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# RISK ASSESSMENT AND HAZARD EVALUATION IN AUTOMOTIVE INDUSTRIES

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**ABSTRACT**
It is to identify the hazards to assess the associated risks and to bring the risks to tolerable level. Shock absorber activity because of the engineering view of the operation, complexity of the systems, procedures and methods always involves some amount of hazards. Hazard identification and risk analysis is carried for identification of undesirable events that can leads to a hazard, the analysis of hazard mechanism by which this undesirable event could occur and usually the estimation of extent, magnitude and likelihood of harmful effects. It is widely accepted within industry in general that the various techniques of risk assessment contribute greatly toward improvements in the safety of complex operations and equipment. The objective of hazard and risk analysis is to identify and analysis hazards, the event sequences leading to hazards and the risk of hazardous events. As of my study from Tenneco automotive i have identified the problem from simple qualitative methods to advanced quantitative methods are available to help identify and analysis hazards. using these technique, we identified the Bump Cap Pressing machine has 50% of injuries when compared to other machines in Damper Assembly. In that machine 75 % of injuries by human error and 25% are machine Errors. So Implementation of safety light curtain device on machine to reduce the 75% of machinery hazards.

**Keywords:** Magnitude, Analysis hazards and Risk assessment.

## 1. INTRODUCTION

For any industry to be successful it should meet not only the production requirements, but also maintain the highest safety standards for all concerned. The industry has to identify the hazards, assess the associated risks and bring the risks to tolerable level on a continuous basis. Shock absorber manufacturing process being a hazardous operation has considerable safety risk to workers. Unsafe conditions and practices in automotive industries lead to a number of accidents and causes loss and injury to human lives, damages the property, interrupt production etc. Risk assessment is a systematic method of identifying and analyzing the hazards associated with an activity and establishing a level of risk for each hazard. The hazards cannot be completely eliminated, and thus there is a need to define and estimate an accident risk level possible to be presented either in quantitative or qualitative way. Because of the existing hazards of automotive process as an activity and the complexity of automotive machinery and equipment and the associated systems, procedures and methods, it is not possible to be naturally safe. Regardless of how well the machinery or methods are designed, there will always be potential for serious accidents. It is not possible for an external agency to ensure the safety of an organization such as an automotive company nor of the machinery or methods it uses. The principal responsibility for the safety of any particular process and the manner in which it is operated rest with the management of that automotive process. It is widely accepted within industries in general that the various techniques of risk assessment contribute greatly toward improvements in the safety of complex operations and equipment. In many industries there is legislative requirement for risk assessment to be undertaken of all hazardous equipment, machinery and operations taking account of the procedures used for operation, maintenance, supervision and management. Hazard identification and risk analysis involves identification of undesirable events that leads to a hazard, the analysis of hazard mechanism by which this undesirable event could occur and usually the estimation of extent, magnitude and likelihood of harmful effects. The objective of hazard and risk analysis is to identify and analysis hazards, the event sequences leading to hazards and the risk of hazardous events. Many techniques ranging from simple qualitative methods to advanced quantitative methods are available to help identify and analysis hazards.

## 2. OBJECTIVES

Keeping the aforementioned problems in mind, the project work has been planned with the following objectives

- Review of literature on Hazard Identification and Risk Assessment.
- Review of TCR & TIR in shock absorber manufacture and their analysis.
- Study of risk assessment methodologies.
- Application of Hazard Identification and Risk analysis for improvement of

## 3. SUSPENSION SYSTEM AND ITS TYPES

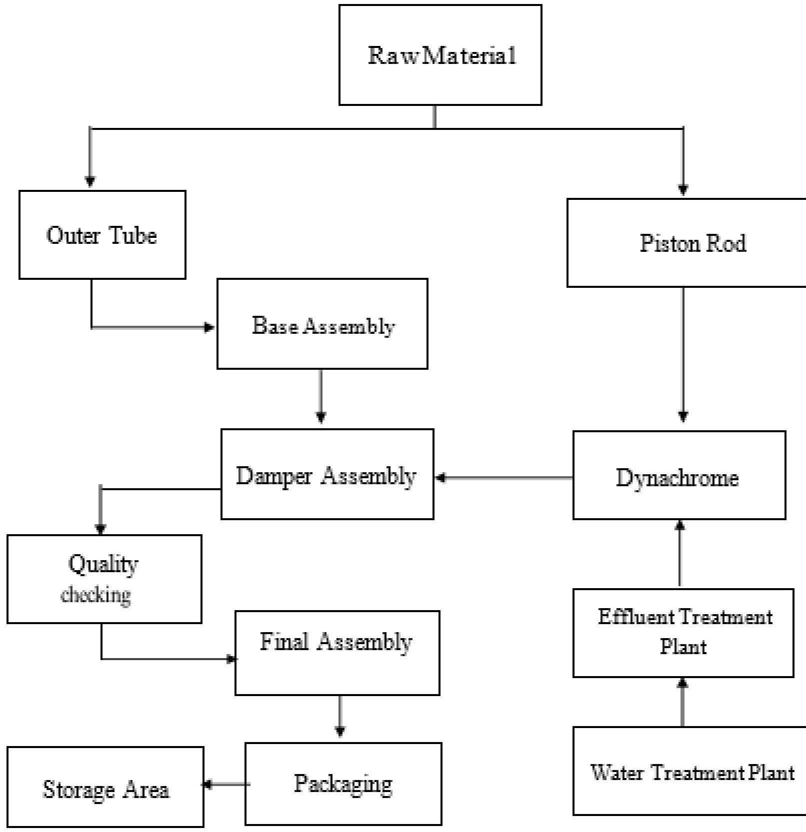
In the early 1900, s cars still road on carries spring. After all early drives had thinks to worry above than the quality their ride-like keeping their cars rolling over the rocks and ruts that often passed for roads Pioneering vehicle manufactures faced Yearly on with the challenges of enhancing driver controlled and passenger comfort. This yearly suspension design found front wheels attached to the axial using steering spindles and king prlt. This allowed wheels to pivot while the axial reamed stationary. Additionally, the up and down oscillation of the leaf spring was damped by device called a shock absorber. Those first shock absorbers were simply to arms connected by a bolt with friction disk between them resistance was adjusted by tightening loosening the bolt. As might the expected, the shocks were not very durable, and the performance left much to be desired. Over the year’s shock absorbers have evolved into more sophisticated designees.

**TYPES OF SUSPENSION USE**

- SHOCKS
- STRUT

## 4. WORKING PRINCIPLE

Shock absorbers are placed between the road wheels and the body. When the wheel comes across a bump on the road, it rises and deflects the shock absorbers, there by storing energy their in. On releasing, due to elasticity of the shock absorber material, it rebounds there by expanding the stored energy. In this way the shock absorber starts vibrating, of course, with Amplitude decreasing gradually on account of internal shock absorber material and friction of the suspension joints, till vibrations die down.




## 5. LITERATURE REVIEW

### QURESHI (2010) HAZARD AND OPERABILITY STUDY (HAZOP)

To identify the nature and scale of the dangerous substances and give an account of the arrangements for safe operation of the installation, for control of serious deviations that could lead to a major accident and for emergency procedures at the site. To identify the type, relative likelihood and consequences of major accidents that might occur; and to demonstrate that the manufacturer (operator) has identified the major hazard potential of his activities and has provided appropriate controls.

### KHAN AND ABBASI (2010) PROPOSED OPTIMAL RISK ANALYSIS (ORA), UK NUCLEAR POWER INDUSTRY

Hazard identification and screening. Hazard analysis using qualitative hazard assessment by optimal hazard and operability study (opt HAZOP). Probabilistic hazard assessment by modified fault tree analysis (MFTA). Consequence analysis which include development of accident scenarios and damage potential estimates. Risk estimates.

### DZIUBINSKI ET AL. (2006) STUDIED BASIC REASONS FOR MACHINE FAILURE

The probable consequences taking individual and societal risk into consideration and proposed methodology of risk assessment for hazards associated with hazardous substance transport in long pipelines. Taking that methodology as example, subsequent stages of risk analysis were considered paying special attention to the applied techniques and calculation models. A specific feature of this methodology was a combination of qualitative and quantitative techniques which offer a possibility of a full risk assessment.

## LAUL ET AL. (2006) IDENTIFIED HAZARDS

Hazards like (chemical, electrical, physical, and industrial) and potential initiators that could lead to an accident. Hazard analysis is used to evaluate identified hazards. Hazard analysis is done by "what if check list", Hazard and Operability (HAZOP) analysis, Failure Mode and Effect Analysis (FMEA), Fault Tree Analysis (FTA), Event Tree Analysis (ETA) and provided methods together with the advantages and disadvantages, for developing a safety document for chemical, non-nuclear facilities.

## JEONG ET AL. (2007) MADE A QUALITATIVE ANALYSIS BY HAZARD AND OPERABILITY METHOD (HAZOP) UNIVERSITY OF WESTERN SYDNEY

To identify the potential hazards and operability problems of decommissioning operations and concluded that the decommissioning of a nuclear research reactor must be accomplished according to its structural conditions and radiological characteristics and radiation exposure must be controlled to within the limitation of the regulation to perform the dismantling work under the ALARA principle safely. The applied HAZOP analysis to determine if the operation has potential to give rise to hazardous situation and found the range of hazardous events. They identified the route by which each of the hazardous events could be realized. After HAZOP analysis they introduced MO-HAZOP program which calculates probability of an event which is the product of probabilities of every factor.

## 6. METHODOLOGIES FOR RISK ANALYSIS

The objective of risk analysis is to produce outputs that can be used to evaluate the nature and distribution of risk and to develop appropriate strategies to manage risk. Events or issues with more significant consequences and likelihood are identified as „higher risk" and are selected for higher priority mitigation actions to lower the likelihood of the event happening and reduce the consequences if the event were to occur. Qualitative methods use descriptive terms to identify and record consequences and likelihoods of the events and resultant risk. Quantitative methods identify likelihoods as frequencies or probabilities. They identify consequences in terms of relative scale (orders of magnitude) or in terms of specific values (for example estimate of cost, number of fatalities or number of individuals lost from a rare species). For both qualitative and quantitative methods, it is important to invest time in developing appropriate rating scales for likelihood, consequence and resultant risk. The full range of risk situations likely to be encountered within the scope of the exercise should be considered when developing rating scales.

### 6.1 QUALITATIVE METHODS

Qualitative approaches to risk assessment are the most commonly applied. Qualitative risk assessment methods are quick and relatively easy to use as broad consequences and likelihoods can be identified and they can provide a general understanding of comparative risk between risk events, and the risk matrix can be used to separate risk events into risk classes.

Qualitative approaches are best used as a quick first-pass exercise where there are many complex risk issues and low-risk issues need to be screened out for practical purposes. Qualitative approaches have some shortcomings compared with more quantitative approaches. Key criticisms are that qualitative methods are imprecise it is difficult to compare events on a common basis as there is rarely clear justification of weightings placed on severity of consequences and the use of emotive labels makes it difficult for risk communicators to openly present risk assessment findings.

| Risk Rank Likelihood x Consequence | L1 Almost certain | L2 Likely | L3 Possible | L4 Unlikely | L5 Rare |
|---|---|---|---|---|---|
| C1 Catastrophic | 1 | 2 | 4 | 7 | 11 |
| C2 Major | 3 | 5 | 8 | 12 | 16 |
| C3 Moderate | 6 | 9 | 13 | 17 | 20 |
| C4 Minor | 10 | 14 | 18 | 21 | 23 |
| C5 Insignificant | 15 | 19 | 22 | 24 | 25 |

**Table: 1 A qualitative method for the classification of risks**

Qualitative approaches are best used as a quick first-pass exercise where there are many complex risk issues and low-risk issues need to be screened out for practical purposes.

## 6.2 SEMI QUANTITATIVE METHODS

Semi-quantitative approaches to risk assessment are currently widely used to overcome some of the shortcomings associated with qualitative approaches. Semi- quantitative risk assessments provide a more detailed prioritised ranking of risks than the outcomes of qualitative risk assessments. Semi-quantitative risk assessment takes the qualitative approach a step further by attributing values or multipliers to the likelihood and consequence groupings. Semi-quantitative risk assessment methods may involve multiplication of frequency levels with a numerical ranking of consequence. Several combinations of scale are possible

| | | Consequence Level | | | | |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| Likelihood level | Descriptor | Insignificant | Minor | Moderate | Major | Catastrophic |
| 5 | Almost Certain | 5 | 10 | 15 | 20 | 25 |
| 4 | Likely | 4 | 8 | 12 | 16 | 20 |
| 3 | Possible | 3 | 6 | 9 | 12 | 15 |
| 2 | Unlikely | 2 | 4 | 6 | 8 | 10 |
| 1 | Rare | 1 | 2 | 3 | 4 | 5 |

| RISK RATING |
|---|
| EXTREM |
| HIGH |
| MODERATE |
| LOW |

**Table 2: Example of a Basic Semi-Quantitative Risk Rating Matrix**

semi-quantitative risk matrix where the likelihoods and consequences have been assigned numbered levels that have been multiplied to generate a numeric description of risk ratings. The values that have been assigned to the likelihoods and consequences are not related to their actual magnitudes but the numeric values that are derived for risk can be grouped to generate the indicated risk ratings. In this example, Extreme risk events have risk ratings greater than 15, High risks are between 10 and 15. An advantage of this approach is that it allows risk ratings to be set based on the derived numeric risk values. A major drawback is that the numeric risk values may not reasonably reflect the relative risk of events due to the possible orders of magnitude differences within the likelihoods and consequences classes. In many cases the approach used to overcome above drawbacks has been to apply likelihood and consequence values that more closely reflect their relative magnitude, but which are not absolute measures. The semi-quantitative risk matrix ofTable1.4 shows the relative risk values that would be derived by replacing the qualitative descriptions of likelihoods and consequences with values that better reflect their relative order of the magnitude and provide more realistic relativity within each class.

| | | Consequence Level | | | | |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| Likelihood level | Descriptor | Insignificant | Minor | Moderate | Major | Catastrophic |
| 1 | Almost Certain | 1 | 10 | 100 | 1000 | 10000 |
| 0.1 | Likely | 0.1 | 1 | 10 | 100 | 1000 |
| 0.01 | Possible | 0.01 | 0.1 | 1 | 10 | 100 |
| 0.001 | Unlikely | 0.001 | 0.01 | 0.1 | 1 | 10 |
| 0.0001 | Rare | 0.0001 | 0.001 | 0.01 | 0.1 | 1 |

**Table :3 Risk points for semi quantitative matrix**

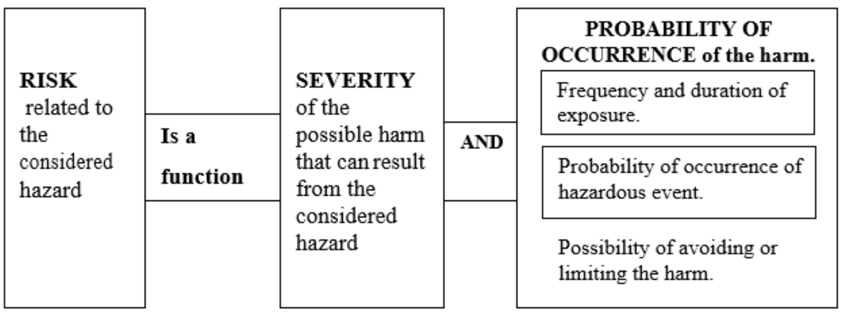
In this example the risk assessment clearly indicates that there is order of magnitude difference between likelihood classes and also between consequence classes. Using this approach, it is possible to derive numbered risk levels by multiplying likelihood and consequence levels for each cell of the matrix. For example, a risk event which is possible (likelihood level = 0.01) and would have a major consequence (consequence level = 1000) would show a risk level of 10. If the issues were comparable then this event would pose same risk as another event which was, for example likely (0.1) but with lower, moderate (100), consequences.
The matrix of Table 3.7 also shows that in this particular case the risk ratings have been weighted to place more emphasis on higher consequence events. This is frequently done to reflect an organization's lower tolerance of higher consequence events. This step can be difficult to justify and can be misleading in over emphasizing some risk events. Semi-quantitative risk assessments methods are quick and relatively easy to use clearly identify consequences and likelihoods. They usually provide a general understanding of comparative risk between risk events and are useful for comprehensive risk assessments.

## 6.3. QUANTITATIVE METHODS

Quantitative risk assessment is increasingly applied in the shock absorber industry due to business requirements to support financial decisions, evenly compare financial risks with environmental and social risks, and to demonstrate transparency, consistency and logic of approach. However quantitative risk approaches often are not intuitive and require some up-front learning investment by decision makers. Quantitative risk assessment is used across the full range of risk applications from deriving preliminary first-pass separation of risk events to much more comprehensive assessments. The comprehensive assessments can derive detailed risk profiles for priority ranking, estimates of the costs that may be incurred due to risk events, input to financial models and a basis for cost-benefit analysis. Quantitative risk assessment follows basic risk assessment approach to its full extent by attributing absolute values to likelihood and consequences. Estimates of likelihood are made in terms of event frequency or probability of occurrence of the risk event. Estimates of consequence can be made using any consistent measure selected according to the nature of the application. The risk quotient is used to differentiate on a comparative basis between the risks events using a consistent measure of risk and to identify those events that pose the most risk. Where consequences are expressed in financial terms, the risk quotient is equivalent to the commonly used term expected cost‟ or „expected value”.

## 7. RISK ASSESSMENT

Risk assessment is the process used to determine likelihood that people may be exposed to an injury, illness or disease in the workplace arising from any situation identified during the hazard identification process prior to consideration or implementation of control measures. Risk occurs when a person is exposed to a hazardous situation. Risk is the likelihood that exposure to a hazard will lead to an injury or a health issue. It is a measure of the probability and potential severity of harm or loss. Risk assessment forms crucial early phase in the disaster management planning cycle and is essential in determining what disaster mitigation measures should be taken to reduce future losses. Any attempt to reduce the impact of disaster requires an analysis that indicates what threats exist, their expected severity, who or what they may affect, and why. Knowledge of what makes a person or a community more vulnerable than another added to the resources and capacities available determines the steps we can take to reduce their risk.




## 7.1 TYPES OF HAZARD IDENTIFICATION AND RISK ANALYSIS

There are three types of hazard identification and risk assessments:

Baseline Hazard Identification and Risk Analysis;
Issue-based Hazard Identification and Risk Analysis; and
Continuous Hazard Identification and Risk Analysis.

They are all inter-related and form an integral part of a management system. A brief description of each of the three types of Hazard Identification and Risk Analysis is given below:

## 7.2 THE INTER-RELATIONSHIP BETWEEN TYPES OF HIRA

The relationship between the different types of HIRA is as illustrated in Figure. The figure illustrates

Risk profiles are used for planning the issue-based HIRA action programme.

Provides clear guiding principles for compatibility so that the issue-based HIRA and continuous HIRA are more effective enabling continuous improvement.

Codes of practice, standard procedures and management instructions etc. and new information from issue-based HIRA can be used to improve on the continuous HIRA and update the baseline HIRA so that it remains comprehensive.

The issue-based HIRA and baseline HIRA draw from the data captured by the continuous HIRA process to be effective.

The risk management process serves management.

### Step 1 Hazard Identification

The purpose of hazard identification is to identify and develop a list of hazards for each job in the organization that are reasonably likely to expose people to injury, illness or disease if not effectively controlled. Workers can then be informed of these hazards and controls put in place to protect workers prior to them being exposed to the actual hazard.

**Step 2 Risk Assessment**

Risk assessment is the process used to determine the likelihood that people exposed to injury, illness or disease in the workplace arising from any situation identified during the hazard identification process prior to consideration or implementation of control measures.
Risk occurs when a person is exposed to a hazard. Risk is the likelihood that exposure to a hazard will lead to injury or health issues. It is a measure of probability and potential severity of harm or loss.

**Step 3: Risk control**

Risk control is the process used to identify, develop, implement and continually review all practicable measure for elimination or reducing the likelihood of an injury, illness or diseases in the workplace.

**Step 4: Implementation of Risk Controls**

All hazards that have been assessed should be dealt in order of priority in one or more of the following hierarchy of controls
The most effective methods of control are:

Elimination of hazards
Substitute something safer
Use engineering/design controls
Use administrative controls such as safe work procedures
Protect the workers i.e. By ensuring competence through supervision and training, etc.

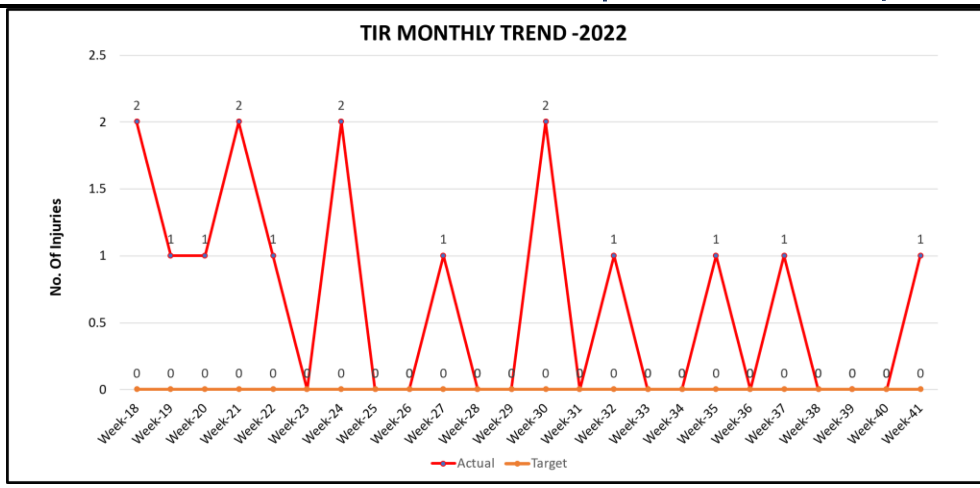
Each measure must have a designated person and date assigned for the implementation of controls. This ensures that all required safety measures will be completed

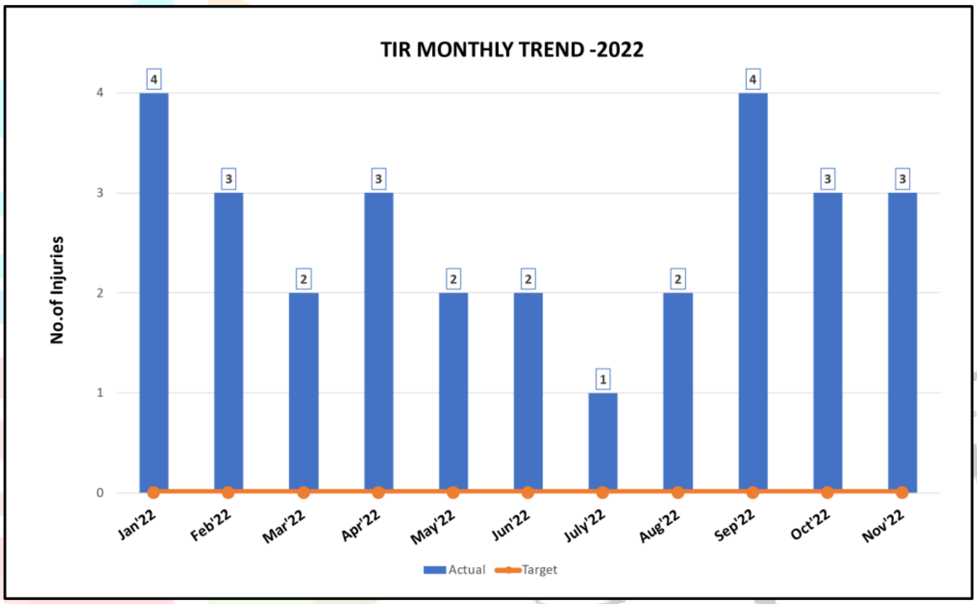
**Step 5: Monitor and Review**

Hazard identification, risk assessment and control are an on-going process. Therefore, regularly review the effectiveness of your hazard assessment and control measures. Make sure that you undertake a hazard and risk assessment when there is change to the workplace including when work systems, tools, machinery or equipment changes. Provide additional supervision when the new employees with reduced skill levels or knowledge are introduced to the workplace.

## 8. RESULT OF RISK ASSESMENT

According to Preliminary hazard survey and the hazard identification using Risk Assessment in the various stages of process, equipment's, and working practices in machines, storage and handling of machines such as Welding area, rod assembly, Bump cap pressing machine, Oil filling Machine, Noise testing machines and other supporting machines, switchyard are clearly analyzed for its potential hazards, potential effects, and potential causes. The action results are calculated with severity (assessment of severance), probability of occurrences, like hood of detection of events with Risk Priority Number. Among the action result shows Machine Handling additional controls methods to reduce Physical hazards and Major injuries. The existing system of machine safety system is inadequate to avoid accident. The suggestion is given to Implementation of Safety Light curtain on Bump Cap Pressing Machines to minimize the minor injuries up to 80 % in Machine




## 9. CONCLUSION

The first step for emergency preparedness and maintaining a safe workplace is defining and analyzing hazards. Although all hazards should be addressed, resource limitations usually do not allow this to happen at one time. Hazard identification and risk assessment can be used to establish priorities so that the most dangerous situations are addressed first and those least likely to occur and least likely to cause major problems can be avoiding. while implementing the safety light curtain will remove 50% of accident. The recommendations are provided to avoid the occurrence of such hazards. Safety instructions, extract of risk rating matrix and safe operating procedures were updated.

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