INTEGRATED APPROACH TO SAFETY CIRCLE
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Approving Committee

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Safety Circle is designed considering fulfilling of organisation aim of "***Zero harm through Overall development of employee and change in attitude"*** with the following objectives:

i ***To Involve grass root level employee and contract workers***
ii ***To improve observation power by:***
   a. ***To differentiate between hazard and Risk***
   b. ***To understand the five human factor responsible for more than 90% of incidences***
   c. ***To understand the near miss and importance of its reporting***
iii ***To Improve analytical power***
iv ***To get contribution from grass root level employee for better records***
v ***To improve team work***
vi ***To Improve in retaining Safety Knowledge***

Safety Circle Process flow chart for QCFI

This is the Flow Diagram for the Safety circle working process standard of QCFI. Some key decisions and assumptions taken and safety circle cases has been divided in two categories described below as **Case -1** and **Case-2**:

Case -1: Incidences did not occur but there is high probability of occurrence in near future with existing working practice. Problem identified, analysed and solved by the working group with the help of their facilitator. In this "case study report and presentation" will follow DMAIC principle some of the silent features:

a. Selection of the problem can be either by the group or given by the management and selection can be based on observation / hidden hazard supported by data. If not supported by data, then severity should be considered and Risk classification matrix should be used.
b. For root cause analysis Cause & Effect diagram or Tree diagram can be used.

Case -2: Incidence already took place either in the form of near miss or human injury, or property damage or environment damage

a. In this case, problem is generally given by the management based on severity rating through Risk classification matrix.
b. All the nine steps of Incident Investigation (I^2) are to be followed and investigation should be completed in specified time limit.
c. For root cause analysis Cause & Effect diagram or Tree diagram can be used.

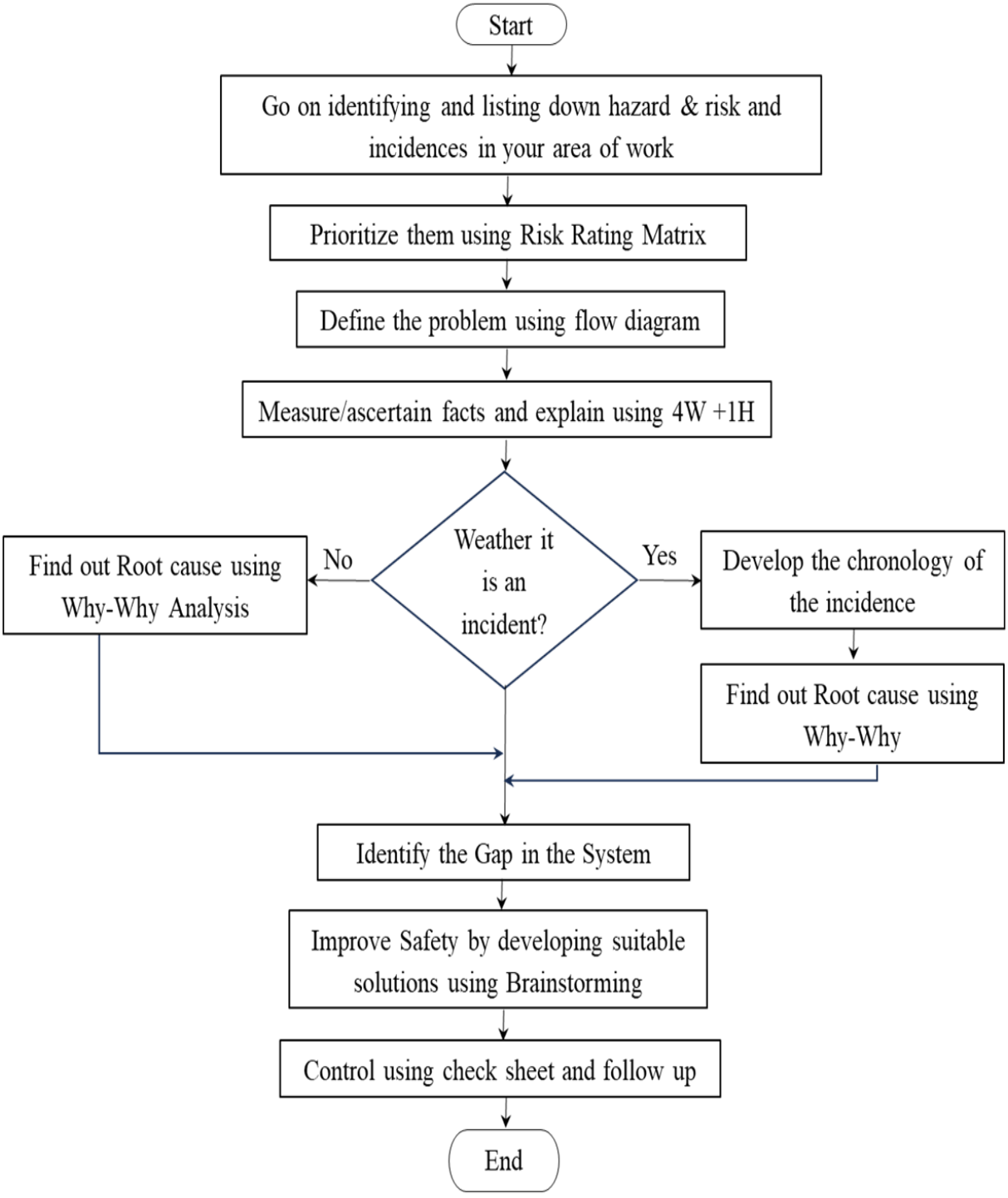


Fig-1.0: Safety Circle Process Flow Diagram

Step-1: Formation of Team

It is the responsibility of the line manager to sensitize the Facilitator/Line manager to take initiative and organize safety circle training for their workforce including contract workers wherever possible and motivate them to eliminate all unsafe act and unsafe condition either it is visible or under the carpet and not visible. During the training they will be sensitized about working in hazard condition, its impact and **WHY** safety is required for all of us?

When an incident happens, there is a tremendous impact on the person, his family, his friends, and the neighbors. The impact is not just physical - it leads to mental & emotional issues, financial setbacks. It can lead to fear, humiliation, embarrassment – some end up feeling that their personal autonomy has been lost.

The Facilitator will encourage each group to come up with the maximum reasons to work Safely. The group with the maximum reason then shares all the reasons and the others add to the list in case any of their points have not been covered.
Some reasons for working safely:

- To support my family
- To have a comfortable lifestyle
- Avoid pain and hospitalization
- Safety of my co-workers
- Enjoy life with family and friends
- Reputation
- To avoid becoming dependent on anyone – physically or financially

So, it can be concluded as "accidents add to miseries, subtract from pleasure, multiply worry and divide income."
Once they are sensitized, they should be motivated to form safety circle group. Group may consist of front-line executive, regular employee and contractor worker (if possible) should also be included in the team. In case of investigation of incident (Accident or Near Miss) victim should also be included in the team as temporary member (only for the particular case) till completion of investigation.

The composition of the safety circle is divided in three categories namely:

Category-A: For contractor only

a) Facilitator – Contractor Supervisor
b) Leader – Contract Worker
c) Member – 2 to 3 Maximum Contractor workers

Category-B: Optional Group

a) Facilitator – Middle level Executive
b) Leader – Junior Executive
c) Member – 2 to 3 Maximum Regular plus Contractor workers

Category-C: Executive (Special Project take in High Hazard)

a) Facilitator – Middle/Senior Level Management
b) Leader – Executive
c) Member – 2 to 3 Maximum Executives

The Leader of the safety circle team shall have the following responsibilities:

a) Call for meetings
b) Preside over meetings
c) Ensure timely investigation and completion of project as per milestone
d) Keep investigation focused for complete results
e) Ensuring that adequate resource is available for team
f) Ensuring all team members participate
g) Update the management about status of investigation
h) Ensure report is complete

Step-2: Identification of Hazards/Incidence:

During the safety circle regular meetings, group should list down all hazards available in their working area with photographs. The group also ensures to keep after photograph on elimination. These hazards can be categorized as:

a) Human Injury
b) Equipment Damage
c) Environment Damage
d) Normal Process Interruption

Team can include near miss happened/happening in the organization in the list. But if it is taken from the near miss bank maintained by the department then it should be included one by one only. One by one means select one near miss as per risk rating matrix and second should be included only after resolving the first one. During CCQC/NCQC evaluation it will be considered only of following conditions are satisfied:

Unsafe condition	:	Supported by before and after photographs
Unsafe Act	:	Supported by Date, Time, Name & Organization Id. Number of Victim, and corrective action taken. If organization do not want to share victim details **masking** of name and organization Id can be done. For example, Mukesh Thakur, 476295 can be written as **Muxxsh Txxxur, 4xxx95.**
Near Miss - Human	:	Supported by Date, Time, Name & Organization Id. Number of Victim and corrective action taken. If organization do not want to share victim details masking of name and organization Id can be done. For example, Mukesh Thakur, 476295 can be written as **Muxxsh Txxxur, 4xxx95.**
Near Miss – Others	:	Date, Time, Equipment Name and corrective action taken
Accident – Human	:	Date, Time, Name & Organisation Id. Number of Victim and corrective action taken
Accident – Others	:	Date, Time, Equipment Name and corrective action taken

****Note Before:**

a) In case of Human Injury only **serious and fatality** potential act and condition should be accepted by the facilitator/coordinator, also it should be supported by before and after photograph and validated by head of the department.
b) In case of Environment damage, Equipment Damage etc. present status to be mentioned in the remark column.
c) Serious/Fatality potential or repeated Near Miss can be taken from the list of near miss reported in the organization. Only action taken near miss will be eligible for the marks.
d) Structured safety round to be done periodically to identify hazard and risk associated and take spot correction and recorded in standard format is given in **Annexure-A**. For which spot correction is not possible, action plan to be mentioned. Structured safety round should be done by Sr. Management/middle management, front line executive and field working group

Identification of Hazard and risk associated with will be easy if we are able distinguish between hazard and risk and at the same time able to recognize the five human factor responsible for more than 90% of incidences takes place. Elimination of incidences can be done if we are able timely judge the line of fire takes care of human at risk behavior.

What is the difference between a 'hazard (Khatra)' and a 'risk (Jokhim)'?

HAZARD - A hazard is something that can cause harm, e.g. electricity, chemicals, working up on a ladder, noise, a bully at work, stress, liquid metal, gases, spill on the floor, Broken Equipment etc. Existing or Potential Condition that alone or interacting with other factors can cause harm.

RISK - A measure of the probability and severity of a hazard to harm human health, property, or the environment. A measure of how likely harm is to occur and an indication of how serious the harm might be. A risk is the chance, high or low, that any hazard will cause somebody harm.
Eg. A broken ladder is a Hazard but when we use it, it becomes a risk

HAZARD	RISK	HAZARD	RISK
			
Snake in Jungle	**Snake at workplace**	**Cycling on Roadside**	**Holding Runing Car**
			
Hanging Load	**Standing under Load**	**Water in the River**	**In the river without knowing Swimming**

Line of Fire:

hazards may get converted into risks if we place ourselves in the line of fire. Below given are three situations which explains how the worker is in the line of fire:

 	**Struck-by**- A pedestrian struck-by a moving vehicle or an object falling from a higher level striking a worker below are examples of struck-by incidents.
 	**Caught-in or between**- A Contractor worker is standing between a Truck and an excavator. When the excavator spins around the counter weight pins the worker against the Truck. Another example would be a worker placing his leg too close to a rotating gear and gets it pulled into the gear.

		**Released energy**- A pipe releasing hot steam from a valve that is being removed or a flame shooting out of a malfunctioning engine are examples of released energy.

Slips, Trips and Falls are another major and common causes of incidents. Slips and trips are one of the most common causes of major injuries at work. The worst kind of these accidents can prove to be fatal but they can also lead to cuts, bruises, head injuries, back injuries and fractures. **Most could have been prevented by being alert and not distracted is one way to prevent this**.

People have varied risk perceptions and their response to risks is different. It is the perception of risk that determines our behavior and what actions we take to contain the risk and keep ourselves safe.

What are the five human factor responsible for most (>90%) of the incidences:

	**Complacency:** It is a false belief that because of your experience, you cannot have an incident. Complacency can be described as a feeling of self-satisfaction accompanied by a loss of awareness of potential dangers. Such a feeling often arises when conducting routine activities that have become habitual and which may be "considered", by an individual, as easy and safe. A general relaxation of vigilance results and important signals will be missed, with the individual only seeing what he, or she, expects to see. As time goes by with no problems occurring, we become complacent and let our guard down. Complacency is a common contributor to unintentional injuries. When workers get overly comfortable with a procedure, they will often mentally minimize the amount of risk involved. The more you do something and nothing adverse happens, the more you feel you can continue doing it without consequence.

	**Distraction:** Distractions take attention away from what an operator needs to do when performing a task. Distractions can be internal or external. Internal distractions can be some kind of worry / anxiety or a result of anticipation or day dreaming; while external would-be noise, conversation of co-worker, mobile phone, etc. The study findings revealed that the distracted workers recognized a smaller proportion of hazards compared with undistracted workers. Another example a person is driving a car with one hand and holding ice cream on another hand and at the same time taking on phone.
	**Fatigue:** Fatigue means extreme tiredness resulting from mental or physical exertion. We tend to underestimate our level of fatigue and overestimate our ability to cope with it. Therefore, it is important that we are aware of the signs and symptoms of fatigue – in themselves and others. Fatigue self-management involves a three-sided program of regular sleep, healthy diet (including reduced use of alcohol and other drugs), and exercise.
	**Hurry:** What is Hurry? Rushing to get job done. It is human nature to want to get a job done as quickly as possible because getting a task done in a hurry gives you: i. the ability to start your next task sooner ii. more time to do other things that may be more enjoyable iii. Sometimes it is pressure to meet the deadlines. Rushing can result in accidents, errors, and more time spent in the long run.
	**Overenthusiasm:** Over Enthusiasm - Showing excessive degree of zeal. We put pressure on ourselves by putting ourselves in unsafe situations or taking on more work than we can handle. We often do that to try to save face, to impress people by positively promoting super powers that we do not possess. These poor judgments are often the result of making assumptions about what is expected of us.

Identification of Incidents:

Here selection of incidence to be done from the list of accidents and near miss happened in past one year. Since most of the incidences of major category are taken care by the organisation just after the accidents but near misses are left out. So here safety circle gets an opportunity to select the near miss case from the list for solving as per Risk Rating Matrix

Step-3: Selection of the Hazard for resolving:

Just knowing hazards is not enough, learning how to assess risk makes decision making easy. Risk is ***the likelihood and the severity of a negative occurrence (injury, ill-health, damage, loss) resulting from a hazard***. *R*isk assessment means understanding the gravity of the consequences. Risk assessments are important because they help you to:

- Think about the potential harm
- Identify people including you who may be at risk
- Protect the people at risk
- Plan the work safely
- Make improvements

To protect ourselves and our colleague from danger by following three actions:

- **A**wareness- *Be eyes, ears and mind- pick up even weak signals – Be Alert*
- **S**ense the Hazard- *whether there is potential for you to be in the LOF, or Slip, Trip or Fall*
- **K**now- *whether your safeguards are strong?*

Ask before you Act in Hindi Pehchano **(पहचानों),** Parkho **(परखों),** Jano aur phir karya karo, **(पूछो और करो)**

For Given below three different cases our action will be different why?

Case-1: You are driving a scooter back from the plant and you are wearing a helmet

Case-2: You are wearing a helmet and driving back from the plant in the night and the roads are unlit and the scooter's headlight is not working

Case-3: You are wearing a helmet and driving back from the plant in the night and the roads are unlit and the scooter's headlight is not working and you are very sleepy

Action will be different because to keep yourself safe depending on level of risk involved.

Do the selection and decide the priority to eliminate the risk as per risk rating matrix or any other methodology followed in the respective organisation. We also need to think about the consequences of these hazards and consider their impact on us and on people around us.

A. Reactive Analysis: There is intent to investigate all incidents and thus below matrix shall be used to capture serious near-miss cases/ Incidents to facilitate quality investigation.

1) Incident/ Near Miss Classification Matrix

Nature of Incident/ Near miss: (Score: 4 to 1)	**Consequences / Potential consequences: (Score: 5 to 1)**
A. Work related repeat incidents - **4** B. Work-related first-time incident-**3** C. Non-Work-related repeat incident- **2** D. Non-Work-related first-time incident-**1**	A. **5.** Fatality or permanent disability, & or Severe Property damage or effecting Legal compliance / Environment / Community. B. **4.** Lost time injury, Significant Property damage to Plant, Potential of fire and Explosion, impact on Health. C. **3.** MTC, Restricted work cases, Property damage to department / section D. **2.** FAC, Minor property damage E. **1.** Minor bruise, No property damage

Y Axis – Consequence

CONSEQUENCE ↑	4	3	2	1
5	20	15	10	5
4	16	12	8	4
3	12	9	6	3
2	8	6	4	2
1	4	3	2	1
	NATURE OF INCIDENCE/HAZARDS →			

OR

any other Risk Matrix followed in the organization can be used for priority of selection of incidents for investigation and developing solution

How to give priority to Hazard/Accident/Near Miss

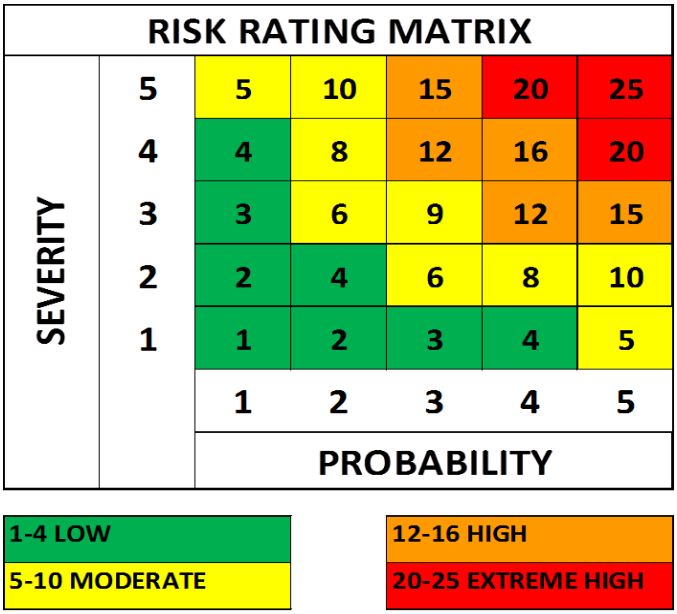
- As per the matrix only high priority Incident/ near miss with scoring 15 to 20 investigation shall be lead at higher level.
- Incident/ Near miss of medium priority with scoring 5 to 14 investigated can be led by first level executive/Section In-charge/**Safety Circle Group.**

Risk score (Nature of Near Miss / Incident X Maximum Potential consequences)	
Score range (15-20)	High Priority – Investigation Required
Score range (5-14)	Medium Priority – Investigation Required
Score range (1-4)	Low Priority – Investigation Not Required – Concerned Head Of Department will assign the recommendation and close

B. **Proactive Analysis:** Here is intent to resolve risky condition/act first to eliminate any incidents in future. Hence all spotted hazards done in the previous steps should be prioritized with the help of given below risk rating matrix. Employee are free to select any risk rating matrix followed in his/her organisation. Here for explain two examples are given one normal risk rating matrix and another one is followed in FMEA. For both the cases probability and severity scale is given and same can be followed as far as possible.

Increasing Probability				
1	**2**	**3**	**4**	**5**
Never heard of in Industry	Heard of in the industry	Has happened in the Organization or more than once per year in the industry	Has happened at the Location or more than once per year in the Organization	Has happened more than once per year in the Location
Unlikely	**Possible but not probable**	**Low Probability**	**Medium Probability**	**Almost Certain**

Potential Severity	People	Description
1	Slight injury or health effect	Possibility of First Aid cases or minor discomfort cases e.g. Headache, dust/fumes/gases having irritation in the nose when inhaled - a person can return to work after a rest.
2	Minor injury or health effect	Possibility of Reversible injuries or illnesses requiring Medical Treatment (MT)/ not a loss time injury (LTI) case. For Example, loss of consciousness from medical reasons only (e.g. diabetes, epilepsy, narcolepsy, etc.), needle stick injuries and cuts from sharp objects.
3	Major injury or health effect	Possibility of Reversible injuries or illnesses or LTI e.g. Punctured eardrums, fractured ribs or toes, chronic back injuries, loss of consciousness from work-related activities e.g. blow to the head, heat-induced.
4	Single Fatality or permanent total disability	Possibility of Single fatality, permanent disability or irreversible illness such as corrosive burns, amputation, a near miss with potential of single fatality.
5	Multiple fatalities	Possibility of Multiple fatalities or multiple irreversible illnesses. A near miss with potential for multiple fatalities.



Based on the risk level, as derived from the risk matrix given above priority of spotted hazards/ near miss to be selected for analysis and developing solution or any site modification.

First Priority: Extreme High Risk, points between 20 and 25, should to solved first. the operation or activity shall be stopped until additional controls can be implemented or an alternative process or activity can be found that will reduce the risk to an acceptable level.

Second Priority: High Risk, points between 12 and 16, should to solved after first priority hazard. the operation or activity shall be stopped until additional controls can be implemented or an alternative process or activity can be found that will reduce the risk to an acceptable level.

Third Priority: Moderate Risk, points between 05 and 10, should to solved after second priority hazard is resolved. Assessment team needs to be satisfied that the identified controls are implemented and effective and that no additional controls can be identified to further reduce the risk

Last/Fourth Priority: Low Risk, points between 01 and 04 should to solved after third priority. If the residual risk is low, it is still important to make sure that the identified controls are implemented and effective and to be aware of further opportunities for improvement.

OR

any other Risk Matrix followed in the organization can be used for priority of selection of Spotted hazard and developing solution

NB: Second, Third and fourth priority hazards are generally taken by safety circle team, even first can also be taken up if it can be solved in less time with the approval of top management.

OR

C. FMEA method of Risk Rating Matrix:

Above risk classification matrix shown is only an indicative and may vary from organization to organization and type of industries. Safety circle should follow the existing practice followed in their own organization. However, safety circle may use Failure Mode and Effect Analysis (FMEA) in process especially in context of priority matrix. Also, generally when severity is considered Log scale are better so that issues which may result in loss of human life, damage to environment and to the customers get much higher priority numbers compared to minor injuries and loss to equipment.

Severity Guidelines

Effect	Rank	Criteria
None	1	No effect
Very Slight	2	Negligible effect on Performance. Some users may notice.
Slight	3	Slight effect on performance. Non vital faults will be noticed.
Minor	4	Minor effect on performance. User is slightly dissatisfied.
Moderate	5	Reduced performance with gradual performance degradation. User dissatisfied.

Severe	6	Degraded performance, but safe and usable. User dissatisfied.
High Severity	7	Very poor performance. Very dissatisfied user.
Very High Severity	8	Inoperable but safe.
Extreme Severity	9	Probable failure with hazardous effects. Compliance with regulation is unlikely
Maximum Severity	10	Unpredictable failure with hazardous effects almost certain. Non-compliant with regulations

Occurrence Ranking

Occurrence	Rank	Criteria
Extremely Unlikely	1	Less than 0.01 per thousand
Remote Likelihood	2	≈0.1 per thousand rate of occurrence
Very Low Likelihood	3	≈0.5 per thousand rate of occurrence
Low Likelihood	4	≈1 per thousand rate of occurrence
Moderately Low Likelihood	5	≈2 per thousand rate of occurrence
Medium Likelihood	6	≈5 per thousand rate of occurrence
Moderate High Likelihood	7	≈10 per thousand rate of occurrence
Very High Severity	8	≈20 per thousand rate of occurrence
Extreme Severity	9	≈50 per thousand rate of occurrence
Maximum Severity	10	≈100 per thousand rate of occurrence

RISK RATING MATRIX

SEVERITY											
	10	10	20	30	40	50	60	70	80	90	100
	9	9	18	27	36	45	54	63	72	81	90
	8	8	16	24	32	40	48	56	64	72	80
	7	7	14	21	28	35	42	49	56	63	70
	6	6	12	18	24	30	36	42	48	54	60
	5	5	10	15	20	25	30	35	40	45	50
	4	4	8	12	16	20	24	28	32	36	40
	3	3	6	9	12	15	18	21	24	27	30
	2	2	4	6	8	10	12	14	16	18	20
	1	1	2	3	4	5	6	7	8	9	10
		1	2	3	4	5	6	7	8	9	10
		PROBABILITY									

Step-4: Define the Problem:

Mile Stone/Gantt Chart

First step is to make a milestone chart for completing the project in time . The milestone chart is a simple activity planning chart. It lists all the activities and the time it takes to complete that activity in days or weeks or months. The time difference between the starting activity to the finishing activity is the total estimated project time. That Gantt chart is similar to the milestone chart. The essential difference between the two is that in Gantt Chart the starting date and ending date of each activity is indicated instead of weeks or months as in a milestone chart, an sample example is shown in **Annexure-B.**

Both the charts are very good project schedule monitoring tools.

A. Case-1: Follow simple DMAIC principle for problem solving:

1. Define:

The safety is responsibility of each & everyone at workplace. The incident pertaining to hazardous conditions or Near-miss accident cases of the different category should be define and elaborated with the help of flow diagram. Flow diagram is a graphical or pictorial representation of the steps that are performed to produce some output. Flow diagram applies to a product, service, and information etc. It is a systematic method of writing the sequences of activities with arrows indicating the direction of flow of the process sequence. In fact, it is known as the "Arm Chair journey of a process" without actually visiting the place. It is helpful in locating problem areas as given below:

There are basically three types of flow diagrams:

i **High Level Flow Diagram:** The high-level flow diagrams are very broad and less detailed flow diagrams giving a very quick overview of the process. For example, the high-level flow diagram for a traveler wants to reach from one city to another. The broad steps involved are:

a) Buying an e-ticket
b) Reaching the airport
c) Checking-in the luggage and getting boarding pass
d) Reaching the aircraft & flying
e) Reaching the destination airport
f) Collecting the baggage
g) Reaching destination

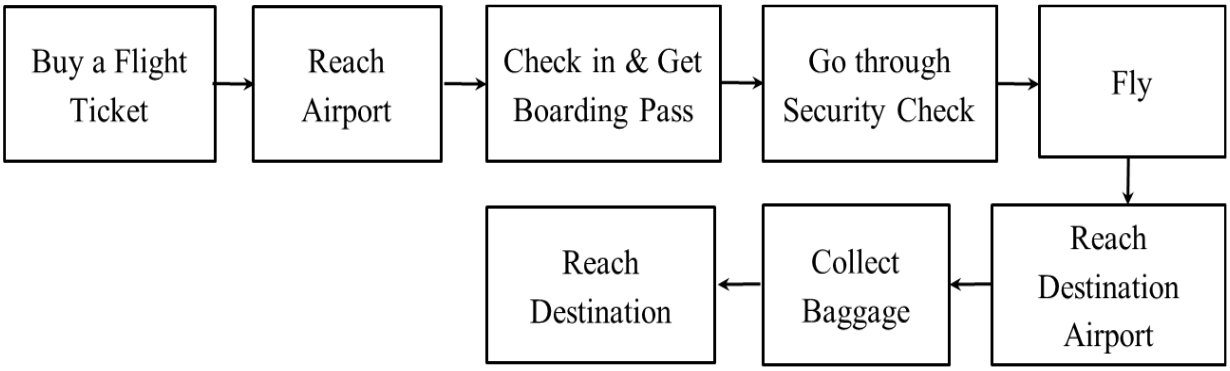


Fig. 1.1: High Level Flow Diagram

ii **Matrix Flow Diagram:** In the matrix flow diagram, some additional information is provided. In the above case, there are four groups of people namely, the traveler, taxi driver / transporter, airport officials and on board officials. More than one activity takes place in each of the domains. These activities are represented in a matrix form as shown in the diagram below

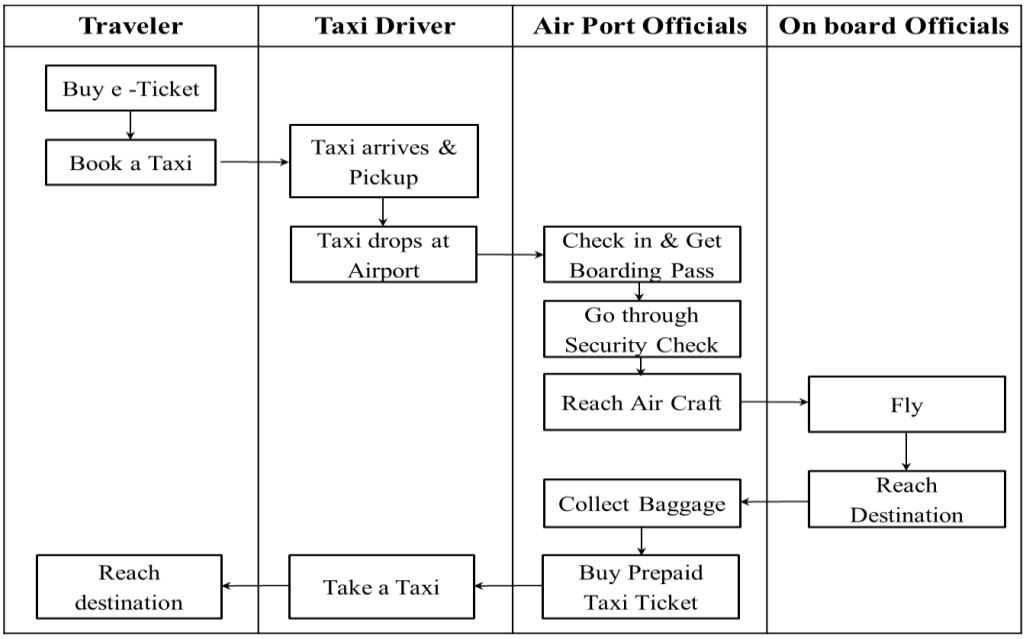


Fig.1.2:Matrix Flow Diagram

iii **Detailed Flow Diagram:** The detailed flow diagram is a listing down of all the activities in their natural sequence. For drawing this, a set of symbols are used.

How to draw a Flow Diagram?

a) Always start the Flow diagram with a start symbol.

b) First note down all the activities.

c) Insert each activity inside a rectangle known as activity symbol.

d) Connect each activity (rectangle) with an arrow indicating the direction of flow of operation.

e) Whenever there is a change in the activity based on a decision, introduce a decision symbol (diamond). Follow the activities along each decision path and complete the loop.

f) Whenever a reference is made to a data base use the data base symbol.

g) If one page is not sufficient to complete the flow diagram and you have to continue on another page, use the connector symbol at the end of the first page and beginning of the next page.

h) When all the activities have been listed out and our goal for drawing the flow diagram has been achieved, complete the flow diagram with a terminal symbol again with “End” or “Stop” written in it.

We are now ready to draw a detailed Flow diagram. Let us now take the same case of a person wanting to reach one city from another city by flight. Using all the above symbols, let us draw a detailed flow diagram incorporating all the activities involved in a person reaching from one city to another city in as much minute details as possible. The resulting detailed flow diagram will be as shown below.

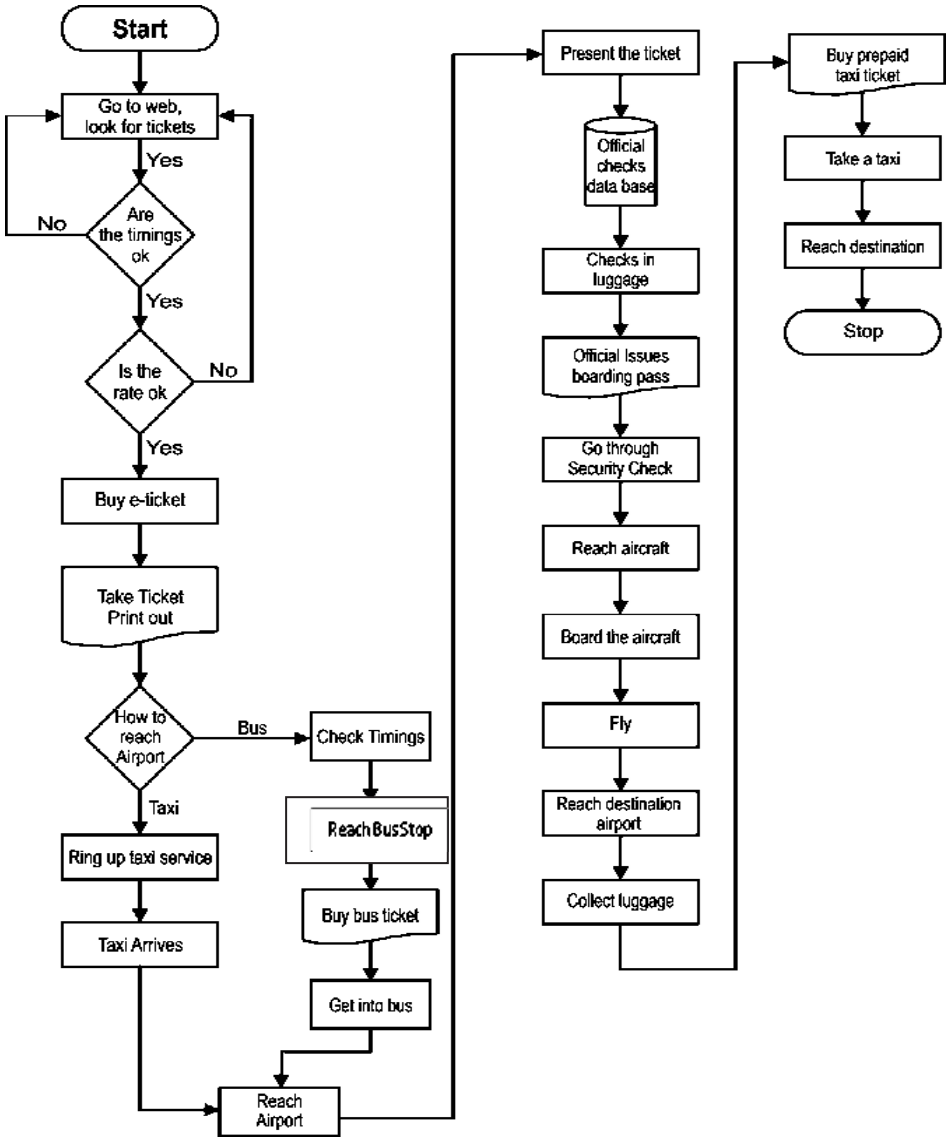


Fig.1.3: Detailed Flow Diagram

2. Measure:

The Hazard/Incident may be ascertain / evaluated on the basis of Physical, Human & System. For this, its impact under 4W & 1H should be analysed in detail for understanding its impact on the individual, Unit & Organization. The repeated Hazard/incident MUST be evaluated with facts & figures in details on behavior-based safety. In this step circle members collect relevant data, pertaining to their chosen problem (Hazard/Incident). The data collected should be relevant to the problem taken. Very often circles collect some data and later, they do not use them anywhere, this should be avoided. After collecting data (fact finding) and making some preliminary analysis, they should do 4W + 1H analysis.

A sample analysis of Fire took place in coke conveyor belt. The circles must ask the following questions and find the relevant answers.

4W+1H	Question	Lead Indicator (Proactive)	Lag Indicator (Reactive)
What	is the problem	Possibility of occurrence of fire in Coal conveyor Gallery.	Occurrence of fire in Coal conveyor Gallery
When	does the problem occur?	Season, day or night, condition, situation etc.	Date and Time of incident, season, day or night etc.
Where	is the Gap?	Between standard and Actual	Between standard and Actual
	Is the Business Location (Optional)		
	Is the Geographical Location	Macro detail	Macro detail
	Is the Physical Location	Pin point Location	Pin point Location
	Is the Process Location	Affected portion of Process	Affected portion of Process
Who	(optional)	Who will be affected if incident happens?	who all got affected due to incident happened?
How	**much could be/is the the magnitude of the problem**?	E.g., how much time would be required to set things right, how much manpower may be needed to recover, loss of production, Loss of coke production, Loss of conveyor belt, Human injury risk etc.	E.g., how much time would be required to set things right, how much manpower may be needed to recover, loss of production, Loss of coke production, Loss of conveyor belt, Human injury risk etc.

Thus, this is the crucial data collection step. The answers to these questions with relevant data and subsequent analysis will give focus and direction to solve the problem. An example of 4W + 1H for titanic case is given in **Annexure-C.**

3. **Analyze:**
   a) **Root Cause Analysis (RCA):** The above data/facts may be analysed to generate probable causes/Sub-causes & root causes for the incident / condition using why-why technique. The detailed facts & figures will provide the reasons for such negligence. An example of why-why diagram for fire in cock conveyer belt is given in **Annexure – D1** as a tree diagram and in **Annexure-D2** as a fish bone diagram. Team can choose any of the above to show their root causes.

b) Identifying Gaps in The System

Investigations shall identify those systems that need to be strengthened to maintain unit and corporate attention on the continuous need to improve these systems. Typically, these areas for improvement flow from the key factors already identified and shall be noted on the investigation report.

Possible safety elements that may be affected are:

- Operating Procedures
- Work Permit (including Hot work, Working at heights, Confined space entry)
- LOTO, Machine Guarding
- Material Movement
- Mechanical Integrity
- Emergency Response Planning
- Management of Change
- Contractor Safety
- Training

4. Improvements:

To overcome the above incident/ conditions many solutions may be sought for improvement. The best solution using brain storming may be adopted to eliminate the **Gap (Problem)** in the system. Development/Recommendation of solution to Problem/Gap in the system shall be developed for all the Problems/Gaps identified. Number of actions may vary but must have at least one recommendation for each Problems/Gaps. Well written recommendations shall be well worded and specific. While considering recommendations, the five steps for the system shall be considered priority wise as given below:

1. Elimination
2. Substitution
3. Engineering control
4. Procedures & Training
5. PPE

Further, the recommendation has three important parts:

- A clear description of the recommended action to be taken to prevent recurrence
- The name/position of the person responsible for implementation
- A Time bond action Plan (completion date), Mile stone before and completion should be shown.

Our final objective should be in change the behavior/culture of the human so that a safe work culture can be established.

5. Control:

This step is for "holding the gains". Circles have to inform the department, and get the changes incorporated. If any changes are made in the process sequence or maintenance Practice, then the corresponding standard procedures (SOP) or standard maintenance practice should be modified incorporating the necessary changes. All the operators are to be trained as per new requirements.

Usually, circles assign to its team members a predetermined schedule to monitor the important factors/ parameters/levels of the process to ensure whether it is operating as per regular implementation levels. Check sheet, graph, HIRA, JSA, Tool Box talk etc. are useful to observe the safety improvement in the system.

Circles also implement any Pokka-yoke (i.e. mistake proofing) system to ensure the zero mistake and zero harm by the new modifications made. Also circles make a milestone chart once again showing the planned and actual time it has taken.

Some circles summarize the lessons they have learnt by going through this project work. Some circles draw a radar graph, showing the before and after levels of various aspects of learning. Most of the circles provide a list of tools and techniques they have used during their study.

The BEST solution implementation will improve the accident-free zone in the department with SYNERGY efforts. In conclusion, we may say that it is a very comprehensive approach, starting from the identification of Hazard/Risk, selection through risk analysis, Root cause analysis, development of solution and holding the gains.

B. Case-2: Nine step Incident Investigation Process (a pictorially represented):

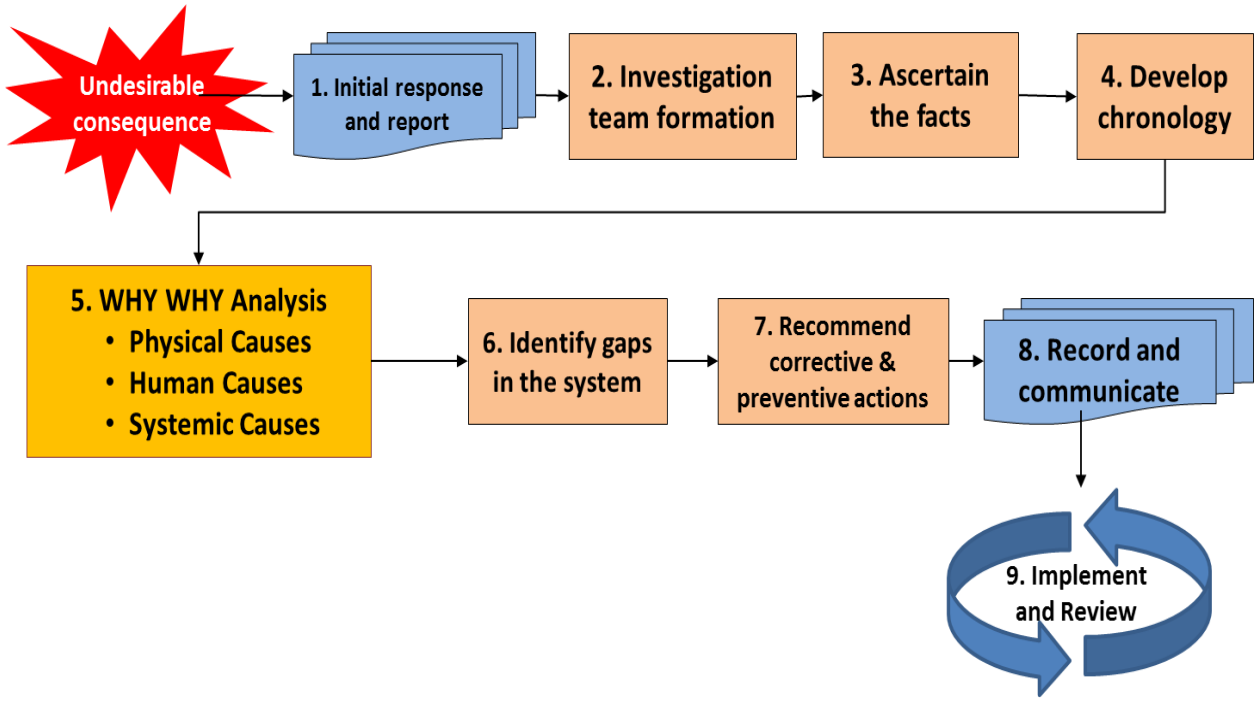


Fig-1.4: Incident Investigation Process

This will also follow the DMAIC process except one or two extra steps included such as initial response and reporting of incidence and Development of chronology. These two additional steps will also form part of DMAIC process as given below:

1. **Define:**
   a) Initial Response
   b) Define using Flow diagram
   c) Mile stone Chart
2. **Measure:**
   a) Fact Finding (Physical, Human and Systemic)
   b) Use of 4W + 1H
   c) Chronology
3. **Analyses:**
   a) Root Cause analysis using why-why technique and representing either through tree diagram or Fish bone diagram.
   b) Gap Analysis
4. **Improvement:**
   a) Development of solution/recommendation and corrective action with the help of brain storming

Control:

b) Check sheet
c) Revision of SOP/SMP if any
d) Record, communication and training

Initial Response and Report:

When an incident takes place, the concerned line manager shall prioritize his response in the following order

i People
ii Environment
iii Property
iv Interruption of normal process

The preliminary report shall cover 2 key aspects:

i Information of date, time, location and what happened
ii What are the immediate actions were taken

The preliminary report is the starting point for the incident investigation after inclusion of victim in case of human injury in the team formation

Ascertaining the Facts:

In this step, the investigating team shall collect and organize the facts related to the incident/ hidden hazard. The following is a comprehensive list, which shall be looked at:

a) Relevant technical information (process/facility)
b) Operating procedures (normal, transient, deviations)
c) Risk analysis
d) Chronological description
e) Information on the injury, damage and costs
f) List of witnesses, Photographs of evidence
g) Loss of production and its impact
h) Visit incident site, Assess changes due to initial response to incident
i) Ascertain events that preceded the incident
j) Specify the dimensional characteristics of the scene of incident

The types of evidence can be broadly brought under three heads:

1. **Physical** e.g. PPE, Guards, Sensors, Machinery etc.
2. **People** e.g. employees, supervisors, contractors who were involved in the incident / work area and who could share vital information for the investigation during discussions

3. **System** Related e.g. Rules and Procedures, Preventive Maintenance, Risk Analysis etc.

Based on the above, the facts related to the incident shall be finalized. The focus shall be on:

a) Physical evidence
b) Facts (not opinions)
c) Information collected during discussions (not assumptions)
d) Documented information

Develop Chronology

The sequence of events prior to, during and after the incident is very important to incident investigation process and hence the Chronology of events shall be developed. The team shall

a) List all events in chronological order as collated during interviews and from "hard" facts collected.
b) Identify discrepancies for further investigation.
c) Identify potential key contributing factors for further investigation.

Step-5: Analysis-Root Cause Analysis using Why-Why Technique

It is a systematic approach used to reveal "Key Contributing Factors" through identification of people, physical and system causes.

a) **Physical cause:** Usually becomes apparent through observations - hardware, machines, vessels, etc.
b) **Human cause:** Acting inappropriately or failing to act, intentional and unintentional behavior, mistakes, lack of awareness, not knowing, etc.
c) **System cause:** Communications, procedures, training, documentation, policies, standards of performance, etc.

Why-why analysis uses the simple yet very powerful principle of "cause and effect" logic. Based on experience, it has been seen that to get to the operating system key factors, the team would need to drill down to at least 5 levels of why. The creator of the 5-why technique, Mr. Taichi Ohno, is quoted using the following example to demonstrate using 5-why for root cause analysis:

1. **Why did the robot stop?**
   Ans: The circuit has overloaded, causing a fuse to blow. **- Physical**
2. **Why is the circuit overloaded?**
   Ans: There was insufficient lubrication on the bearings, so they locked up. **- Physical**
3. **Why was there insufficient lubrication on the bearings?**
   Ans: The oil pump on the robot is not circulating sufficient oil. **- Physical**
4. **Why is the pump not circulating sufficient oil?**

Ans: The pump intake is clogged with metal shavings. **- Physical**

5. Why is the intake clogged with metal shavings?

Ans: Because there is no filter in the pump. **- Physical**

It is a root cause if it is design fault otherwise further why why is required

6. Why there was no filter in the pump

Ans: Taken out for cleaning but not replaced timely **- Human**

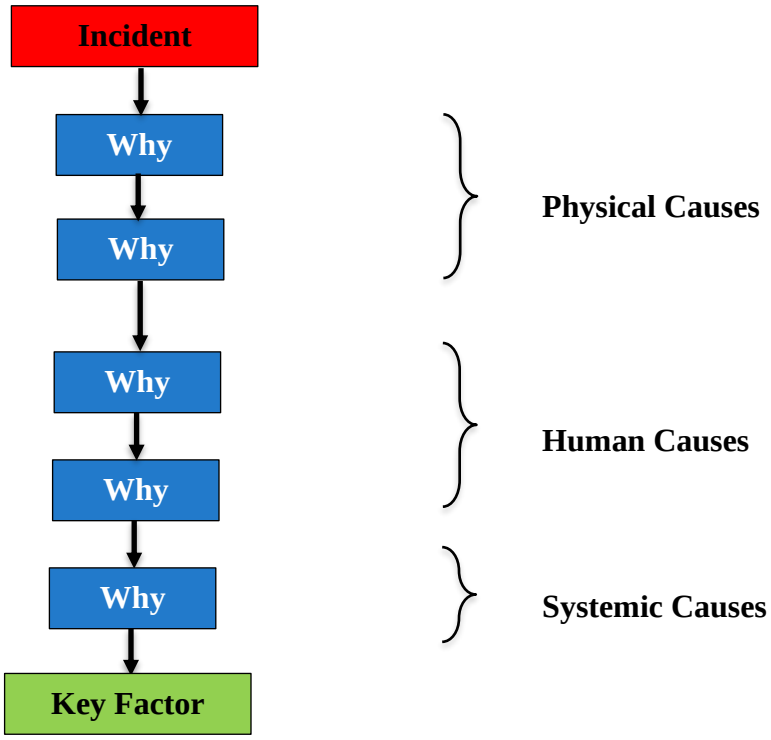
7. Why filter was not replaced timely

Ans: There was no check sheet/record available with the section **– Systemic and Root Causes**

Pictorially why – why technique is illustrated below:

Idealy how many times should you ask:

Experience shows, you should drive down at least five level (5 times) to get to operative system key factor (s) or systmic root cause. For example:



NB: Root cause analysis can be represented in cause-and-effect diagram or Tree diagram

Elaboration importance of all the why

First why: Clear statement of the reason for the defect or failure to occur, understood even by people that is not familiar with the operation where the problem took place. Often this 1st why must be a short, concise sentence that plainly explains the reason. Do not try to justify it, there will be time to do that later ~~on~~ in the following why's if it is pertinent to the thought process. It is okay to write it down even if it seems too obvious for you. (it may not seem that obvious to other persons that will read the document).

Second why: Amore concise explanation to support the first statement. Get into the technical arena, the explanation can branch out to several different causes here. It is ok to follow each of them continuing with their own set of remaining 3 why's and so forth.

Third why: Do not jump to conclusions yet, follow the regular thought process even though some underlying root causes may start surfacing already. This 3rd why is critical for a successful transition between the obvious and the not so obvious. The first two why's have prepared you to focus on the area where the problem could have been originated; the last three why's will take you to a deeper comprehension of the problem. You do not need to answer all the why's at the same time, it is an investigation activity and it will sometimes require you to go to the process and see things you could have missed at first. You may be missing the obvious by rushing into "logical" explanations".

Fourt why: Clear your mind from preconceived explanations and start the fourth why with a candid approach. You may have two or more different avenues to explore now, explore them all. Even if one or several of them turn out not to be the root cause of the problem, they may lead to continuous improvements. This is a good time to include a cause-and-effect analysis and look at the four or five main cause.

Fifth why: When you finally get to the fifth why, it is likely that you have found a systemic cause. Most of the problems in the process can be traced to them. Even a malfunctioning machine can sometimes be caused by an incorrectly followed preventive maintenance or incorrect machine parameters setup. When you address a systemic cause, do it across the entire process and detect areas that may be under the same situation even if there are no reported issues yet. if you have reached the fifth why and you are still dealing with process related cause(s), you may still need one or two more why's to deep dive into the systemic cause. A good way to identify if the 5 why's was done properly is to try to organize the collected data in one sentence and define it in an understandable manner. Something like:

- *"**ROBOT STOP**" mainly due to "**no filter in the pump**". This was caused by "**pump intake is clogged with metal shavings**" mainly because "**robot is not circulating sufficient oil**" was allowed by "**locking up due to insufficient lubrication on the bearings**", and this led to "**circuit has overloaded, causing a fuse to blow**".*

Why's – Conclusion

Do not forget that the sought outcome of a 5 why exercise is a root cause of a defined problem, not the resolution of the problem itself. If you can come up with a reasonable answer, the 5 why's exercise would be successful. If it cannot be done, then quite probably more data needs to be collected to get a better grip of the problem and then the 5 why process can be re-started.

Challenge the root cause(s) that resulted from the 5 why's exercise to try to reproduce the defect. If you cannot there is a very big chance that you have not got to the bottom of it yet. If you do reproduce them, move on to the corrective action part and congratulate your team for a job well done.

A sample Tree diagram and Fish bone diagram is given in Annexure-D and Annexure-E respectively

Validation of Root Causes: Here it is expected to validate the root causes you have identified. This can be done either with the help of data or by experience persons view and same to be recorded in the format given below:

Table 5.1

Possible cause	How to verify	Who will verify	By When	Result

Identifying Gaps in the System

Investigations shall identify those systems that need to be strengthened to maintain unit and corporate attention on the continuous need to improve these systems. Typically, these areas for improvement flow from the key factors already identified and shall be noted on the investigation report. Possible safety elements that may be affected are:

a) Operating Procedures
b) Work Permit (including Hot work, Working at heights, Confined space entry)
c) LOTO, Machine Guarding
d) Material Movement
e) Mechanical Integrity
f) Emergency Response Planning
g) Management of Change
h) Contractor Safety
i) Training

Step-6: Improvement/Solution Development/Recommend Corrective Actions

Recommendations for corrective actions shall be developed for all key factors. Number of actions may vary but must have at least one recommendation for each key factor. Well written recommendations shall be well worded and specific. While considering recommendations, the five steps for the system shall be considered:

a) Elimination
b) Substitution
c) Engineering control
d) Procedures & Training
e) PPE

Further, the recommendation of solution has three important parts:

a) A clear description of the recommended action to be taken to prevent recurrence
b) The name/position of the person responsible for implementation
c) A completion date

PDCA Cycle to be used for development of solution. It is a four-step model for initiating any change. First step “Plan” is to recognize an opportunity and plan for change in terms of what and how. The next step “do” is to carry out the review of the results whether they are as per the expectations. The last step “Act” is to take actions based on the review of the results done in the third step. If not, re-plan and go through the cycle once again. The PDCA Cycle is also known as the Deming Cycle / Wheel.

Note: Recommendations that need to be completed before operations resume shall be clearly identified. Other recommendations such as longer-term, system related improvements / evaluations require a completion date that extends beyond start up.

Record & communicate (After Approval granted)

Once solution for all the root causes are done it has to be presented in front for higher management to get approval for implementing in the following format

Sl. No	Activity	Root Cause	Recommendation
1.	Broke rule of not crossing the machine shop	Poor Safety Culture	Group Recommendation
2.	Complaint of the bump not closed	Ineffective process for closure of unsafe observations	Group Recommendation
3.	Closed wagon not available	Poor material handling and movement process	Group Recommendation
4	Poor Risk perception	Inadequate Safety procedure and Risk Assessment process	Group Recommendation

Once approval is obtained you can start implementation process using PDCA cycle

Sl. No	Activity	Root Cause	Recommendation	Action	Check for deviation
1.	Broke rule of not crossing the machine shop	Poor Safety Culture	Group Recommendation		
2.	Complaint of the bump not closed	Ineffective process for closure of unsafe observations	Group Recommendation		
3.	Closed wagon not available	Poor material handling and movement process	Group Recommendation		
4.	Poor Risk perception	Inadequate Safety procedure and Risk Assessment process	Group Recommendation		

Make necessary changes in the existing documents, SOP/SMP and get issued revised copy for further circulation.

If it is a new modification it has to be widely circulated for horizontal implementation

Bow Tie: It is optional not mandatory, however if someone uses Bow Tie diagram to show case their solution developed will be appreciated

Current risk approaches have tended to focus more on demonstrating design safety and less on maintaining operational safety. The development and appropriate use of bow tie barrier diagrams have the potential to significantly improve process safety. The bow tie illustrates both the prevention barriers, which stop the top event from occurring, and the mitigation (recovery) barriers, which reduce the consequence severity if at all top event occurs. With the help of **Bow Tie** diagram, it is possible to show the cause & root causes of the effect and implementation of recommendation at the same time. In any case due to failure of any barrier if top event (Effect) occurs than its consequences with mitigation barrier it can be shown.

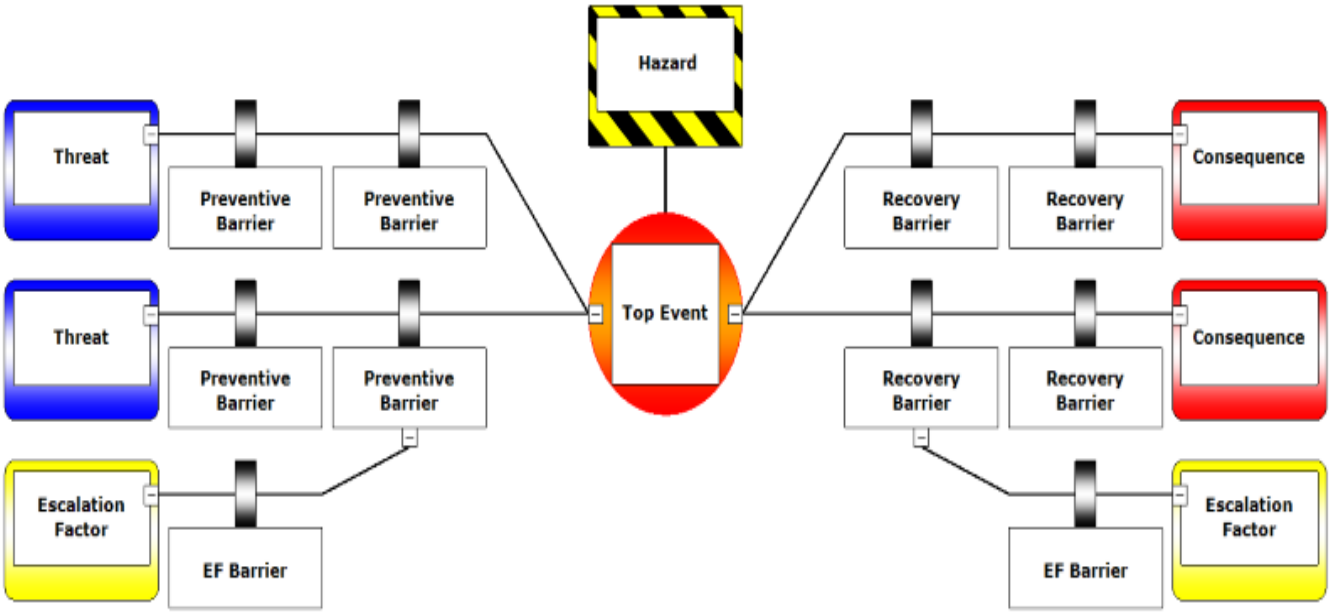


Figure- 1.5: Bow Tie Diagram

Step-7: Control: Implement and Review

Record And Communicate (Similar Use)

The findings of the incident must be documented in an incident report. Reports shall be written such that, they are understandable even by others who are not directly involved in the affected area. Unit specific terminology shall be avoided. The final report shall be released / published within 6 working days from the date of completion of investigation. The report shall be clear, complete, and self-standing for:

a) Sharing/clarity within the plant.
b) Sharing with other sites as applicable through Corporate HSE.

Communication: Effective communication of the results of incident investigations is a vital component to prevent recurrence.

Communication within the unit: The Incident Investigation Report shall be shared and discussed with appropriate personnel, learning must be shared with all own employees and contractor's employees from the affected area, as well as those whose job tasks are related to the incident findings.

Safety Circle should make time bond check sheet for consistence performance and inform management. Management will have the following responsibilities for implementing the recommendations:

- Communication
- Provide resources
- Prioritize across Unit / other sites
- Implement systems to prevent recurrence

To ensure prompt follow-up and closure of recommendations from an incident investigation report, such a system must provide for periodic status reports to approving authority until all recommendations are acted upon and closed out.

a) Assess Gains:

Tangible if any otherwise please mention **Intangible** for example:

a) How much you could able to improve safety
b) Your personal development,
c) Team works
d) Develop habit of doing spot correction
e) Improve ability to identify hazard, risk assessment and able to keep yourself and others line of fire etc.

7. **Control**

You are expected to make a time bond check sheet with mentioned activity wise responsibility as:

Sl. No.	Activity	Methodology
1.	If a recommendation is not being implemented or followed	take written management consent
2.	All recommended actions – corrective and preventive action should receive attention	Preparation of time bound check sheet with responsibility
3.	Tracking – establish at periodic intervals, sustenance of the recommendations	Preparation of time bound check sheet with responsibility
4.	Review effectiveness of the corrective and preventive actions	Monitoring of final result
5.	Provide timely updates to Senior Management on status of all action items	Through software / other suitable medium

Table-2 (Sample)

Sl.No.	Activity	Frequency	Responsibility	Remarks

Road Map for Implementation:

Sl. No.	Description	Time Frame
1	Kick-off & Awareness Programme for top management	1st day
2	Development of trainers	4 days per batch
3	Awareness program by trained trainers (2 programs in presence of QCFI faculty) for total employees / workers	Cont., after 2nd steps.
4	Formation & Development of Circles	Cont.., after 3rd step
5	Hand Holding	Contn., after 4th steps with the help of trained trainers
6	Review Periodically by internal assessors every month & by QCFI faculty by every quarter.	Cont., after 5th steps

Eligibility Criteria: Teams Eligible to participate in CCQC for the calendar year should have completed their project on or before 31st August of the current calendar year.

Safety Circle Evaluation System during CCQC and NCQC:

Part-A: Pre-Convention Case study Evaluation system during CCQC and NCQC:

Steps	Description	Max Marks (50)	
		Case-1 (Lead)	Case-2 (Lag)
Step-1a	**Identification of Hazard / Risk (Every Hazard/ Risk identified will get 0.4 marks**). Unsafe act and condition reported should be supported with before and after photographs/sufficient proof and validation.	**20**	**20**
Step-1b	**Selection of problem using Risk rating method**	**4**	**4**
Step-2\ (D)	**Defining and selection of Problem**	**8**	**8**
	Gannt Chart or Mile stone Chart	2.0	2.0
	Define the problem with the help of Flow Diagram / Pictorial depiction	6.0	6.0
Step-3 (M)	**Measure by Ascertain the Facts (Human, Physical, Systemic) and 4W + 1H**	**18**	**21**
	a) Physical Factor (facts with details)	4.0	4.0
	b) Human Factor (facts with details)	4.0	4.0
	c) Systemic Factor (facts with details)	4.0	4.0
	d) Approach for ascertaining the fact	2.0	2.0
	e) 4W + 1H	4.0	4.0
	f) Develop The Chronology (for Incident)	0	3.0
Step-4 (A)	**Analysis**	**27**	**27**
	a) Physical	5.0	5.0
	b) Human	5.0	5.0
	c) Systemic	5.0	5.0
	Approach & logic to find out root cause (systemic) with the help of Tree diagram / Cause & Effect diagram.	6.0	6.0
	Validation of Root Causes	6.0	6.0
Step-5 (I)	**Improve**	**14**	**11**
	Developing solution and Recommendation	**6.0**	**3.0**
	Record & communicate (After Approval granted)	**2.0**	**2.0**
	Implement		
	i) Use of PDCA Cycle.	**2.0**	**2.0**
	ii) Comparative milestone chart	**2.0**	**2.0**
	iii) Assess Gains	**2.0**	**2.0**
Step-6 (C)	**Control**	**9.0**	**9.0**
	Review by using appropriate tools		
Total Marks		**100**	**100**

Note Before: following bonus marks subject to maximum marks will not exceeding 49 marks

a) **1.5 bonus marks** if contractor worker is included in the team in Category -B

b) **Minus 1.5 Marks** if victim is not a part of team in case for incident Investigation (co-worker of victim if is he/she is not on duty).

Part-B: Case Study Presentation

Criteria	Criteria Description	Marks (Max-25)
Criteria -1	Sequence, Clarity, Team Participation, Smooth Change over from one speaker to another	5
Criteria -2	Time Management: How Circle has managed the time to explain the Project.	5
Criteria -3	Communication Skill & Confidence level	5
Criteria -4	Special Features	5
Criteria -5	Answering Satisfactorily & Correctly the Questions asked by the Judges.	5

Part-C: Knowledge Test: 20 Multiple Choice Question / 25 marks

A. Questions on Problem solving tools and techniques: **5 Questions**
B. Question on Safety: **15 Questions**

Abbreviations:

D : Define

M : Measure

A : Analyse

I : Improvement

C: Control

MTC: Medical Treatment Cases

FAC: First Aid Case

FIC: Factory Implementation Committee

DIC: Departmental Implementation Committee

UA: Unsafe Act

UC: Unsafe Condition

NM: Near Miss

Annexure-A

Table1.1: Format of Identification and Listing of hazard, Near Miss and Incident

Sl. No.	Hazard Identified	Type of hazard (P/H/E)**	Risk Score	Risk L/M/H /VH	Date/ Time	Name	ID No.	Location	Remark		Comp. Date	Remark if no compliance
									Photo Before	Photo After		
1.	Choking of hot air unclean flow & pressure line, may result in back fire	P = Y H = N E = Y		P= H= E=	DD/MM/YY HH/MIN				For Equipment/Environment damage description is sufficient, but it should be validated by shop HOD			
2.	Working at heigh with damaged manila rope tied by three persons.	P = N H = Y E = N		P= H= E=								
3.	An opening was found without side railing / cover at 5 mtr. level platform	P = N H = Y E = N		P= H= E=								
4		P= H= E=		P= H= E=								

NB: P=Property Damage or Process Interruption/Production Loss; H=Human Injury; E=Environment Damage

Signature
Validated by Facilitator

Seal and Signature
Approved by HOD

Annexure-B

Table 1.2: Format for Mile Stone Chart

Mile Stone Chart (PLAN)														
Safety Circle Name – Shanrakshan			**Department – Health Safety & Environment**											
Project Title :- Incident investigation on accident of scrap cutting operation at induction furnace division			Reason of selection –									Team name Rohit Shrivastva Karamjeet singh Bhuvan lal Sahu Mayank Mishra Gopal Sahu		
Date of Beginning			25/03/2022					Project No.- 01						
Date of Completion			03/04/2022											
S N	Steps	**Description**	**Days**										**Start**	**Finish**
			1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**		
2	**D**	Selection and defining the problem												
3	**M**	Ascertain the facts												
4		Develop the Chronology for Incident											27/03/2022	28/03/2022
5	**A**	Why Why analysis												
6		Identify gaps in the system											29/03/2022	30/03/2022
7	**I**	Developing Solution and Recommendation & Implementation											31/032022	01/04/2022
8		Record & communicate												
9	**I+C**	Control & Review											02/04/2022	03/04/2022

Annexure-C

What's the Problem?

What	**Problem (s)**	Titanic Sank, Ship Hit Iceberg	
When	**Date – Time**	April 14th, 1912 – 11:40 PM ship struck iceberg	
		April 15th – 02:20 AM ship breaks in two, underwater	
Where	**Difference**	Maiden Voyage, Late Spring, Iceberg Warnings	
	Business Location	Whitestar Line, UK – Passenger Ship, 1 of 3 ships	
	Geographic Location	North Atlantic Shipping Lane, Labrador Current	
		41º 46'N Latitude, 50º 14'N Longitiude	
	Physical Location	Right side of hull, Front compartments 1-6	
	Process Location	Route from Southampton, England to New York City	

Impact to the Overall Goals

Safety	Loss of 1500+ Lives	
	705 Survivors rescued by Carpathia	
Vessel	Loss of entire ship, $US	$ 7,500,000
Business	Bankruptcy of Whitestar Line	
	Liabillity for fatalaties, injuries	
		This Incident $ 7,500,000
Frequency	1st complete loss of passenger shipfor Whitestar Line	

Table 1.3: Example 4W + 1H (Done for Titanic Sink)

Annexure-D 1.1

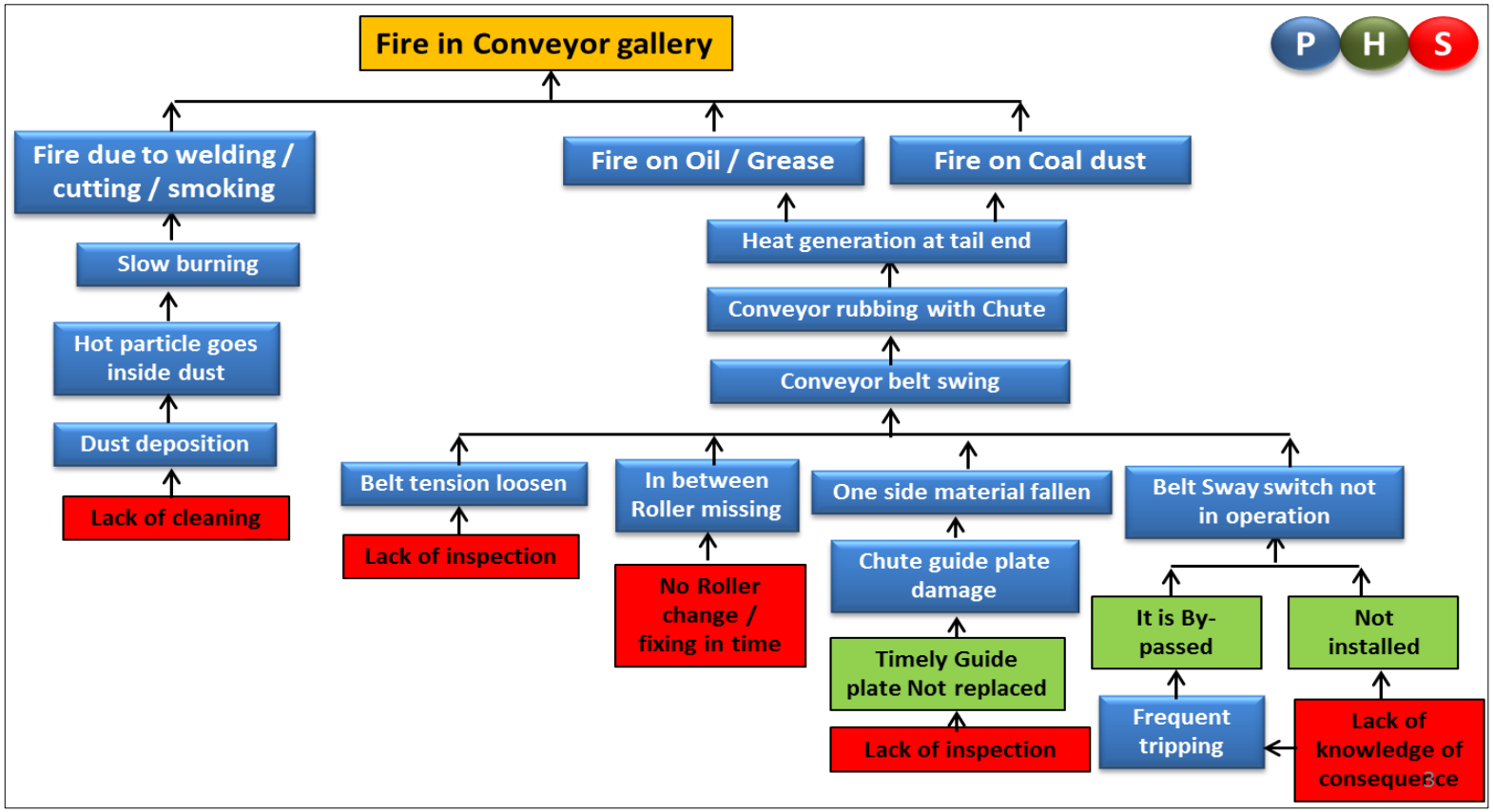


Fig.- 2.1: Tree diagram representing Root cause analysis for fire in Coke conveyor Belt

Annexure-D 1.2

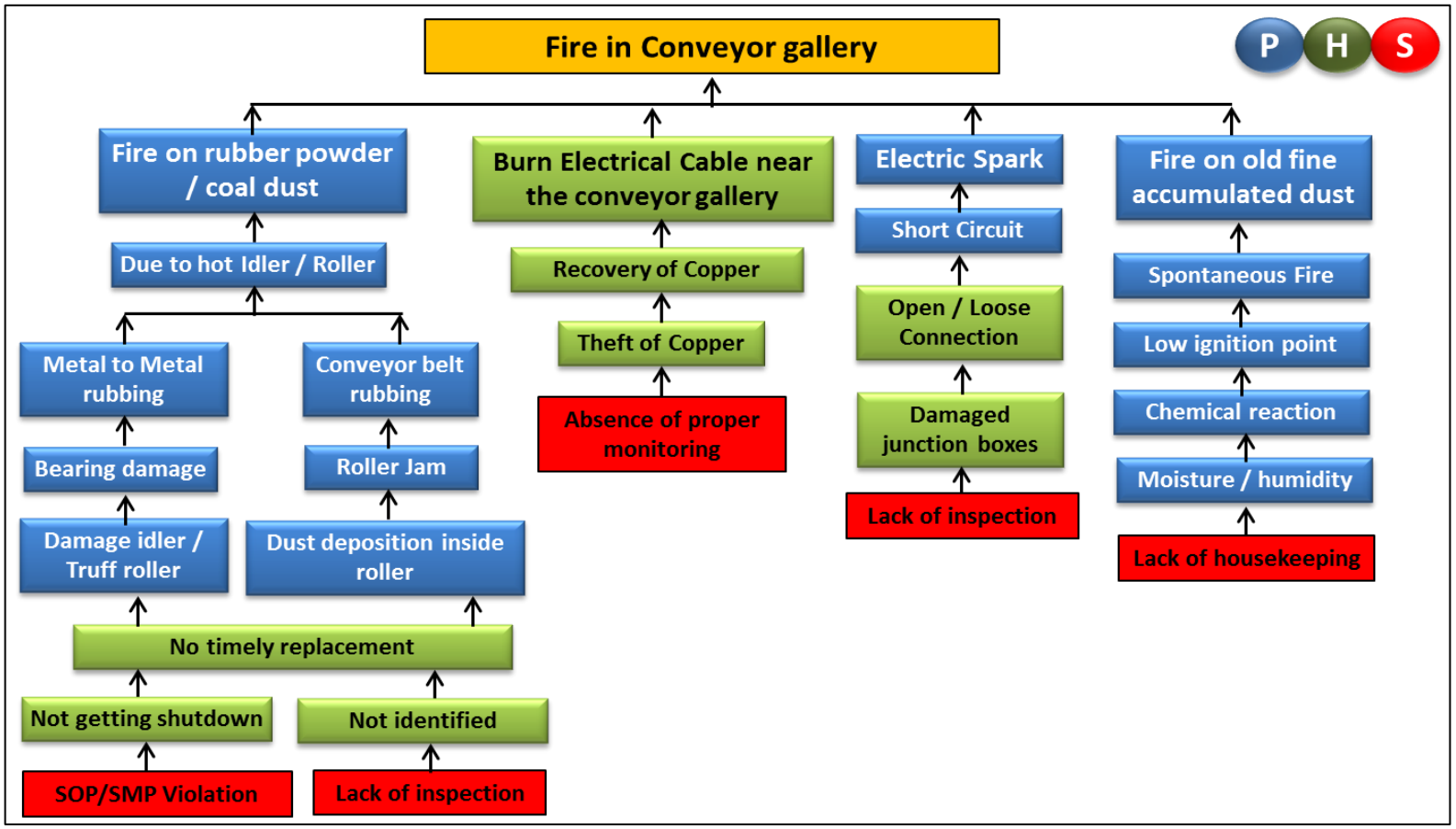


Fig.- 2.2: Tree diagram representing Root cause analysis for fire in Coke conveyor Belt

Annexure-E 2.1

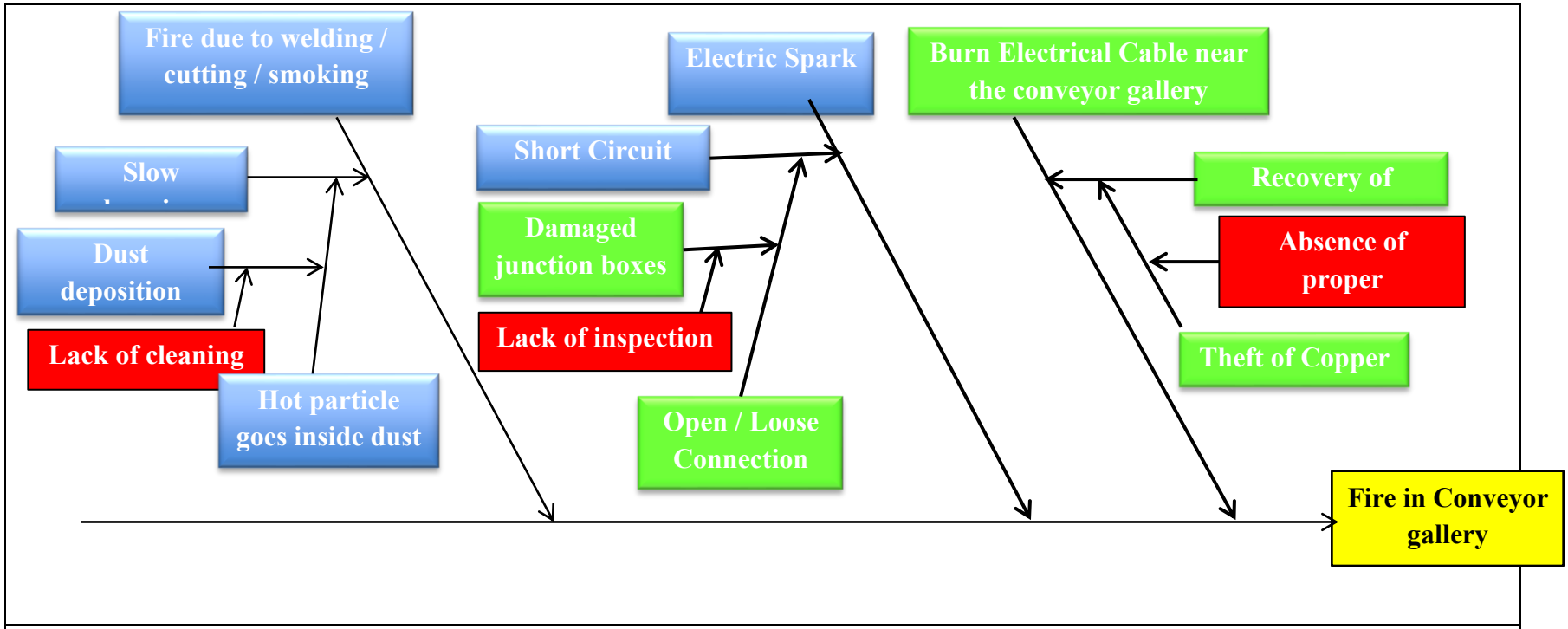


Fig.- 2.3: Cause and Effect diagram represent first arm of Root Cause Identified for fire in Coke conveyor Belt

Annexure- E 2.2

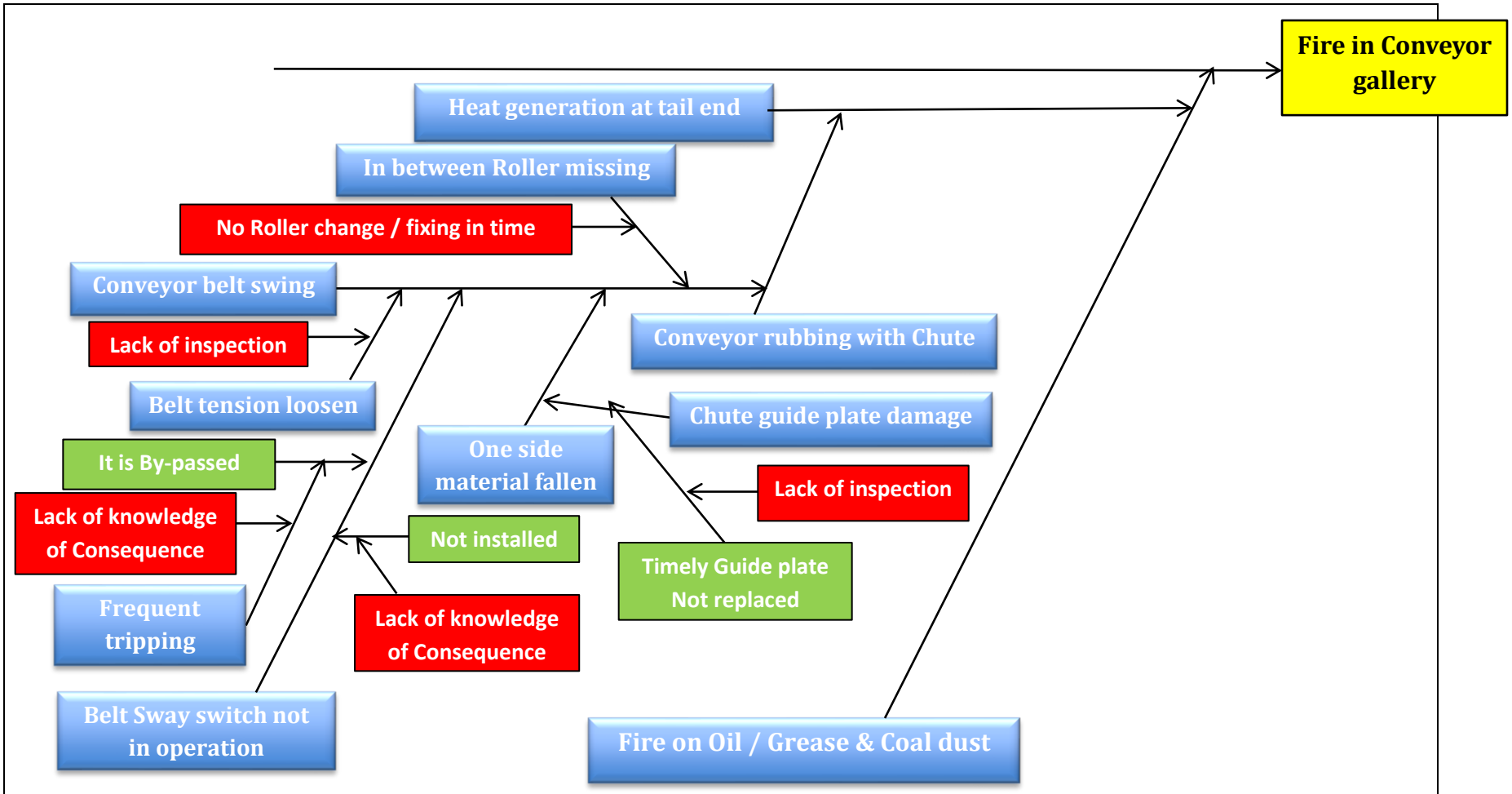


Fig.- 2.4: Cause and Effect diagram represent second arm of Root Cause Identified for fire in Coke conveyor Belt

Annexure- E 2.3

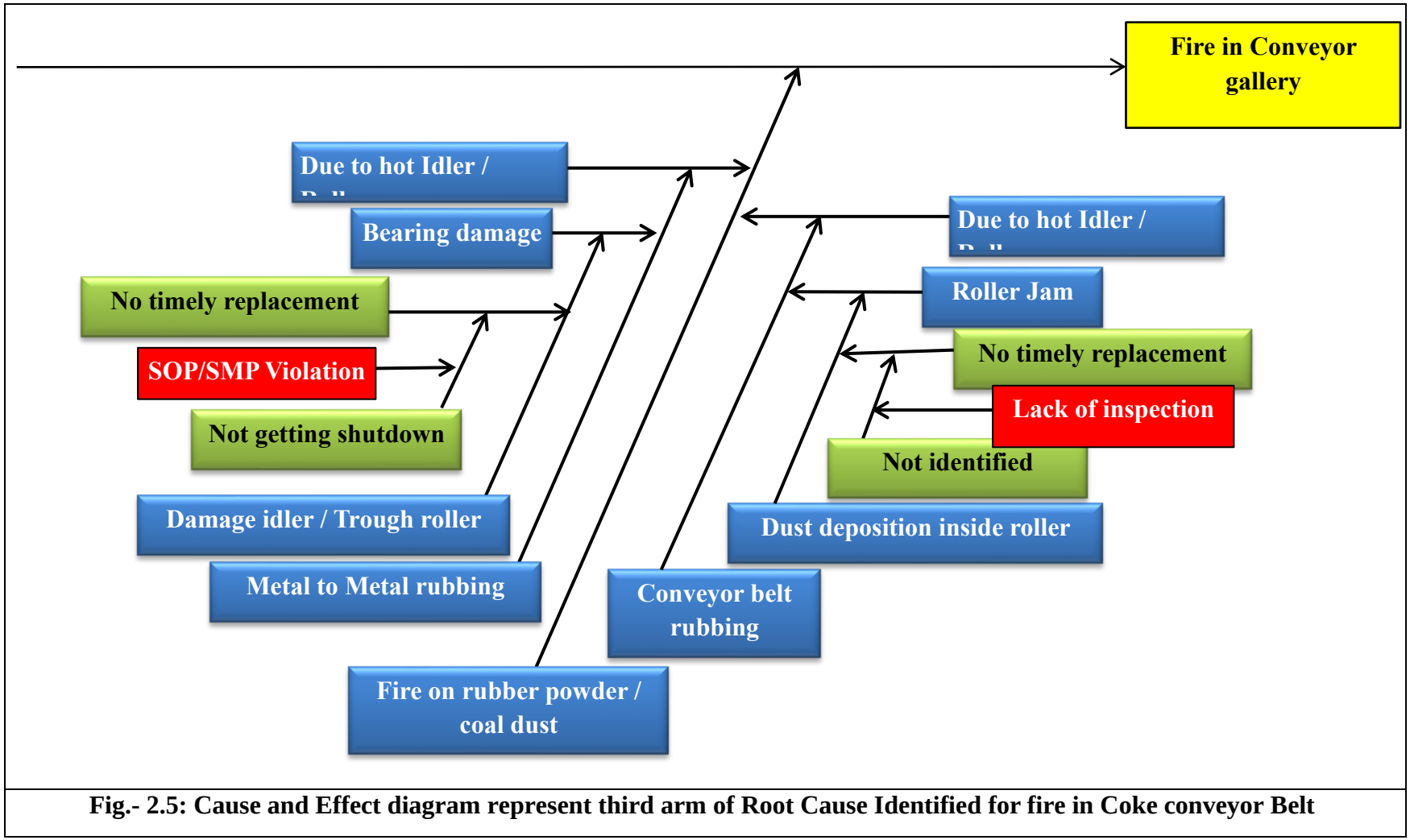


Fig.- 2.5: Cause and Effect diagram represent third arm of Root Cause Identified for fire in Coke conveyor Belt

Annexure-E2.4

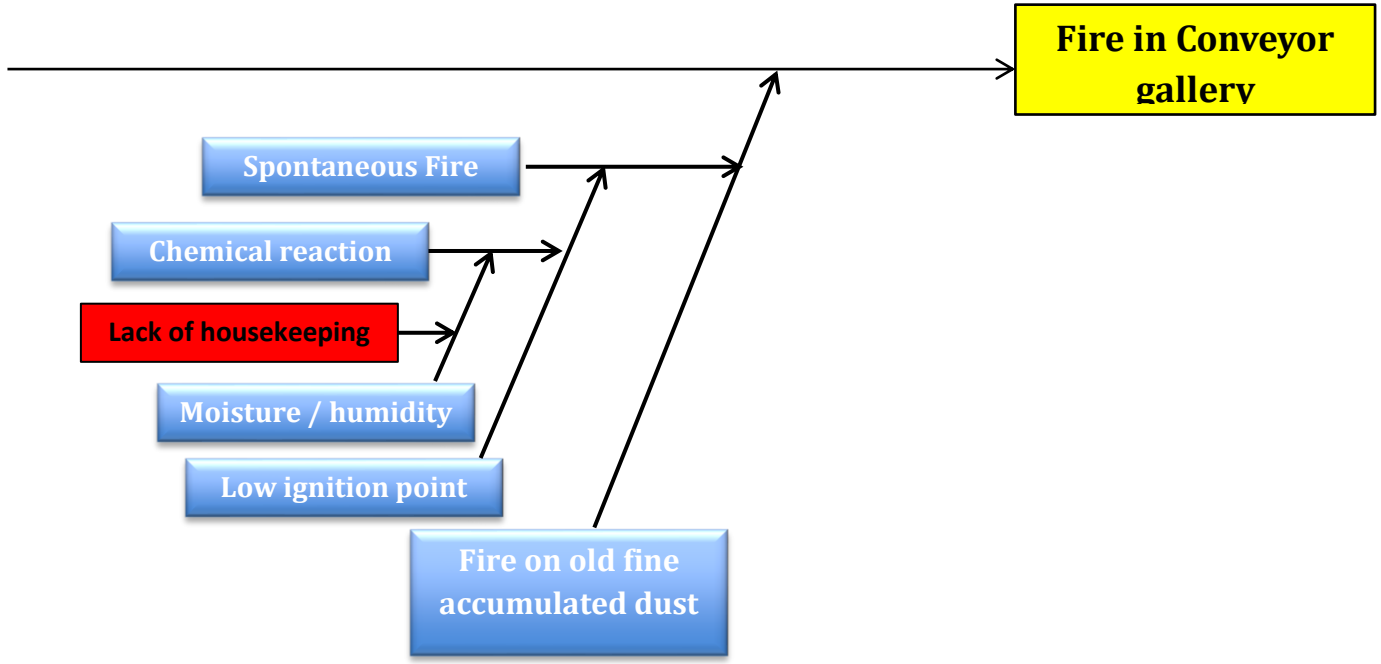


Fig.- 2.6: Cause and Effect diagram represent fourth arm of Root Cause Identified for fire in Coke conveyor Belt

Annexure-E 2.5

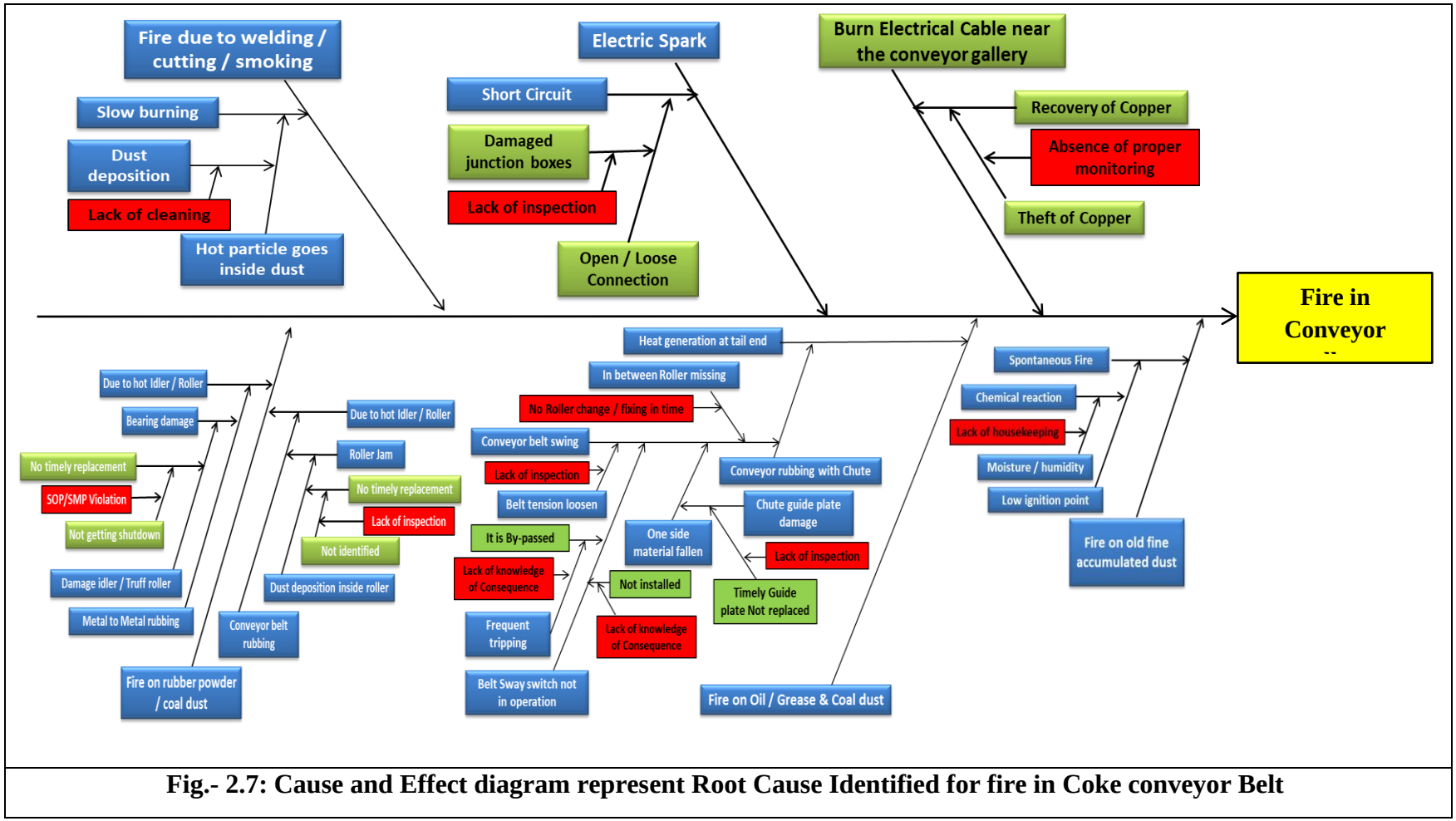


Fig.- 2.7: Cause and Effect diagram represent Root Cause Identified for fire in Coke conveyor Belt