Occupational Safety Improvements by Lean Six Sigma Methodologies in a Manufacturing Industry

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Abstract: **The manufacturing company under consideration recorded the high accident rates for last few years. These accidents cause the organization the heavy man-day loss, the production loss and heavy costs of insurance. The objective of health and safety department at the manufacturing company was to set and improve accidents prevention system. The paper presents how does the six-sigma technique will help to evaluate the safety and environmental hazards in performance of organizations. It is observed that the study helped the management to measure, analyze and improve overall safety plan to protect the life and health of the employees.**

The paper discusses real life case where six sigma has been successfully applied at one of the Indian small scale units to improve safety in processes. The main aim behind this project lies to overcome those problems of the industries which are causing loss due to safety. In order to build up system capabilities and graduate towards higher sigma levels of operation, the backbone exercise of six sigma management system is reached by carrying out the failure mode effect analysis.

***Keywords*: Six sigma, DMAIC, Safety, Lean Manufacturing, Defects, Variation, Accidents**

I. INTRODUCTION

Generally it is needed to prevent accidents before it happens to ensure it happens to ensure safety of life. Various other safety programs are used in industries to improve safety. Six sigma is a highly disciplined process that helps us focus on developing and delivering near-perfect product and services. The word is a statistical term that measures how far a given process deviates from perfection. [1]The central idea behind six sigma is that if you can measures how many "defects" you have in a process and how to eliminate them. The same methodologies are applied to prevent accident to thus, enhancing safety.

II. DMAIC PHASES OF SIX SIGMA

We have applied the six sigma process on safety in a manufacturing firm. The company is situated in the middle of Nagpur. It is the central India's largest manufacturer of double roller machines. It is spread over an area of 5.5 acre with the built up area about 9000aq. meter their manufacturing facilities are ISO 9002 and IS 16949 certified that ensures reliability they are supplying their products throughout the country and exporting along foreign countries.

Objectives of six sigma:

- To improve the Worker's efficiency of working.
- To reduce the number of accidents occurring inside the Industry.
- To identify hazards and control risks while maintaining assurance that these risk controls are effective.
- To avoid the industrial production shut down.
- To avoid financial loss.
- To solve dispute like compensation, requirement by employees

III. APPLYING DMAIC TOOL IN ABOVE COMPANY

3.1Define Phase:

PDCA

In define phase the PDCA is one of the tool to identify the problems related to safety of workers and industry. PDCA helps to make plan for detecting the total inefficiencies in any plant . On the basis of PDCA data is collected and managed.

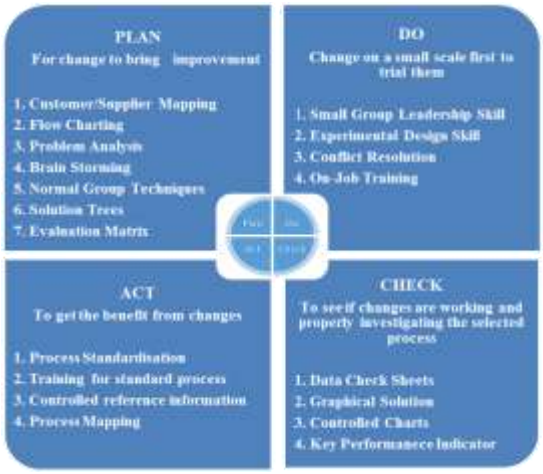


FIG:1 PDCA

SIPOC

Basically SIPOC is a define level tool helps to decide the direction of process or project flow and their benefits. SIPOC stand for Supplier Input Process Output Customer which defines the each point as below-

Supplier –Start point of any project from which project handover ahead.

Customer - Acceptance point of project at any level. Customer may be the supplier when he forward this project to other with some changes.

SUPPLIER	INPUT	PROCESS	OUTPUT	CUSTOMER
FIELD ENGINEER	PROJECT	WORK IS ASSIGNED	PRACTICING SAFE BEHAVIOURS	WORKER
AUTOMOTIVE DEPARTMENT	CONVEYORS	PEOPLE, TOOLS AND MATERIALS IDETIFIED	REDUCTION IN MANUAL HANDLING	WORKER
TRAINING CENTER	WORK METHODS	TRAVEL TO WORK SITE	ZERO INJURIES	WORKER
PRODUCT ENGINEER	SAFETY MATERIALS	COMPLETE HAZARD ASSESSMENT	SAFETY IN WORKING	WORKER
SAFETY DEPARTMENT	SAFETY RULES	CONSTUCTION WORK	CORRECTIVE ACTIONS	WORKER

FIG: 2 - SIPOC

Swot Analysis: It's a tool for strategic planning to help in decision making process. Each of these areas are received to identified the needs of the organization. The organization has direct control over internal factors. Internal benchmarking and communication will eliminate in a process. The organization has no control over external factors. SWOT analysis must start with a vision of a future or ideal state to judge all Strengths, Weakness, Opportunities and Threats.

	Helpful in Achieving Goals	Harmful to Achieving Goals
Internal	Strengths • Labours are skilled. • Management is efficient. • Plant layout is effective. • Workspace is large.	Weakness • Labours on contract basis. • Not proper safety protocols. • Maintenance programs not much effective.
External	Opportunities • Good Transport Facilities • Labour cost is quite low. • Easy availability of raw materials.	Threats • Safety rules not being followed. • No nearby hospitals. • Improper Molten Metal handling.

Table 1 SWOT Analysis

*3.2 Measure Phase***:**

The measure phase generally deals with the data generation related to accidents in company. It again deals with the statistical organizing of data and calculation of sigma level of that company on the basis of that data. The following bar graph shows the distribution of accidental data in per month.

A . Data Evaluation:

The survey was performed on number of workers and supervisors in the industry and filled questionnaires based on their responses. This provided us with data important for the calculation of sigma value for safety.

Let us take that industry works for 250 days in a year and the other parameters are as considered as follows:

Unit - Employee

Defects – Employee recordable injury.

Number of employees = 291

Number of injuries recorded =451

Opportunity for error in unit = 0.6/workday (250/year)

Defects per unit:

DPU= Total defects/total units

=155/291

= 0.5326.

Defects parts per million (ppm)

= (DPU/year *10^6)/opportunity for error in 1 unit

= 3050.6 ppm

Using given formula for conversion of ppm into sigma

= 0.8406 + square root ((29.37-(2.221ln (ppm))) = **4.2 Sigma**

Cause and effect diagram **:** The diagram shows causes of accident in industry and their effects. The diagram helps to study the industry in proper way. It again indicates the defect areas where the methodology is to be applied. Generation of proper solution is effective in causes and effects diagram. Following dig. is generated accordance to industry condition.

FIG:3 Cause and Effect Analysis

B. Graphical Representation

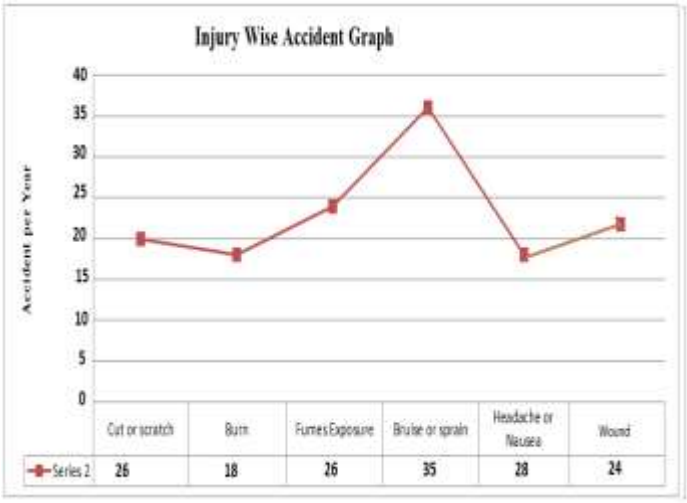


FIG:4 Accident Graph

C.5-S Audit

A 5-S(Sort, Straighten , Shine, Standardize, Sustain.) + Safety sheet is shown here. It requires to mark yes or no in the sheet and then to calculate section score. The total score is then divided by six to obtain audit score. This score on a 0 to 6 scale shows which section of the plants requires most attention and which can be taken care of later.

A 5S Audit sheet for Furnace Section is shown here. [3]

Similar Audits were conducted for all six sections of the plant. Their Audit score is given below:

1) Furnace Section : 2
2) Raw material storage Section: 2
3) Six inch working Mill Section : 2.1
4) Eight inch working Mill Section : 1.81
5) Sixteen inch working Mill Section : 2.0
6) Machining Mill Section: 2.34

Production – Safety and 5S Audit (Before)

Plant /Dept./Cell – **Raw Material Storage Section**
Audit Date - **10/10/2016**
Supervisor – **Devendra Bhosle**
Auditor - **PRG**
Total Score: **12/6 = 2** (Total score calculation : Total section score, then divide by 6 (1=yes/0=No))

SAFETY Keep clutter out of the area	Score	0	Are all the emergency exit clearly visible, not blocked and illuminated
		1	Are all extinguisher and emergency equipment visible, mounted , accessible with inspection up to date
		1	Are all employees wearing proper PPE (Shoes, Glasses, Ear plugs); if welding additional gears.
		0	Are floors free from oil, water, cords that may cause a fall?
		0	Are electrical panels accessible and proper procedures posted?
SORT Keep what is needed throw out the rest	Score	0	Are unnecessary and absolute item and scrap remove from the work area as well as no personal matter in the area.
		1	Is inventory (WIP and finished goods) properly identified and stored in the designed area.
		0	Are SQDIP cell board poster signs and notices current and up to date with proper revision control documentation
		1	Are work instruction and print organized accessible current contained and no hand written notes for the work to be done
		0	Are storage cabinets eliminated from form the area (storage cabinet should only be used as last resort
STRAIGHTEN A place for everything and everything in its place	Score	1	Are position of main corridors , aisles clearly marked
		0	Are all material drop zones Clearly marked in the green and aisles clear
		1	Are scrap and defective material separated and control in area and clearly marked.
		1	Are all drawing, information sheets, and shelves organized and clearly labeled.
		0	Are work area clearly marked easily accessible and does everything have a place and everything is in place.
SHINE Clean and check to reveal problem and improve the environment	Score	0	Are walls, floor and columns bright and clean(fresh paint)
		1	Are the light bulbs reflectors, top of machine, cabinet, material pins and fixtures clean and free to debris and dust
		1	Are the light bulbs in the operating conditions (Not burn out)
		0	Are work surfaces and equipment clean?
		0	Are the information boards and visual controls clean and readable?
STRANDARDIZE Apply common standards and visual management to the area	Score	0	Are 5S responsibilities identified and all employees trained
		1	Are all storage/ equipment area marked and labeled consistent understandably
		1	Is zone champion leadership standardized work defined by cell and completed on time. Is visual management standardized?
		0	Does supervisor LBW audit the success of 5S and the zone champion LBW
SUSTAIN Make the 5S system part of everyday life	Score	0	Are 5S audit done on time by the supervisor
		1	Are abnormal conditions visually and easily identifiable
		0	Are 5S improvements being incorporated regularly using counter measures sheet
		0	Is 5S audit score above 6.0 for the area
		0	Has progress been made on action plan since last review.
		0	Do all the documents have revision grades with correct revision being utilized for all controlled document

FIG:5 Safety Audit for raw material Section

Since Audit score of Furnace section is lowest, safety regulations in Furnace Section are first priority. The order of audit score gives us the sections in the plant which requires attention in a set preference.

3.3.Analyze Phase

The basic step followed under this phase is defining performance objectives, identifying various sources of errors and establishing process capability. We are using different statistical tools to analyze the cause of accidents that have been identified in previous phases. The tools used in this section are 5 Why Analysis, Root Cause Analysis and FMEA.

A. Failure Mode Effect Analysis (FMEA)[8]

Sr No.	Function/ Process	Failure Type	Severity	Occurrences	Detection	RPN
1	Unloading of Steel Bars.	Steel bars may fall onto the worker's body or foot.	8	8	8	150
2	Hot Rolling of Iron Bars.	Worker may come directly in contact with the hot iron bars without safety gears in 6 Inch Mill.	8	7	5	315
3	Safety Equipment.	During welding and other processes safety equipment not being used may harm workers.	7	6	5	210
4	Handling of Scraps.	Handling of raw material and scraps without gloves may cut fingers and injure hand.	6	6	4	144
5	Maintenance of Electric Wires.	Worker may undergo through electric shocks if electric wires lie uncovered around work surface.	6	5	3	75
6	No Gas Mask in Furnace Area.	Lack of gas mask in furnace area may harm the workers.	8	7	6	252
7	Machining of Metals.	The hot chips formed may harm the workers if prevention not taken.	6	6	4	120
8	Safety Gears not being Used.	Lack of safety gears in 16 Inch Mill may harm workers very badly.	8	8	7	504
9	General Maintenance.	Without proper safety equipment and gloves workers may get harm themselves working various activities.	6	7	5	175

Table 2 Failure Mode Effective Analysis

B. 5-Why + Safety Analysis [3]

A 5-Why Analysis Sheet for Furnace Section is shown below. Similar Analysis for all six departments of the industry were done. These sheets were then referred for the Root Cause Analysis of Problems identified.

ROOT CAUSE ANALYSIS – 5 WHY
Improper Sealing of Furnace

Originator's Name : PRG **[Date :** 25 AUG 2015

Problem Description:
The furnace for melting scraps of metals to make iron bars for angle manufacturing is not sealed properly. Hot gases and high temperature environment makes it difficult for workers efficiently.

5 Why's – "Why Made"

Why #1- Maintenance Staff
- Why #2 – Furnace sealing
  - Why #3 – Melting Scraps in the furnace
    - Why #4 – Furnace Section
      - Why #5 – Maintenance of furnaces is not on weekly basis.

5 Why's – "Why Missed" (If Applicable)

Why #1 – Maintenance Staff
- Why #2 – Furnace sealing
  - Why #3 – Melting scraps in the furnace
    - Why #4 – Furnace Section
      - Why #5 – Monthly maintenance plan

Corrective Actions	Who	When	Status
Slow pouring of molten metals into the mould	Maintenance staff	Process Working	Implemented
High quality construction material used.	Maintenance staff	Repair work	Implemented
Workers allowed in furnace only in extreme conditions.	Safety Manager	Furnace Online	Implemented

FIG:6 5-Why Analysis Sheet

C. Root Cause Analysis [5]

A Sample RCA report for the Furnace Department of the industry is shown here.As problems are identified and decisions are made we must make the decision on the best method for solving the issue. Similar Reports were made for all the six major problems identified in define phase.

Root Cause Analysis Report – 5 Why (Furnace)

Safety, Quality, Delivery, Productivity, Inventory, Other | Approvals: Manager, Production, Lean, Engineering, Quality, Safety | Root Cause, Corrective

Originator	Report Date	Customer Affected	Dept.
Devendra Verma	15 AUG 14	NIL	Furnace

Problem Description
Worker prone to slipping in furnace due to small handle on spade

Problem solving team members
Dhiraj Junghare, Pallavi Raut, Milind Nilose

Containment action/ protect the customer: Longer Handle provided, boundary to prevent tripping made. Date Completed: 20 AUG 14

Detailed description of problem(include details, photos & sketches)
Worker while pushing scraps metal in furnace for melting, accidentally stepped on sharp metal scrap and tripped. He fell into open furnace face.

Point of cause, where/how did the problem occur?
The spade handle being smaller than required him to go nearer to the furnace face than actually required. The short handled spade was selected by the worker itself. Long handled spade were available but in less quantity than required.

Root cause analysis and corrective actions – "why Made?"
Why did the problem occur?
Who: Workers in Furnace 1 Area
What: Worker fell into furnace while pushing scrap metal in furnace
When: 13:00 to 13:30 18 JUNE 14
Where: Platform for Scrap introduction into furnace
Why: Leg slipped while pushing scrap metal

Root Cause and analysis and corrective action – "Why Missed?"
Why was this problem not caught by normal system?
Number of workers used by furnace department increased in the week of occurrence of accident. Long handled spades were to be used but since all of them were in use, the worker ignored safety and used short handle spade.
Tools and their purchase is done on a monthly basis not weekly.

Corrective Action	Person Responsible	Due Date	Completion Date
1. Long handle Spades purchased and stored in tool section.	Basavaraj Rajan	20 AUG	18 AUG
2. Boundary around furnace face created	Bhaskaran Rai	20 SEPT	12 SEPT

Evaluate Corrective Action
Temporary corrective action undertaken, automation is proposed for avoiding the problem in future.

Standardize

Have we been trained to the standard?	Yes
Is the Standard adequate?	Yes
Did we follow the standard?	No

Knowledge sharing – Plan to share knowledge to other cells, sites
Report sent to Management, Safety, and all supervisors.

FIG: 7 . Root Cause Analysis for Furnace Department

We note down the improvements done and to see if each department shows effects of improvement we do a 5-S Audit again and see if the audit score for each department increases or not. The tools used in this phase are 5-S Audit, Safety Control Sheet, Safety Improvement Plan and Post Kaizen EHS Checklist.

A sample 5-S Audit done after improvement phase for the Furnace Section of the factory is shown here. [3]

Similar audits were done for all the six sections of the industry.Their Audit score is given below:

1) Furnace Section : 4.0

2) Raw material storage Section: 4.67

3) Six inch working Mill Section : 4.17
4) Eight inch working Mill Section : 4.5
5) Sixteen inch working Mill Section : 4.0
6) Machining Mill Section: 4.34

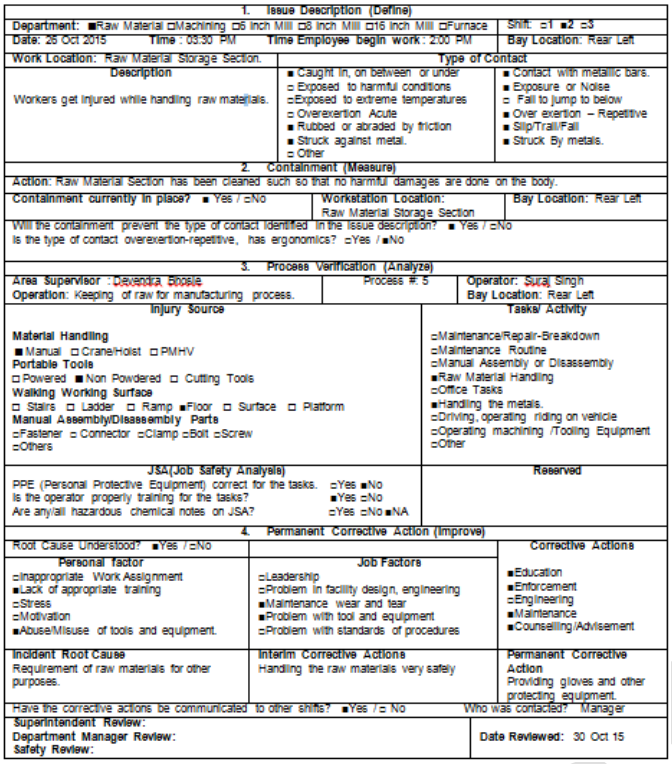
Production – Safety and 5 S Audit (After)
Plant /Dept./Cell – **Raw Material Storage Section**
Audit Date - **10/3/2016**
Supervisor – **Devendra Bhosle**
Auditor - **PRG**
Total Score: **28/6 = 4.67** [Total score calculation : Total section score, then divide by 6 (1=yes/0=No)]

SAFETY Keep clutter out of the area	Score	1 1 1 1 1	Are all the emergency exit clearly visible, not blocked and illuminated Are all extinguisher and emergency equipment visible, mounted , accessible with inspection up to date Are all employees wearing proper PPE (Shoes, Glasses, Ear plugs); If welding additional gears. Are floors free from oil, water, cords that may cause a fall? Are electrical panels accessible and proper procedures posted?
SORT Keep what is needed throw out the rest	Score	1 1 0 1 1	Are unnecessary and absolute item and scrap remove from the work area as well as no personal matter in the area. Is Inventory (VVIP and finished goods) properly identified and stored in the designed area. Are SQDIP cell board poster signs and notices current and up to date with proper revision control documentation Are work instruction and print organized accessible current contained and no hand written notes for the work to be done Are storage cabinets eliminated from form the area (storage cabinet should only be used as last resort
STRAIGHTEN A place for everything and everything in its place	Score	1 0 1 1 1	Are position of main corridors , aisles clearly marked Are all material drop zones Clearly marked in the green and aisles clear Are scrap and defective material separated and control in area and clearly marked. Are all drawing, information sheets, and shelves organized and clearly labeled. Are work area clearly marked easily accessible and does everything have a place and everything is in place.
SHINE Clean and check to reveal problem and improve the environment	Score	1 1 1 1 1	Are walls, floor and columns bright and clean(fresh paint) Are the light bulbs reflectors, top of machine, cabinet, material pins and fixtures clean and free to debris and dust Are the light bulbs in the operating conditions (Not burn out) Are work surfaces and equipment clean? Are the information boards and visual controls clean and readable?
STRANDARDIZE Apply common standards and visual management to the area	Score	1 1 1 1	Are 5S responsibilities identified and all employees trained Are all storage/ equipment area marked and labeled consistent understandably Is zone champion leadership standardized work defined by cell and completed on time. Is visual management standardized? Does supervisor LSW audit the success of 5S and the zone champion LSW
SUSTAIN Make the 5S system part of everyday life	Score	1 1 1 1 1 1	Are 5S audit done on time by the supervisor Are abnormal conditions visually and easily identifiable Are 5S improvements being incorporated regularly using counter measures sheet Is 5S audit score above 6.0 for the area Has progress been made on action plan since last review. Do all the documents have revision grades with correct revision being utilized for all controlled document.

FIG:8 Improved Safety Audit for raw material Section

D. Safety Control Sheet

The Safety Control sheet we used includes Define, Measure, Analyze and Improve prospects of the accident under consideration. It also includes a 5-Why analysis, Job Safety Analysis and sections for interim corrective action as well as permanent corrective actions.



1. Issue Description (Define)

Department: ■Raw Material □Machining □6 Inch Mill □8 Inch Mill □16 Inch Mill □Furnace | Shift: □1 ■2 □3
Date: 26 Oct 2015 | Time : 03:30 PM | Time Employee begin work : 2:00 PM | Bay Location: Rear Left
Work Location: Raw Material Storage Section.

Description	Type of Contact	
Workers get injured while handling raw materials.	■ Caught In, on between or under □ Exposed to harmful conditions □Exposed to extreme temperatures □ Overexertion Acute ■ Rubbed or abraded by friction ■ Struck against metal. □ Other	■ Contact with metallic bars. ■ Exposure or Noise □ Fall to jump to below ■ Over exertion – Repetitive ■ Slip/Trail/Fall ■ Struck By metals.

2. Containment (Measure)

Action: Raw Material Section has been cleaned such so that no harmful damages are done on the body.
Containment currently in place? ■ Yes / □No | Workstation Location: Raw Material Storage Section | Bay Location: Rear Left
Will the containment prevent the type of contact identified in the issue description? ■ Yes / □No
Is the type of contact overexertion-repetitive, has ergonomics? □Yes / ■No

3. Process Verification (Analyze)

Area Supervisor : Devendra Bhosle | Process # 5 | Operator: Suraj Singh
Operation: Keeping of raw for manufacturing process. | Bay Location: Rear Left

Injury Source	Tasks/ Activity
Material Handling ■ Manual □ Crane/Hoist □ PMHV **Portable Tools** □ Powered ■ Non Powered □ Cutting Tools **Walking Working Surface** □ Stairs □ Ladder □ Ramp ■Floor □ Surface □ Platform **Manual Assembly/Disassembly Parts** □Fastener □ Connector □Clamp □Bolt □Screw □Others	□Maintenance/Repair-Breakdown □Maintenance Routine □Manual Assembly or Disassembly ■Raw Material Handling □Office Tasks ■Handling the metals. □Driving, operating riding on vehicle □Operating machining /Tooling Equipment □Other
JSA(Job Safety Analysis) PPE (Personal Protective Equipment) correct for the tasks. □Yes ■No Is the operator properly training for the tasks? ■Yes □No Are any/all hazardous chemical notes on JSA? □Yes □No ■NA	**Reserved**

4. Permanent Corrective Action (Improve)

Root Cause Understood? ■Yes / □No

Personal factor	Job Factors	Corrective Actions
□Inappropriate Work Assignment ■Lack of appropriate training □Stress □Motivation ■Abuse/Misuse of tools and equipment.	□Leadership □Problem in facility design, engineering ■Maintenance wear and tear ■Problem with tool and equipment □Problem with standards of procedures	■Education ■Enforcement □Engineering ■Maintenance ■Counselling/Advisement

Incident Root Cause	Interim Corrective Actions	Permanent Corrective Action
Requirement of raw materials for other purposes.	Handling the raw materials very safely	Providing gloves and other protecting equipment.

Have the corrective actions be communicated to other shifts? ■Yes / □ No | Who was contacted? Manager
Superintendent Review:
Department Manager Review:
Safety Review: | Date Reviewed: 30 Oct 15

FIG:9 Safety Control Sheet

3.4.Improve Phase

A.Data evaluation

Unit - Employee

Defects – Employee recordable injury.

Number of employees = 291

Number of injuries recorded =31

Opportunity for error in unit = 0.6/workday (250/year)

Defects per unit:

DPU= Total defects/total units

=31/291

= 0.1065

Defects parts per million (ppm)

= (DPU/year *10^6)/opportunity for error in 1 unit

= 610.13 ppm

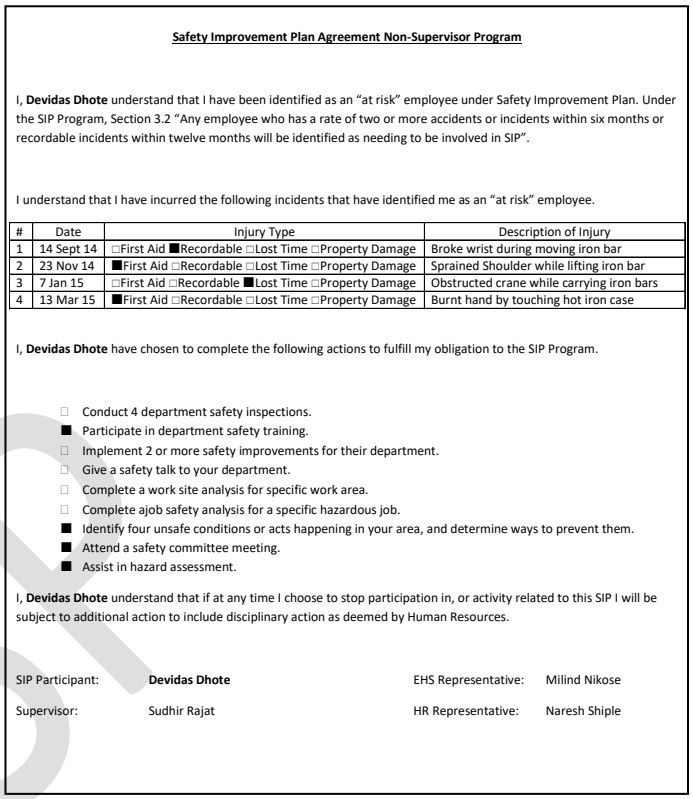
Using given formula for conversion of ppm into sigma

= 0.8406 + square root ((29.37-(2.221ln (ppm))) = **4.7**

3.5 Control Phase

Control Phase is the last phase of DMAIC Methodology implemented in our project. Here we try to sustain the developments made in improve phase and aim towards continuous improvement. It is made sure that the sigma value never degrades in the factory. The tools used here to ensure continuous improvement are Safety Improvement Plan and Post Kaizen EHS Checklist.

A. Safety Improvement Plan



Safety Improvement Plan Agreement Non-Supervisor Program

I, **Devidas Dhote** understand that I have been identified as an "at risk" employee under Safety Improvement Plan. Under the SIP Program, Section 3.2 "Any employee who has a rate of two or more accidents or incidents within six months or recordable incidents within twelve months will be identified as needing to be involved in SIP".

I understand that I have incurred the following incidents that have identified me as an "at risk" employee.

#	Date	Injury Type	Description of Injury
1	14 Sept 14	□First Aid ■Recordable □Lost Time □Property Damage	Broke wrist during moving iron bar
2	23 Nov 14	■First Aid □Recordable □Lost Time □Property Damage	Sprained Shoulder while lifting iron bar
3	7 Jan 15	□First Aid □Recordable ■Lost Time □Property Damage	Obstructed crane while carrying iron bars
4	13 Mar 15	■First Aid □Recordable □Lost Time □Property Damage	Burnt hand by touching hot iron case

I, **Devidas Dhote** have chosen to complete the following actions to fulfill my obligation to the SIP Program.

- □ Conduct 4 department safety inspections.
- ■ Participate in department safety training.
- □ Implement 2 or more safety improvements for their department.
- □ Give a safety talk to your department.
- □ Complete a work site analysis for specific work area.
- □ Complete ajob safety analysis for a specific hazardous job.
- ■ Identify four unsafe conditions or acts happening in your area, and determine ways to prevent them.
- ■ Attend a safety committee meeting.
- ■ Assist in hazard assessment.

I, **Devidas Dhote** understand that if at any time I choose to stop participation in, or activity related to this SIP I will be subject to additional action to include disciplinary action as deemed by Human Resources.

SIP Participant: **Devidas Dhote** | EHS Representative: Milind Nikose
Supervisor: Sudhir Rajat | HR Representative: Naresh Shiple

FIG:10 Safety Improvement Plan Agreement Non-Supervisor Program

4.CONCLUSIONS

We have successfully implemented the methodologies of Lean and Six sigma methodologies to decrease the number of accidents occurring in the industry.

To tabulate the information of pre-improvement and post-improvement stage we consider Number of accidents as well as the change in sigma level of the industry.

TABLE 3

RESULTS AFTER IMPROVEMENT PHASE

Safety Parameters	Before Improvement	After Improvement	Notes
Number of accidents per Year	155	31	Reduced by a factor of 5
Sigma Value	4.2	4.7	Increased by 0.5

By implementation of the methodologies of Lean and Six Sigma in a continuous improvement plan we can achieve six

sigma level of perfection in a manufacturing industry. The control phase insures that the sigma level never degrades in an industry and hence with some time the industry can aim for zero injuries and accidents.

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