International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 09 Issue: 04 | April - 2025 SJIF Rating: 8.586 ISSN: 2582-3930

Hazard Identification & Quantitative Risk Assessment in Manufacturing Industries

Munshi Jarvik Nileshkumar[1], Dr. Sandeep Yadav[2], Prof. Nishant Kushwaha[3]
Department of Fire Technology & Safety Engineering[1,2,3]
School of Engineering and Technology[1,2,3]
Vikrant University, Gwalior (M.P)[1,2,3]

ABSTRACT: Ensuring safety in industries is critical to avoid catastrophic events. 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: Industrial Safety, Reliability, Weibull distribution, safety analysis

I. Introduction

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.

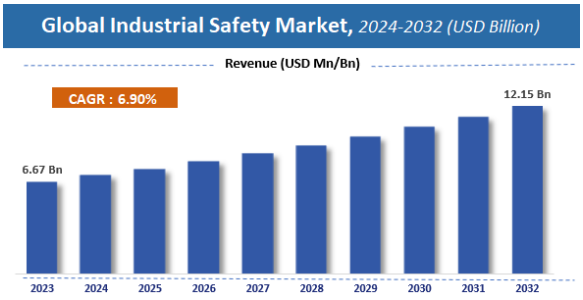

Fig.1 Global Industrial Safety Market

(Source: https://www.zionmarketresearch.com/report/industrial-safety-market)

Figure 1 depicts the Estimated Growth in the Global Industrial Safety Market , which is estimated to reach 12.15 Billion USD by 2032/ This leads to high potential in new innovation in the domain.

II. Hazard Management in Manufacturing Industries

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.

As the manufacturing industry is LPG, propane, etc. They are used that are volatile and highly flammable, can easily generate an electrostatic charge, which increases the likelihood of an accident if not handled properly So we can say that wiring in the manufacturing process involves many risks and therefore risk assessment is very necessary to reduce the frequency of these accidents.

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 .There are a number of things that can help you identify workplace and workplace hazards.

•Walk to the workplace to examine what is in the general area.
•Ask other employees what they think of anything they noticed.
•Review of work instructions or safety analysis.
•Check the operating instructions.
•Review reports of past events.

Hazard Identification (HAZID) is the process of hazard identification, which is the first most important step the risk assessment. There are two possible purposes for hazard identification:
•Obtain a list of risks for later assessment using other risk assessment techniques. This sometimes known as “failure case selection”.
•Carry out a qualitative assessment of the significance of the hazards and the risk reduction measures risks.

Table.1 Severity and Consequences

Description	Category	Definition
Catastrophic	I	Death, and/or system loss, and/or severe environmental damage
Critical	II	Severe injury, severe occupational illness, major system and/or environmental damage
Severe	III	Minor injury, minor occupational illness, and/or minor system damage and/or environmental damage
Minor	IV	Less than minor injury, occupational illness, or less than minor system or environmental damage

Table I defines the description and category of consequences.
The term "hazard" is a condition, event, or circumstance that could lead to or contribute to an unplanned or unwanted event and is divided into environmental subcategories, such as system states, environmental conditions, or "initiator" and "contributor." .dangers. A security analysis requires four key elements if the result is to have a timely and cost-effective impact on the system.

III. Methodology

The wire is pulled out of a coil and inserted into the nail making machine where a gripper dies. The shape of the nail head is machined into the end of the tools. As long as the stickers secure the wire in place, the free end of

the wire is struck by a mechanical hammer. This deforms the end of the wire into the tool cavity to form the nail head. Since the wire is still clamped in the tools, a series of mold cutters snap into the other end of the nail, forming the point and freeing the nail from the other wires detached from the coil. The tools open and an expulsion mechanism hits the nail into the collection container machine. The free end of the wire is pulled out of the coil and fed into the machine. Then the cycle starts again. To make wire nails, the wires must be tightened to the desired size and the desired final wire angle. In this project, drawn wires are used as inputs with final defined dimensions and fixed dimensions. Necessary excipients are sulfuric acid and sawdust. This process can be completed in then ail polisher and then the finished nails are packed in the sales boxes

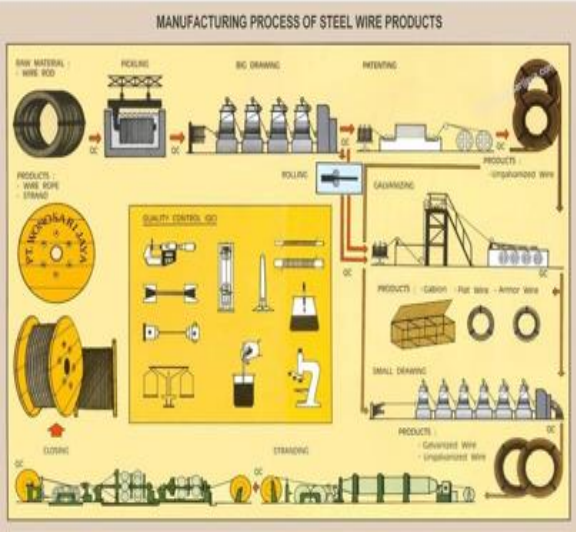

Fig.2 Manufacturing Process of Steel Wire Production

Figure 2 depicts the process chart for the Steel Wire Production.

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.

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.

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.

"The ability of an item to perform a required function under stated conditions for a stated period of time". It is absolutely right that the process industry should try to apply the technologies and reap the benefits of reliability technology. The process industries are

particularly concerned with mechanical equipment reliability. Reliability technology involves an iterative process of reliability assessment and improvement and the relationship between these two aspects is important. Working with the reliability of a system necessarily involves assessing the reliability. In some cases the assessment shows that the system can be sufficiently trusted. In other cases, the reliability proves to be insufficient, but the assessment work show there liability can be improved.

The incident data collected from the steel manufacturing industries referring the system of incident/ accident reporting help the investigating agency to the main cause of the incident/ accident. Also, this data gives the statistics of the accidents happened and helps performing safety system assessment for the industry. Work on the reliability of a system compulsorily involves assessment of the reliability. In some cases the assessment shows that the system is reliable.

The Weibull Distribution for Assessing Reliability:

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.

The Weibull reliability function:

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

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) (2)

IV Experimental Results:

The experimental results are presented next:

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

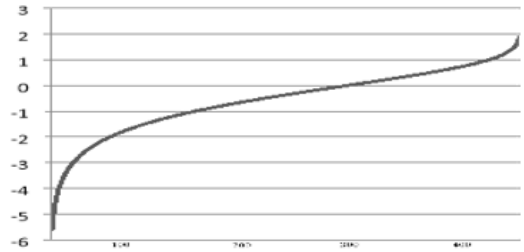

Fig.3 Weibull Probability Plotting Paper for Minor Incidents.

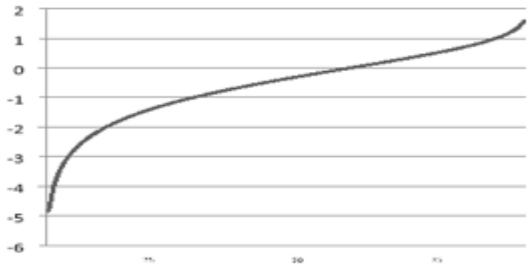

Fig.4 Weibull Probability Plotting Paper for in-time between occurrences.

Least square analysis for all incidents**:**

$$b = \frac{\sum_{i=1}^{N}(InTi)Yi - (\sum_{i=1}^{N} Inti)(\sum_{i=1}^{N} Yi)/N}{\sum_{i=1}^{N}(InTi)^2 - (\sum_{i=1}^{N}(Inti)^2)/N}$$

$$b = \frac{\sum_{i=1}^{1129}(InTi)Yi - (\sum_{i=1}^{1129} Inti)(\sum_{i=1}^{1129} Yi)/1129}{\sum_{i=1}^{1129}(InTi)^2 - (\sum_{i=1}^{1129}(Inti)^2)/1129}$$

$$b = \frac{-815.7497798-(562.072799)*(-596.2720486)/1129}{1124.145598-(562.072799^2)/1129}$$

$$= \frac{-1112.6038}{844.317}$$

$$= -4.0653818/0.35$$

$$b = -1.3177$$

$$\hat{a} = \frac{\sum_{i=1}^{N} Yi}{1129} - \frac{b(\sum_{i=1}^{N} Inti)}{1129}$$

$\hat{a}$= (-0.5281)-(-0.6501)

= 0.12195

β = b=-1.3177 (shape parameter)

$\eta = e^{\wedge}(-\hat{a}/\beta)$

$\eta = e^{\wedge}(-(0.12195)/-1.3177)$

$= e^{\wedge}0.0925$

η = 1.0969

(scale parameter)

The presented results shows which responses correspond to the risks. For low-risk environmental issues, the answer is risk acceptance. For medium risk (higher probability) accidents, the answer is to control the risk. Finally, in the event of a health problem, explosion or fire, as both is serious and highly likely, the answer is to reduce the risks.

V. CONCLUSION

In general, five hazard regulations can be applied in hazardous industries. Risk management is used by management to develop policies appropriate to the factory. Hazard control includes elimination, replacement, technical inspections, administrative inspections and personal protective equipment. However, only three hazard controls were used in this study. These are engineering inspections, administrative inspections and personal protective equipment. These safety inspections serve as a guide in the steel manufacturing plant. In this research, we provide an event estimation algorithm by developing a Weibull distribution as a probability density function and a hazard function based on events at the oil refinery. The rank regression method described by Marhavilas and Koulouriotis [13] in a stochastic approach is used to estimate the shape and scale parameters of the Weibull distribution.

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