination of all reported accidents and incidents available in the EHS industry department. The second step in controlling unreported incidents and accidents has begun. Personal interviews were initiated with people who are likely to have experience or knowledge of the accident or incident. People prefer to talk about an accident or incident that has not been reported if they trust that their revelation will not have harmful consequences. The author conducted an appropriate sample of interviews that provide a reasonably accurate estimate of the proportion of unreported accidents or incidents. During the interviews, the author examined the locations where the incident / accident occurred and a record of the events is kept ready to verify each person's statement. We collected sufficient data between 2016 and 2009 to analyze incidents / accidents within these industries.

IV. RELIABILITY AND WEIBULL DISTRIBUTION

The Weibull distribution is one of the most widely used lifetime distributions in reliability Engineering. It is a versatile distribution that can take on the characteristics of other types of distributions, based on the value of the shape parameter and scale parameter. To apply Weibull distribution to the available data from steel industries we have to categories the data in four major categories and the estimates of the parameters of the Weibull distribution can be found graphically via probability plotting paper, using least squares (rank regression) analysis.

Reliability relationship

There are a number of statistical distributions that are fundamental to the work of reliability. In this work, we will apply the theory of the weibull distribution to the data of the collected events. The weibull distribution is used to perform safety analyzes because details of events derived from historical data are used to predict patterns followed by future events and past events. This distribution uses real-time data to estimate the length of arrival times between events. The weibull distribution is often used in reliability work to insert error data because it is flexible enough to handle decreasing, constant, and increasing failure rates. The probability is represented by the area under the density function curve, which is calculated as an integral, and thus the median of the continuous distribution is the point on the real number line where the area lies exactly half to the left. The mode of continuous probability distribution is the point where the probability-density function reaches its maximum value.

Weibull distribution

The primary advantage of Weibull analysis is the ability to provide reasonably accurate error analysis and failure prediction with extremely small samples. Solutions are possible to signal the problem at the earliest without "having to hit a few more." Small samples also allow testing of cost-effective components. Another advantage of Weibull analysis is that it provides a simple and useful graphical representation of the error data. The great advantage of the Weibull distribution in reliability work is that it can be adapted to any life distributions by setting distribution parameters. It is independent of other variables and uses real-time event data that makes them more reliable in this study.

- Weibull analysis includes:
- The Weibull analysis includes:
- Representation of data and interpretation of the diagram
- Error forecasting and forecasting
- Evaluation of corrective action plans
- Test the soundness of new designs at minimal cost Maintenance planning and cost- effective replacement strategies
- Spare parts forecast
- Warranty analysis and support cost forecasting
- Control of production processes
- Calibration of complex design systems, ie CAD \ CAM, finite analysis, etc.
- We can Recommend the management in response to service problems Data problems and deficiencies include:
- Censored or suspended data Mixtures of failure modes
- Nonzero time origin
- Unknown ages for success fulunits
- Extremely small samples (as small as one failure)
- No failure data
- Early data missing

The Weibull reliability function is defined as

$$\mathbf{R}(t) = \exp\left[-\left(\frac{t}{\eta}\right)^{\beta}\right] \qquad \ldots(1)$$

Where β is the shape parameter and ŋ is the scale parameter or characteristic life. The two- parameter Weibull distribution is by far the most widely used distribution for life data analysis.

Benard's approximation method

Benard's approximation method for calculating the median rank is sufficiently accurate for plotting Weibull probability distribution and estimating the parameters. Benard's approximation is accurate to 1% for N=5 and 0.1% forN=50.

Benard's Median Rank = (i - 0.3) / (N + 0.4)

The least square parameter estimation method provides following equations for calculation on shape and scale parameter.

Weibull probability density function, PDF, is:

$$F(t) = (\frac{\beta}{\eta})(\frac{t}{\eta})^{\beta-1} e^{(\frac{t}{\eta})^{\beta}} \quad \textbf{...(2)}$$

And Weibull hazard function, the instantaneous failure rate is;

$$h(t) = (\frac{\beta}{\eta})(\frac{t}{\eta})^{\beta-1} \quad \textbf{...(3)}$$

V. RESULT

The obtained results are presented in this section.

The steps for determining the parameters of the Weibull representing the data, using probability plotting are;

1. Ranking the time between occurrence in ascending order for all the respective categories of incidents and calculate the median value.
2. Conduct the least square analysis method to obtain the values of shape parameter and scale parameter.
3. Construct the weibull probability plotting paper

Where X axis represents transformation of simple logarithmic of time between occurrences (TBO) and Y axis represents a complex double log reciprocal transformation.

4. Obtain the values of X and Y axes using the formulae

Y= ln(ln(1/(1-Median rank)))
X = ln (TBO) and
Weibull paper for minor incident 2009 to 2016.

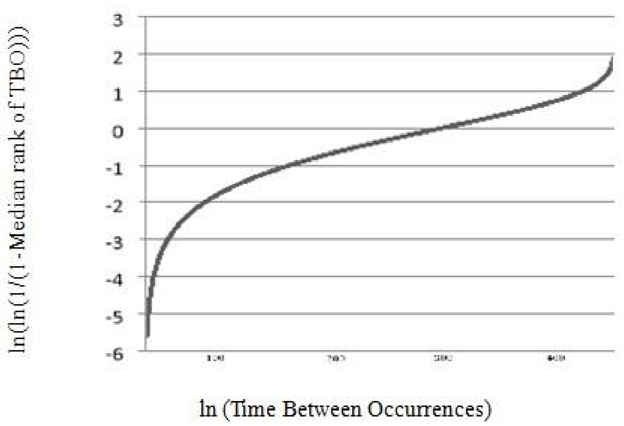

Fig.2 Weibull Probability Plotting Paper for Minor Incidents.

The least squares parameter estimation method provides following equation for calculation of shape and scale parameter.

Weibull paper for critical incidents as shown in Figure 2 gives interpretive clues about the critical incidents category happening. The estimated slope of curve using rank regression is 0.54621 and it is less than 1. This is often referring to an infant mortality failure mode. It includes maintenance error, no installation of components. Compilation of safe operating procedure, and improper. The least squares parameter estimation method provides following equation for calculation of shape and scale parameter. The detailed calculations for major incidents for N=196 are as follows:
Weibull paper for critical incidents as shown in Figure 2 gives interpretive clues about the critical incidents category happening. The estimated slope of curve using rank regression is 0.7763 and it is less than 1. This is often referring to an infant mortality failure mode. It includes maintenance error, no compilation of safe operating procedure, and improper installation of components.

Table.1 Weibull analysis as probability density function and hazard rate function

Type of Incident	Shape parameter (β)	Shape parameter (η)	f(t) probability density function	h(t) Hazard rate function
Minor	0.54621	2.7237	$0.7362t^{-0.4}$ e $xp(0.6927t$	$0.7362t^{-0.438}$
major	0.9536	0.8396	$1.1357^{0.0464}$ e $xp(01.191t$	$1.1357^{0.0464}$ $t^{-0.438}$
critical	1.71	0.19866	$0.860^{00.713}$ e $xp(0.5033t$	$0.860^{0.713}t^{-0.2}$
catastrophic	-1.161	0.1380	$0.841^{0.0464}$ e $xp(1.1910t$	$0.841^{0.0464}t^{0.9}$

All	1.3177	1.0969	$-1.48847t$ e $xp(0.91166$	$-1.4884t^{0.317}$ $t^{1.939}$

VI. CONCLUSION

From the above calculation and research it can be concluded that Data on incidents at an oil refinery that provide minor, medium, major, severe, and catastrophic assistance in a system safety assessment in any organization, The system safety assessment was performed on incident data collected at an oil refinery, where ranking regression analysis and least squares parameter estimation were also performed in the process of developing the time between events. Weibull distribution theory helps to document statistics on the time between the occurrence and recurrence of events This research work provides algorithm evaluation using the weibull distribution to construct the probability density function and the hazard ratio function based on the events.

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