JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

HAZARD IDENTIFICATION AND RISK ASSESSMENT IN THE COMMERCIAL VEHICLE MANUFACTURING INDUSTRY

[1]M.K.Nawines Pravin, [2]P.Senthilkumar, [3]R.Ranjith, [4]K.Perumal [5]P.Vignesh,
[1]P.G Student, [2]Professor, [3,4,5,]Assistant Professor,
[1]Department of Industrial Safety Engineering, [2,4]Department of Mechanical Engineering,
[5]Department of Safety and Fire Engineering, [3] Department of Environmental Engineering
[1,2,,4,5] K. S. R College of Engineering, Tiruchengode, India
[3] Rajamangala University of Technology, Thanyaburi, Thailand

Abstract: In a manufacturing plant assembling components involves many numbers of processes and loading of components in the finishing process creates problems for the workers. Cutting equipment plays an important role in industries. The objectives of the investigation are to reduce the Hazards in the workplace based on the worker's operation using HIRA (Hazard Identification and Risk Analysis) The appropriate risk controls are engineering controls, administrative controls, and personal protective equipment. There are three main stages, first to identify the Hazard in the workplace second to analyze the hazard, and third to control the identified hazard using some control measure. This HIRA study may help the employer be more productive in ensuring the safety and health of workers. the problems are identified by their severity. Data using FMEA (Failure mode and effects analysis) worksheet.

***Index Terms* – Hazard, Risk Analysis, Commercial Vehicle.**

1. INTRODUCTION

Hazard Identification and Risk Analysis (HIRA) deals with the identification and quantification of risks that are exposed, due to accidents resulting from the hazards present or handling of hazardous substances in the workplace. This involves Hazard analysis which essentially is the identification and quantification of the various hazards that are likely to occur in the industry as well as the quantification of the consequences due to a particular hazard. The risk analysis estimates the probability as well as the severity of a particular hazard over an exposed group of people, plant equipment, or both. HIRA assists in identifying the most likely hazards that can have a significant impact on workplace safety in an industry. It helps in devising effective management measures as well as engineering measures for both preventive as well as post-disaster management.

2. LITERATURE REVIEW

Frank Crawley, A Guide to Hazard Identification Methods (2020) Hazard Studies, sometimes known by other names, is a structured approach by a team to the identification (and where appropriate the elimination) of safety issues within a Project in a timely manner. There are now 8 clearly defined phases. The level of analysis is appropriate to the detail of the project at the appropriate phase. In the early phases 0–2, it may be found that the technical uncertainty or risk (Safety and Environment) is unacceptable and that a project should be either delayed until more data are available or canceled. Once the design is fixed, changes are likely to be expensive.

2.1 MARVIN RAUSAND:

Marvin rausand is professor emeritus in the department of mechanical and industrial engineering at the norwegian university of science and technology (ntnu), norway, and author of risk assessment: theory, methods, and applications and reliability of safety-critical systems: theory and applications, both published by wiley. Introduces risk assessment with key theories, proven methods, and state-of-the-art applications risk assessment: theory, methods, and applications remains one of the few textbooks to address current risk analysis and risk assessment with an emphasis on the possibility of sudden, major accidents across various areas of practice from machinery and manufacturing processes to nuclear power plants and transportation systems. updated to align with iso 31000 and other amended standards, this all-new 2nd edition discusses the main ideas and techniques for assessing risk today.

The book begins with an introduction to risk analysis, assessment, and management, and includes a new section on the history of risk analysis. It covers hazards and threats, how to measure and evaluate risk, and risk management. It also adds new sections on risk governance and risk-informed decision-making; combining accident theories and criteria for evaluating data sources; and subjective probabilities. The risk assessment process is covered, as are how to establish context; plan and prepare; and identify, analyze, and evaluate risk. Risk Assessment also offers new coverage of safe job analysis and semi-quantitative methods, and it discusses barrier management and HRA methods for offshore applications. Finally, it looks at dynamic risk analysis, security, and life-cycle use of risk.

2.2 ROSALINA PETERS:

David Vose is a senior partner of Vose Consulting, a risk analysis consulting, software, and training firm with offices in the US, Europe, and Russia. He has worked in risk analysis since 1988 in an extensive range of industry and government problems from insurance, banking, corporate finance, food safety, nuclear power, and epidemiology to oil and gas, construction, utilities, and general commerce. he has co-authored and edited several international guidelines on risk. A charismatic speaker, David gives frequent public and in-house risk analysis seminars. David has served as an expert witness in a variety of high-profile court cases. A keen squash player, he lives with Veerle and their two children in Ghent, Belgium, and dreams of one day owning an old Bentley when there's room in the garage.

Disaster risk reduction is a relatively nascent field of study focusing on the identification and preparedness to handle disasters. This extensive book delves deep into the core areas of this discipline. It presents tools and techniques for risk assessment such as hazard analysis, etc. Also included in this book are methods for risk awareness, training to survive disasters, policies, etc. It will serve as a reference guide for students, professionals as well as policymakers associated with this field.

This book concerns itself with the quantification of risk, the modeling of identified risks, and how to make decisions from those models. Quantitative risk analysis (QRA) using Monte Carlo simulation offers a powerful and precise method for dealing with the uncertainty and variability of a problem. By providing the building blocks the author guides the reader through the necessary steps to produce an accurate risk analysis model and offers general and specific techniques to cope with most modeling problems. A wide range of solved problems is used to illustrate these techniques and how they can be used together to solve otherwise complex problems. Vincent T. Covello, Joshua Menkes and Jeryl Mumpower, Risk Evaluation and Management Published in the Year of 1986.

3. RESEARCH METHODOLOGY

3.1 HAZARDS DURING CONSTRUCTION PHASE

Potential hazards during the construction phase of the project could be due to the mechanical hazards, navigation/ transportation hazards, physical hazards and storage and handling of hazardous materials.

Mechanical Hazards: Mechanical hazards during the construction phase arise due to the moving parts in the machinery, especially the belts and bolts of the construction equipment, which are heavy and pose a threat to the work personnel. Other hazards include falling (during working at heights), falling objects like handheld tools, etc.; failure of slips and traps created for scaffolding; and due to faulting of electrical equipment.

Navigation/ transportation Hazards: Planning of access/egress to the construction site also plays a significant role in minimizing the associated hazards such as vehicle/barge collisions.

Physical Hazards: The noise and vibrations generated during construction phase may affect the workers' health, and hinder effective communication. In addition to noise and vibration, hot works also pose a considerable hazard to the workers.

3.1.2 HAZARDS DURING OPERATIONAL PHASE

Material Hazards: During operation, Liquid Cargo will be handled at the proposed facility. The Liquid cargo hazard classification can be made based on its Characteristics such as Flammability, explosiveness, toxicity or corrosivity etc.

Handling Hazards: The proposed jetty involves handling Liquid Cargo. The hazards related to edible oil transport and unloading may be due to accidents, breaking of unloading arms, failure in mechanical components, etc. The handling hazards include:

- Insufficient knowledge of the hazardous nature of Liquid Cargo in use leading to inappropriate handling of the Liquid Cargo.
- Failure to use appropriate control measures and Personal Protective Equipment (PPE)
- Use of expired/worn Personal Protective Equipment (PPEs)
- Failure of liquid delivery tools.
- Possible hazards during ship movements at the port are collision, grounding, etc.
- Likely hazards during loading and unloading of Liquid Cargo.
- During ship unloading operations, a possible hazard may arise due to collision by another vessel and others.

3.1.3 HAZARD DUE TO NATURAL CALAMITIES

Cyclones, tsunamis, and Storm surges are the most destructive forces among the natural devastations. It causes instant disaster burial of lives and destruction to entire coastal properties. The damage and loss can be minimized if an appropriate preparedness plan is formulated. The following statutory guidelines are recommended by the National Disaster Management Authority (NDMA) to minimize the impact due to cyclones, tsunamis, and storms.

Table 3.1 Hazard due to Natural Calamities

Types of Disasters	Risk incurred	Mitigation steps
Earthquake	Highest vulnerability towards earthquake occurrence (based on history) resulting in massive destruction.	The structure proposed should comply with per relevant IS Codes for Earthquake resistant structures for adequate factor of safety.
Tsunami	Kandla region had been affected by Tsunami in past with a ht. of 12m in 1945. Thus, it is also one of the major risks applied to the SIPC locations.	Land use planning should be as per the zoning maps by Gujarat State Disaster Management Authority (GSDMA)
Cyclone	Gujarat falls in the region of tropical cyclone and is highly vulnerable to associated hazards such as floods, storm surges etc. Kandla falls in the belt in which the wind speed ranges between 45-47m/sec. Over 120 cyclones originated within the Arabian Sea in the past 100 years. Damage to property and life is huge.	Structure proposed should comply as per relevant IS Codes for cyclone resistant structures for adequate factor of safety.
Drought	Kandla is a drought-prone area with less rainfall Drought vulnerability increases groundwater exploitation	Rainwater harvesting should be mandatory
Epidemics	Outbreaks of Epidemics such as swine flu have been seen in the past	Necessary steps should be undertaken to have hygienic conditions and medical assistance within the location to cater to an epidemic

A Risk Analysis should, therefore, be seen as an important component of any or all - ongoing preventive actions aimed at minimizing and thus hopefully, avoiding accidents. Re- assessments should therefore follow at regular intervals, and/or after any changes that could alter the hazard, so contributing to the overall prevention program and disaster management plan of the project.

3.2 PRELIMINARY HAZARD ANALYSIS (PHA):

Preliminary Hazards Analysis (PHA) is a broad-based study carried out to identify potential hazards associated with various process operations, types of chemicals, and associated activities carried out at any facility. The objective of Preliminary Hazards Analysis is to further direct greater depth of analysis and suggest remedial measures for hazard potential areas. The PHA is always better done in the early stages of the project so that requisite time is available to implement recommendations and it is economical to implement in the beginning rather than modifying the system subsequently after commissioning the facility.

The areas identified for carrying out PHA are given below:

- Areas where large quantities of hazardous chemicals are stored or processed.
- Areas where operating temperatures and pressures could be particularly high.
- Areas where flammable inventories exist. At times the flammable inventories may not be hazardous in itself but even a minor fire in the vicinity may be sufficient to cause knock-. on effect resulting in release of hazardous

chemicals.

- Specific operations associated with the high probability of failure.
- Areas where destructive and dangerous chemical reactions could take place resulting in major heat evolution, release of toxic products in reaction, polymerization, etc.
- Areas where potentially corrosive material is stored and handled and where pipeline or tank failure due to corrosion would result in major release of the corrosive or toxic chemical.
- Areas where passive or active safety systems are associated with a generally high failure rate.

3.3 RISK ANALYSIS

A hazard is generally realized as a loss of containment of a hazardous material. The routes for such loss of containment can include release from pipe fittings containing liquid or gas, releases from vents/relief and releases.

The objective of hazard identification is to identify and evaluate the hazards and the unintended events, which could cause an accident. The first task usually is to identify the hazards that are inherent to the process and/or plant and then focus on the evaluation of the events, which could be associated with hazards. In hazard identification and quantification of the probability of occurrence, it is assumed that the plant will perform as designed in the absence of unintended events (component and material failures, human errors, external events, process unknown), which may affect the plant/process behavior.

Edible oil is less hazardous but even edible oil storage and handling may result in various incidences during cleaning and maintenance of the line and storage vessel.

The proposed project has the risk potential of toxic and flammable chemicals. For Hazard identification, Maximum Credible Accident (MCA) scenarios have been assessed. The maximum credible accident has been characterized as an accident with a maximum damage potential the occurrence of which is most probable.

During the burning of edible oil, the maximum threat zone (Lethal & 2nd-degree burn) extends to a distance of 100m. The information available in the literature regarding exposure versus damages is given below: -

Table 3.2 Preamble

Incident Radiation intensity, KW/m^2	Type of damage	Damage to human
37.5	Damages the process Equipment's	100 % Lethality in one minute, 0.1% in 10 seconds
25.0	Minimum energy to ignite wood up on indefinitely long exposure	100% lethality in 1 minute, Significant injury in 10 seconds Via
12.5	Minimum energy to ignite the combustion materials	1 minute: First degree burns in 10 seconds.
9.5	--	Pain threshold reached after 10 seconds: II degree burns after 20 seconds.
4.0	--	Causes pain if duration is longer than 20 seconds: But blisters Unlikely.
1.6	--	Causes no Discomfort

3.4 CAUSES OF FIRE

a) Fuel and Storage Tanks

Ferry terminal / jetty contain materials like edible oil and are the material of focus in our project as they can pose hazardous actions in the jetty. Individual ferries have hydrocarbons on board, and the proposed jetty will also have docks for dispensing fuel to the ferries coming at the jetty, which requires that they have fuel storage tanks. These tanks need to safely contain the hazardous materials, and the dispensing equipment must be used properly and maintained to ensure that the materials will not leak or spill into the water or onto the pier, which can cause fire. As improper usage or faulty equipment can result in spills and other emergencies, fueling docks and fuel storage tanks are some of the most incident-prone locations and items in the jetty.

b) Ferry Fire

Ferry fires are one of the most common ways that jetty fires can begin. These fires can spread to the rest of the jetty and to other ferries. The most common causes of ferry fires are electrical malfunctions, unattended portable heaters, smoking, and poor housekeeping. Smoking is a common cause of fires, whether on a ferry or in the jetty. Electrical fires are also common and can occur whether the jetty is or is not in use. Exposed wiring can arc to outside materials, or it can cause a short circuit. Wiring on ferries can become exposed due to the constant movement of the ferry in the water as well as the corrosive properties of the damp sea air. Improperly sized fuses or circuit breakers can also cause the wiring to arc to another material. Overloading electrical sockets and accidents with light bulbs may also cause electrical fires on ferries.

c) Fire in a public area

Smoking also causes fires in public areas like restaurants, waiting rooms, common toilets, parking lots, and public parks. Electrical fires are common in restaurants due to short circuits or exposed wiring.

d) Other causes -calamity

Fires in the jetty are potentially calamitous. Fires may cause the spread of hazardous materials, especially hydrocarbons from ferries and storage tanks. The types of ferries passing through the jetty can be hazardous and may be in danger of spilling during a fire or another incident. Fires may also ignite when the ferries are not being operated or even supervised.

e) Operation and Maintenance

Other sources of fires in ferries and jetties include those caused during maintenance and operation, including fuel transfer, welding, and cargo stowage.

f) Prevention for Jetty fire

- Firefighting system to be set up and the Jetty shall have its own independent firefighting arrangements. Shall maintain the fire main pressure at 7 kg/cm2.
- Identify smoking zone areas on the jetty and public area to avoid fire due to smoking.
- Enforcing an inspection program of all electrical equipment at regular intervals can prevent some fires from occurring. This can be done by either the jetty management or the fire department themselves.
- Ensuring that the fueling pumps and pipes are safely installed is also important in minimizing fires due to fuels.
- Another prevention strategy is to require that fire extinguishers be located within certain distances of each other, or to keep other means of fire protection equipment in specific location soft he jetty and public area.
- Fire tenders to be located at each berth.
- Signage to be provide notification to the public and staff of restrictions that apply to certain areas or facilities within

the jetty and public area. Signage should be present at specific locations, such as fueling procedures at fueling stations, as well as throughout jetty and terminal. Signage including 'No Smoking' signs, fire safety signs, hazardous materials storage signs, and evacuation route signs will be present at the jetty.

- A manually activated electric fire alarm and an automatic fire alarm that is audible through the jetty and public area is distinguishable from any other signal will be provided.

4. RESULTS AND DISCUSSION

4.1 Results of Hazard Identification:

In the commercial vehicle manufacturing industry, a thorough hazard identification process was conducted to assess potential risks to workers, equipment, and the environment. The following hazards were identified:

Mechanical Hazards: Heavy machinery and equipment used in assembly lines and fabrication processes pose risks of entanglement, crushing, and impact injuries.

Chemical Hazards: Various chemicals and solvents utilized in painting, welding, and cleaning processes present risks of skin irritation, respiratory problems, and fire hazards.

Ergonomic Hazards: Repetitive tasks, awkward postures, and lifting heavy components contribute to ergonomic hazards, leading to musculoskeletal disorders and injuries among workers.

Electrical Hazards: Improper wiring, exposed circuits, and malfunctioning equipment pose risks of electric shock and fire incidents.

Fire and Explosion Hazards: Combustible materials, welding activities, and flammable liquids increase the likelihood of fire outbreaks and explosions in manufacturing facilities.

Noise Hazards: Prolonged exposure to high levels of noise from machinery and equipment can result in hearing loss and other auditory health issues among workers.

5. CONCLUSION

In conclusion, effective hazard identification and risk assessment are crucial elements in ensuring the safety and well-being of workers and the overall success of commercial vehicle manufacturing operations. By implementing robust risk mitigation strategies and fostering a culture of safety, companies can minimize workplace accidents, protect their workforce, and uphold regulatory compliance standards. Continuous improvement and proactive hazard management practices are essential for sustaining a safe working environment and achieving long-term success in the industry.

REFERENCES

[1] Abdelrahman I., M., Abdelrahman M., R., Yasmin A., Yomna N., E., Menatalla, K., & Ahmed, M. (2021). Supply Chain Risk Assessment Using Fuzzy Logic. 2021 3rd Novel Intelligent and Leading Emerging Sciences Conference (NILES). https://doi.org/10.1109/niles53778.2021.9600100.

[2] Akmal G, P., Betty, P., & Farisya, S. (2021). Risk Analysis in the Preparation of a Business Continuity Plan (BCP) in it Services: a Case Study of Universitas Indonesia. Computer Science and Information Technology Trends. https://doi.org/10.5121/csit.2021.112209.

[3] Anis M. K., Nishika, R., & James T. N. (2015). Utilization of Risk Management with in Small Businesses : A Case Study of 5 Selected Black Owned Businesses in Johannesburg (South Africa). International Journal of Approximate Reasoning. https://doi.org/10.12816/0014608.

[4] Aomduan, J., & Chaiyaporn, K. (2022). Cybersecurity Risk Assessment for Insurance in Thailand using Bayesian Network Model. 2022 Joint International Conference on Digital Arts, Media and Technology with ECTI Northern Section Conference on Electrical, Electronics, Computer and Telecommunications Engineering (ECTI DAMT & NCON). https://doi.org/10.1109/ectidamtncon53731.2022.9720387.

[5] Arnauld-Maximilian, S., Ronald, V.-T., & Amaury-Alexandre, S. (2022). Assessing Relations between Sustainable Business Models and Digital Transformation: A Bibliometric Analysis. 2022 Portland International Conference on Management of

Engineering and Technology (PICMET). https://doi.org/10.23919/picmet53225.2022.9882816.

[6] Arne A. A., & Sutrisno. (2022). The Effect of Profitability, Asset Structure, Business Risk, and Liquidity on Capital Structure in Health Sector Companies Listed on the Indonesia Stock Exchange. International Journal of Economics, Business and Management Research. https://doi.org/10.51505/ijebmr.2022.6614.

[7]Berger, T. (2022). Human Resource Risk Management Concepts. AHFE international. https://doi.org/10.54941/ahfe1002796.

[8] Bondarenko, S., Shlafman, N., Kuprina, N., Kalaman, O., Moravska, O., & Tsurkan, N. (2021). Planning, Accounting and Control as Risk Management Tools for Small Business Investment Projects. Emerging Science Journal, 5(5), 650-666. https://doi.org/10.28991/esj-2021-01302