Management and Optimization of Hazards In Working Industries

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Abstract: Industry isoneofthe oldest,anditisbeing realizedallover the worldthattheindustry has cometooccupy animportantposition inthe nationaldevelopmentprograms.Moreover, all overthe industry employsavery largeamountofmanpower.Still,very little attentionhasbeenpaid so fattothedevelopment ofindustry onscientificandorganized lines. Thereisnoworthwhile efforttousethe appropriate technologyin spite ofvastscope, variety, volume of the works, talent and resourcesin the developingcountries. The safety in Industry isone of the important measure to be takenbuthassomewhatbeenneglectedin the industry. Unfortunately to some extent, thishappensnotonly at themicrolevel buteven ona macrolevel. It must be accepted that the industryhastobeoperatedonscientificlines andithastocatertotheeconomicandsocial well-being ofallthoseinvolvedinit. Thestudy includeshow tointroducenew practicesforsafe guardof the workers fromtheworkplacehazardsintheindustry and optimizing hazards.

KEY WORDS:*Common Hazards and factors effecting, Control of Hazards, Analysis of Hazards, Safety Measures, Prevention techniques and Implementation.*

I.INTRODUCTION TO COMMON HAZARDS:

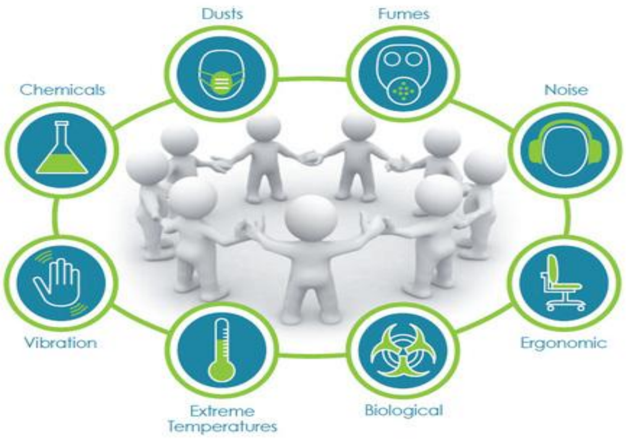
There are differenttypes ofindustrialhazards, whichareclassifiedonthe basisoffactors that affecttheman atwork.

The chemical factorsinclude theFireand Explosion, toxicchemicals,smokepresentatthe working place, theairborneconcentrationof the dustparticles,denseness offumeatthework place,vaporpressure, the toxicgasespresentat the workplace.

Themechanicalfactorsincludethetrappingof anobject, contactwith the loosepartof machinery,ejection ofany partor thehigh pressure engineoil.

The ergonomic factor includes the improperly designed tools, the unplanned plant layout, insufficientspace,wrong workingmethodand uneven workingposture.

The biological factor includes the effluentwater, theportablewater,method offoodhandling and personalhygiene.



These factors include the physicalcondition like the lightat thework place,noiseat thework place,thetemperaturevariationfrom thenormal temperature,pressurevariation from the atmosphericpressure,the effect ofultraviolet radiation, infraredradiation,ionizing radiation whichincludes alphaparticles-betaparticles and gamma particles anddifferentatomic rays.

II. CONTROL OF WORK PLACE HAZARDS:

The mostof the hazardstakeplacedue to the humanerrororduetothe unsafeenvironment, theseunsafe environmentand theerrors are controllable ifaproperplanning isdoneand the instructionsare followed. The proper job design is themostefficientmethodofcontrolling the hazards. The jobdesign isthemostefficient method ofcontrolling the hazards. The job designistheconsciously plannedstructuring of work effort performedby an individualorateam ofpersons.Good jobdesignmustanswer thejob-related questions such as-

1. What workisto beperformed
2. Who is to performthe work
3. Where theworkisto be done
4. Whenthe workis to be done
5. Whythejob is necessary
6. How should the work be accomplished

Fig: 2.1

1. PHYSICAL HAZARDS:

a. UltravioletRays*:* Thepropercontrolon ultraviolet raysisvery necessary fromthe humanhealthpointofviewattheworklaces thiscanbeachievedbytheproperisolationof the system and by using the appropriate personnel protectiveequipment’s. The placeat which there is acontinuousexposureof the ultraviolet raysthe continuousmedical treatment and checkup is must.

b. Radiation:Theeffectfromtheinfrared radiation canbeminimizedby properly enclosing theoperating system, by theuseof reflectivescreenandby thehelpofpersonnel protective equipment.

c. ***AtomicRays:***Thecontinuousexposure totheatomicrays isvery hazardous,thiscanbe controlledby thepropersealing ofthe reactor, reduction ofexposuretimeandproperprotective dress againstradiation.

d. TemperatureandHumidity:Somedata on accidents in relation to thetemperaturereveal a ratherstrange phenomenon. The studies conductedshow an increase inaccidentsboth with the decreaseandincreaseoftemperature froman optimumof65°F-69°F.

Heatcouldbegainedby thebody through convection(C), radiation (R)andtheproduction ofbody heatthroughmuscularactivity andbasal metabolism (M).Similarly,theheatlossis throughevaporation (E),convection and radiation.Thereforeheatbalanceequationmay be expressed as

M ±R±-E = 0 or
E = M±R±C

Nowtherateofevaporationdependsuponthe sweatingmechanismofthebodyanduponthe relative humidity or water pressure of the environment inwhichthe individualis working. Heatmaybetroublesomeundertwoconditions: warm-moistandhot-dry.Warm-dryconditions donotposeaproblemwhereasinahot-moist climateitwould be impossibleto survive. However,whereheatis radiated,ameliorationof thisconditionwilldepend onpreventing theheat from falling o the body or, where this is possible, removing the workman from the environmentatappropriate timesto allowhimto cooloff.

e. VisualEnvironment:Themajority of industrialtaskswilldepend fortheirefficiency of adequatevisionand thereforelighting arrangementmay playanimportant role in determining the efficiency with whichtask are carried outapartfromdirectlighting standards,thereare someotherimportantfactors,whichcan Affectperformanceandrateofaccidents. Thecontrasts between thesurroundingsandthetaskbeingperformed,thecolor schemesandthepresence andabsenceofglarecouldgreatlyinfluencetheoverallefficiencyand effectiveness ofthework.

f. Vibration:Duringwork,apersoncould befrequentlysubjectedtovibrationfrom the various resources. Theeffectofvibrationand movementsupon thepersonmay rangefrom motion sickness through slightdiscomfort to physicaldamage. A relationship ata tolerable limitbetween theamplitude(A)andfrequency (F) ofa vibrationasfollows:

-AF3=2forthelow frequencyvibration1 to6 cyclesperseconds

-AF2=1/3formediumfrequencyvibration6to60 cyclesperseconds.

-AF=1/60forhighfrequency vibration above60 cyclespersecond.

However,itisdifficult to makespecific design recommendationwhich willensures that the effectsofvibrationonefficiencyareminimal. Notmuchattention isgiventovibrationbecause eventhepeople/operators themselvesfeel that theyarepaid, inpart atleast, totolerate discomfort (which can include thatdue to vibration). Itappears mostoperators accept vibration provided thatitnotcauses actual physicaldamage.

g. Noise:Noise can be defined as unwanted sound. Noise could be a frequent causeoffatigueandirritationresulting inlossof output. The ear isquitesensitive. The risk of damagetotheearappears tobe greatestfrom frequency of soundsbetween2400 to 4800 cyclespersecond.Hearing losesmay increase withage.For instanceat theageof50years, hearing lossof50decibelsmightbeexpected above1200cyclespersecondand5decibelsat125 cycles per second compared with the hearingoftheindividualofthe age of20.Someformofearplugs,orsimplecottonwool may provideprotection againstunavoidable noise, which mightbecheap and effective preventiveremedy. There arevarious waysof reducing noise. Probably at themostimportant methodis the reduction ofnoiseatthesource itself. Alsothinkof isolatingthe equipment from thesurrounding structureoritstotalenclosure to prevent the noise spreading, or by mounting noisemachineson resilientbases.

2.CHEMICAL HAZARDS:

a. Fire and Explosion:The fire and explosion is the mostcommonhazardinalltypesofindustry thiscanbecontrolledbythe carefulnessoftheworkers workingatsite.By The schedule preventive maintenance, through supervision. Keeping the fire extinguisheringood operating condition, personal protectionriskassessmentand followupof recommendation, proper training andguidance, strictcompanylaws.

b. Dust:Thiscanalsobecontrolledbythe properselectionofsiteorby thespraying of water while handling the dust producing material,theproperexhaustsystem and ventilationsystem is themosteffectivemeasure, useofpersonnelprotectiveequipment.

c. Smoke:Theeffectofsmokecanbe minimized by the proper design of the ventilationsystem andexhaustarrangementand by maintainingproperairand fuelratio

d. Fumes:Thehazardoffumescanbe reducedby theproperventilationsystem and exhaustarrangementandby using proper personnelprotective equipment.

e. ToxicChemicals:Thiscanbecontrolled by theproperselectionofthestoring vessel, properhandling ofthematerials,safety training withsupervision,engineering methods,and personnelprotective equipment.

*3.*ERGONOMICHAZARD

Everyindustrialsystemconsistsofsomeorall of the following components:hardware (the physical aspects), software (non-physical aspects)andthephysical environmentandthe organization.Anobjectiveofthedesigner isto arrangethesecomponents togiveaharmonious andefficientoperation. Anobjectiveof ergonomic istomatchorprovide theinformationtomatchthe variousotherpartsof thesystemtothecharacteristicandtheabilities ofthepeopleinvolved in it.By utilizing ergonomics,thedesigner'sopportunitytocreate asystem,whichreliably achievesitsfunctions, are improved.Ergonomicsis somewhat synonymouswith human factorswith engineering,whichisafieldofstudy concerned with theabilitiesand limitations ofhuman beingsin thedesignoftools, instrumentsand work places. Theproperworkmethod,safe operationprocedure,mechanizedsystem and job safetyanalysiscancontrol thesetypesofhazard. The proper layoutand arrangementforproper working area, good housekeeping can also control this.Thetraining andproperinstruction before inductingthemtojob arealso some ofthe controllable measures.

4. MECHANICAL HAZARDS:

Thesetypeofhazardsgenerally takesplacesdue to improper training, carelessnessof the employee, impropersupervision, management failure,system failureetc. So,thesehazardsare effectivelycontrolledbythepropertrainingof theemployee,adynamicsafety engineer,proper supervision,properguarding ofthemachinery, proper housekeeping, and theappropriate use of the personnelprotective equipment.

III.CAUSES OF DIFFERENT INDUSTRIAL HAZARDS:

Allhazards are the results of someunsafe environmentorsome unsafe act. There are differentcausesfor thedifferenttypeofhazards and theyare as follows:

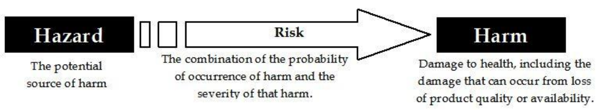


Fig: 3.1

1. PHYSICAL HAZARDS:

a. ***Noise*:**Themaincauseofthehazard due tonoise is the highnoise producedby the processequipment duetovery highspeed, friction pressure, impactetc.

b. ***Lights*:**The sufficientlightattheworkplace,notuniform flicker, glare, shadow, stroboscopic effect etc.

c. ***Vibration*:**Due to improper foundation for the heavy machinery, problemsin the parts of theprocess machineryetc.

d. ***AtomicRays***:Theradiationscoming out from the nuclear reactor in atomic powerplants.

e. **Pressure:**Any pressure below or above the atmospheric pressure as pertherequirementofworketc.

f. **Ultraviolet Radiation:**The hazard duetoultraviolet radiation taking place duringtheweldingtec.

g. ***Temperature*:**Improper ventilation system,heavy friction inside the machinery dueto improperoiling, dueto radiationfrom heattransfer medium technique.

h. ***InfraredRadiation*:**Thisisthemost common hazard in glass industry.

Fig: 3.2

2. CHEMICAL HAZARDS:

a. ***FireandExplosion:***Shortcircuitin electrical system, due to inflammable liquids, solids, gases, failure ofcable/windingetc.

b. ***Fumes*:**Condensation of particles after volatilization like lead, zinc and ferrousfumesetc.

c. ***Vapor:***Inthermalplants,wherethe highheating operation takesplace and indifferentprocessoperations.

d. ***Smoke*:**Improper burning of fuel and poor fuelquality, combustible substancewith themoisturecontent, leakagefromtheprocessvessel.I.C. machinesetc.

e. ***Dust:***Material handling, operationlikegrinding,crushingandfrom the dustyoutfield withtheimproperly designed ventilationsystem/.

f. ***Gasses*:**Handling of gases for process, welding, testing, cutting etc.and vesselleakage.

g. ***Toxic Chemicals:***Raw materials, process requirement, endproducts, enteringthrough various routesetc.

Fig: 3.3

3. ERGONOMIC HAZARDS:

a. ***Improperly Designed Tools:***The improperly designedtoolsorusing the toolswhicharenotdesignedkeeping in view thedesiredmethod of operation and the nature or work.

b. ***Wrong/InsufficientWorkMethods:***Lack ofsupervision,impropertrainingetc.

c. ***UnevenWorkingPosture:***Theuneven workingpostureorthewrongselection of the worker for the particular type of operation.

d.*PoorPlant/AreaLayout*:Theproper planningIthedesignstageitselfplayas amajortool topreventhazard. The insufficientworking space,haphazard placementof the machinery, inefficient housekeepingresults inhazard.

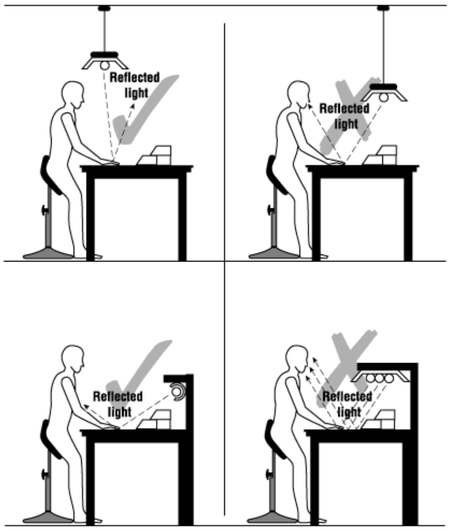


Fig: 3.4

4. MECHANICAL HAZARDS:

a. ***Trapping:***Thisisthecommonhazardin heavy machinery industry, it may always lead due to improper training, it may alsobeduetothe insufficient guardingsystem.

b. ***Contact*:**Thishazardtakesplacedueto thepersoncoming incontactwiththe moving parts ofthe machinery,and improperguarding.

c. ***Falling*:**Thismaytakeplaceduetothe falling of machinery part on the employee oritmaybeduetothefalling orworkerfromthe high rise machinery.

d. *Impact*:Thismay takeplacedueto improperhousekeeping, duetothe projectededgesof themachinery orof theindustrialbuilding.

e. *Entanglement:*Thishazardtakesplace due to the carelessness of the workeror maybe due totheloosewearing clothes.

Fig: 3.5

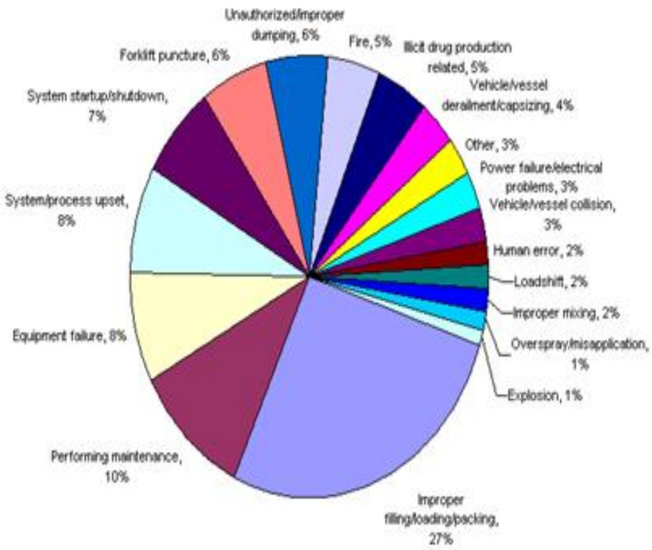


Fig: 3.6

IV. HAZARD EVALUATION TECHNIQUES:

Therearedifferenthazard evaluation techniques with their own merits and demerits; they are used as per the nature ofconstructionsites.Thedifferenthazard evaluationtechniquesare:

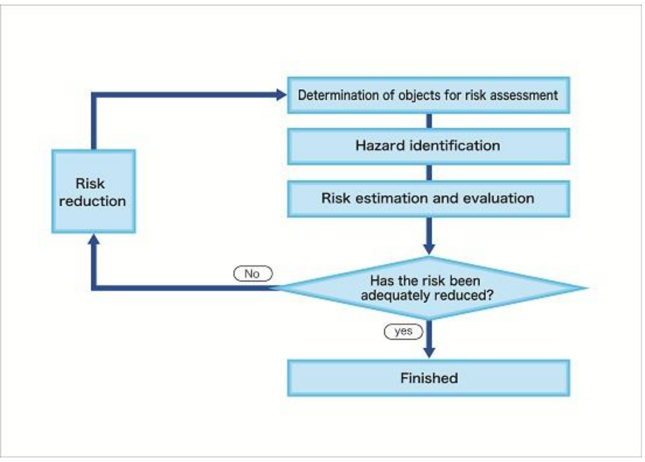


Fig: 4.1

A. JOBSAFETYANALYSIS:

Ajob safetyanalysis (orjob hazard analysis)isa procedure to make ajobsafe by
i. Identifyingthe hazardorpotentialaccidents associated witheach steptothejob and
ii. Developingasolutionforeachhazardthatwilleithere liminate orcontroltheexposure. Oncejobhazardsareknown,propersolutions can be developed. Some solutions maybe physicalchangesthatcontrolthehazardsuchas placingaguardoverexposedmovingmachine parts. Others may be job procedures that eliminateorminimizethehazard,suchas,safe pilingofmaterials.Jobsafetyanalysisisalso helpful in discovering elimination or safeguardingthemotions,positionsandactions thatare hazardous. Itaids in the determination of equipmentand tools needed forsafety. TechniquesofJob SafetyAnalysis:

a.Selectingthejob.
b.Breakingthejobdownintosuccessive steps.
c.Identifying the hazards and potential accidents.
d.Developing ways to eliminate the hazards and preventthe potentialaccidents.

B. HAZOP STUDY:

Analysisofspecificaccidents inconstruction industry isinvariably conductedby an investigating team,whichattemptsto establish the cause/causes, the result and the fault in designoroperating procedure isrectifiedto preventsimilaraccidentsinfuture.Learning by experience is inevitably expensivein termsof humansufferingsand financialloss.Hazard and operability study,orHAZOPSinshort isa provenmethodofproviding thecauseofan accident. Somebasicdefinitionsof thetermsfrequently usedin HAZOP STUDIESare:

a. Intention: The intensiondefineshow a particular construction activity is expected to operate. Thiscan takenumberofformsandcan beeither descriptiveordiagrammatic.Inmany cases itwillbe aflowsheetoraline diagram.

b.Deviation: Thesearedeparturefrom the intension which are discovered bysystematically applyingthe guide works.

c.Causes: Theseare thereasonswhy deviation mightoccur.Onceadeviationhasbeenshown tohaveaconceivableorrealisticcause,itcanbe treated asmeaningful.

d.Consequences: These aretheresultsofthe deviation mayoccur.

e.Hazards: Theseareall consequences,which can causedamage, injury or loss.

f.GuideWords: Therearesomesimplewords, whichareusedtoqualifytheintensioninorder to guide and stimulate the creative thinking process,and sodiscoverdeviations.

C. FAILURE MODES AND EFFECT ANALYSIS:

AFMEA tabulatesfailure modesofequipments andtheireffectsonasystemor aplant. The failuremodedescribes howequipments fails (open,close,on,off,leak etc.). Theeffectofthe failuremodeisdeterminedby thesystems responseto theequipmentfailure.A FMEA identifies single failure modes that either directlyresultsinorcontributesignificantlyto anaccident.Humanoperates errors are usually notexamineddirectly in FMEA,howeverthe effectsofamaloperation asaresultofhuman errorareusually indicatedby anequipment failuremode.A FMEAisnotefficientfor identifying anexhaustive listofcombination of equipmentsfailurethatleads to an accident.
The purposeofFMEAistoidentify single equipmentandsystemfailuremodesandeach Failuremode'spotentialeffectson thesystem or plant. This analysis typicallygenerates Recommendations, forincreasing equipment reliability thusimproving processsafety.The FMEA may be easily updated for design changesorsystem/plantmodifications.

D. FAULT TREEANALYSIS:

FaultTree Analysis is a technique thatmay be utilized to traceback throughthe chronological progression ofcausesandeffects thathave contributed to aparticular event,whetheritbe accident(industrialsafety)or failure.
Thefault treetoassistsin cause analysis, firstly t h e event, t h e accidents orfailure-must b e i d e n t i f i e d . Secondly, a l l t h e approximatecauses(contributoryfactors)must be i n v e s t i g a t e d a n d i d e n t i f i e d . Thirdly, e a c h approximate cause (i.e. Eachbranch of a Contributoryfactor) must betracedtoidentify andestablishall theconceivablewaysin which eachmighthaveoccurred. Eachcontributing factor or cause, thus identified is then studied furthertodeterminehow itcouldpossiblyhave happened, andsoon, until the source ofthe chain ofeventshasbeen highlighted, foreach branch ofthefault tree.

E. EVENT TREE ANALYSIS:

Aneventtreegraphically showsthepossible outcomesofanaccidentthatresultfrom an initiating event(aspecificequipmentfailureor humanerror.Aneventtreeanalysisconsiders the responsesofsafety systemsandoperators to the initiating eventwhendetermining the accident's potentialoutcomes. The resultof the EventTreeAnalysis are accident sequences, that is,setofthe failuresorerrors thatlead to an accidentoutcome in termsof the sequence of events thatfollowan initiatingevent.AnEventTreeAnalysis iswellsuitedor analyzingcomplexprocessesthathaveseveral layersofsafetysystem orenergyprocedures in place torespondtoinitiatingevents. EventTreeisusedto identify thevarious accidentsthatcanoccurinacomplexprocess. After these individual accident sequences are identified the specific combination of failures that can lead to the accidents can then be determined usingFaultTree Analysis.

F. BEHAVIOUR-BASED SAFETY ANALYSIS:

The BehaviorScience TechnologyInc.® (BST®) assessmentofsitehadsurvey scoresthatwereaboveaverage comparedto similar jobsites, indicating thatemployees regarded the projecta"good placeto work."

As its name indicates, behavior-based safety analysisisfocusedonbehavior.Behaviorsare theproperupstreamfocusforsafetyfortwo reasons:

a.At-risk task-related behaviorsarethefinalcommon pathwayforalmostallincidents.

b.Mostat-riskbehaviorscommonatsite are supportedsomehowby the cultureofthe site.

Behavior- basedsafetyisaprocessapproachto improvesafety performancebyhelping workshops to:

a.Identify safety-relatedbehaviorsthatare critical toexcellentperformance.

b.Gather data on workshop safety excellence.

c. Provideongoing,two-wayperformance feedback.

d.Remove system barriers to continue improvement.

Inaddition totheverbal feedback,thedata gathered by the observers isanalyzedcomputer softwareandreportsand chartsofworkshop performanceby printedandpostedas charts feedback.
Removingbarrierstocontinuousimprovement. Usingthecommentsandobservationdata,site personnelcantargetareas for improvement.
Another important barrier to continuous improvement involved fall operation. The identifiedsafe behaviorfor fallprotectioncalled forpersonneltoapply theirPPEbeginning with theclimb to theirworkstation, anduse itwhile workingatheights.

G. REALTIVE RANKINGTECHNIQUES:

RelativeRanking isactually ananalysisstrategy rather than a single, well defined analysis method. Thisstrategy allowshazardanalystto comparetheattributes of severalprocessesor activities todetermine whetherthey possess hazardous characteristics thataresignificantalso beused tocompareenoughtowarrantfurther study.
RelativeRanking canalso beusedtocompare several process sitting,designorequipments layoutoptions and alternative appears to be the "best"orleasthazardousoption. These comparisonsarebasedonnumericalvaluesthat representtherelativelevelofsignificancethat the analystgivesto each hazard.
The mainpurposeofusingRelativeRanking Methods istodetermine theprocessareaor

operationsthataremostsignificantwithrespect tothehazardoftheconcern.Bythismethodthe relationshipofprocessattributesarecompared to determinewhichareaspresentthegreaterrelative hazard orrisk?

CONCLUSION:

From the above study and analysis of hazards and its impact on the surroundings, it's very important to make the survey and implement considerable measures to avoid the danger ofany accidental mishaps which will lead to a saferprocess of outcomes in the industry.

Apparentlyit's common in every industry wherein hazards prevail, so every employee/ worker must be aware of the hazards and its preventive measures to optimize it, which ultimately contributes in generating more efficient production in short span of time without occurrence of any accidents. This paper consists of all the facts which contribute its safety and success of optimized hazards.

It's a great proverb **"PREVENTION IS BETTER THAN CURE"**, let's adopt it.

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