LEARNING OUTCOME & RESOURCES

Learning Outcome

• Understanding the importance of critical thinking.
• Developing the skillset needed to conduct a root-cause analysis.
• Knowledge to apply different techniques to problem solving.

Resources

• REMC Company Handbook.

Workbook

Refer to complimentary exercises in your workbook.
THE PROBLEM

What might be the consequences of not understanding a problem in detail?

Discuss as a group and take notes in your workbook, exercise (16-1).
Critical Thinking
• Critical thinking is the **objective analysis of facts** to form a judgment.

• It is **aimed at achieving the best possible outcome** in any situation. It must involve gathering and evaluating information from as many different sources as possible.

• It is **based in the analysis of facts** rather than opinions.
  • **Facts** are information that is usually not debateable.
  • **Opinions** are subjective, value judgements based on isolated items (e.g. own experience, history) and can be debateable.
BENEFITS OF CRITICAL THINKING

• It helps with effective communication and problem-solving abilities.

• It helps to reflect in one's own beliefs. Provides the tools for the process of self-evaluation.

• It helps to evaluate new ideas, selecting the best ones and modifying them if necessary.

• It promotes the ability to deal with changes quickly and effectively.
HOW TO APPLY CRITICAL THINKING

Observe a situation: problem, symptoms, impacts

Analyse the situation: root causes

Decide an action to take and assess possible outcomes

Review the results of the decision, implement change where possible
Challenge: Detection of lead in wastewater after treatment discharge.

Observations:

• No Lead present in the incoming water to the facility.
• Mill did not use any dyestuffs/pigments/auxiliaries/chemicals during processing of material which might result in lead residues in wastewater before treatment.
• During treatment of wastewater mill uses ferrous sulphate as an ETP chemical.
• The ferrous sulphate is a by-product from another industry, containing a high amount of lead as an impurity.

Action to take:

• Inform procurement about the chemical specifications required.
• Conduct a quality control of incoming chemicals, including chemical testing.
• Substitute ferrous sulphate with an appropriate alternative.
CRITICAL THINKING METHODOLOGIES

Root Cause Analysis

• 5 Why’s
• Fishbone Diagram

Assessing Alternatives

• SWOT Analysis
• Decision Tree
• Cost Benefit Analysis

Problem Solving

• MAIC Methodology
Root Cause Analysis
FINDING THE ROOT CAUSE: 5 WHYS

1. Spillage of oil on shop floor
   - Action: Clean the oil

2. Machine is leaking oil
   - Action: Fix the generator

3. Gasket (sealing) deteriorated
   - Action: Replace the gasket

4. Bought cheap gasket
   - Action: Change purchasing policy

5. Evaluation of purchase manager on short term cost-savings
   - Action: Change evaluation policy for purchasing manager

6. Costs are too high
   - Action: Reduce unnecessary waste in all processes
EXAMPLE OF APPLYING 5 WHYS: PRODUCT LISTED ON RAPEX (1/2)


Version 1.4

Alert number: A12/1204/17
Category: Clothing, textiles and fashion items
Product: Ladies’ nightwear
Brand: Zeeman
Name: Unknown
Type / number of model: 28059
Batch number / Barcode: Unknown

Risk type: Chemical
The product contains the azo dye Disperse Yellow 23 (CI 26070) releasing an excessive amount of the aromatic amine 4-aminoazobenzene (measured value: 567 mg/kg). When the product is in direct and prolonged contact with the skin, the aromatic amine may be absorbed by the skin. Aromatic amines can cause cancer, cell mutations and affect reproduction.

The product does not comply with the REACH Regulation.

Measures taken by economic operators: Recall of the product from end users (By: Importer)
Measures ordered by public authorities (to: Importer): Ban on the marketing of the product and any accompanying measures
EXAMPLE OF APPLYING 5 WHYS: PRODUCT LISTED ON RAPEX (2/2)

Product recall due to aromatic amine 4-aminoazobenzene

Action: Take product back

Use of restricted Azo disperse dye for dyeing

Action: Avoid use of products containing restricted substances

No risk management performed for the dyestuff in the facility

Action: Perform risk assessment of all chemicals added to the chemical inventory

Dyeing manager not aware of the RSL requirement

Action: Train responsible employees on requirements

Procurement person not aware of the RSL requirement

Action: Improve internal communications

Brand requirement & RSL policy not communicated properly internally

Action: Set-up an internal process to reflect brand requirements
ADRESSING ROOT-CAUSE

A worker is handling a hazardous chemical without using personal protective equipment (PPE)

Why?

PPE was not provided

No considered necessary

SDS not available or used

The worn out PPE was not replaced

No funds made available

Worker has not reported

No procedure

The PPE is available, but the worker does not know how to use it

Worker not aware of need

No training

The PPE is available, but the worker does not want to use it

No enforce-ment

PPE not fitting

....

Properly analysing the situation will allow you to address the real causes in an effective and sustainable way.
## SUMMARY OF THE 5 WHYS

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>• It helps to quickly identify the root cause of a problem.</td>
<td>• If the cause is unknown to the person doing the problem solving it may not lead to any meaningful answers.</td>
</tr>
<tr>
<td>• It helps determine the relationship between the different root causes of a problem.</td>
<td>• If even one WHY has a meaningless answer, the whole procedure can be thrown off.</td>
</tr>
<tr>
<td>• It can be learned quickly and doesn't require statistical analysis to be used.</td>
<td>• It assumes that each symptom has only one sufficient cause. It may not reveal jointly sufficient causes that explain a symptom.</td>
</tr>
<tr>
<td></td>
<td>• The method isn’t necessarily repeatable; three different people applying 5 Whys to the same problem may come up with three totally different answers.</td>
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</tbody>
</table>
UNDERSTANDING THE SITUATION: FISHBONE DIAGRAM
FISH BONE DIAGRAM PROCEDURE

- Define problem statement (effect).
- Brainstorm the major categories of causes of the problem.
- Brainstorm all the possible causes of the problem. Ask: “Why does this happen?”
- Again ask “why does this happen?” about each cause.
- Write sub-causes branching off the causes.
- Continue to ask “Why?” and generate deeper levels of causes. Layers of branches indicate causal relationships.
<table>
<thead>
<tr>
<th>Cause</th>
<th>Effect</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dyestuff boxes are always open.</td>
<td>Exhaust system not available/not working</td>
<td>• Train the chemical store responsible person for how to open the dyestuff carton boxes, also, need to train on dyestuff handling and precaution to take care during weighing of dyestuff.</td>
</tr>
<tr>
<td>New dyestuff boxes weren’t opened properly and cover torn out completely.</td>
<td></td>
<td>• Ensure proper exhaust system working in place.</td>
</tr>
<tr>
<td>No trolley system available to carry dyestuff boxes near to weighing scale.</td>
<td>Dyestuff dust in chemical weighing room</td>
<td>• Ensure trolley system available in place to carry out boxes to weighing scale in case they are away.</td>
</tr>
<tr>
<td>Person responsible for weighing dyestuff carries the dyestuff in spoon from dyestuff box to weighing scale.</td>
<td></td>
<td>• Keep the regularly used dyes near to weighing area to avoid frequent use of trolley to carry out dyestuff boxes up to weighing scale.</td>
</tr>
<tr>
<td>Dyestuff boxes kept away from the weighing balance.</td>
<td>Person responsible for chemical weighing is not fully trained for handling of dyestuff.</td>
<td></td>
</tr>
</tbody>
</table>
## SUMMARY FISHBONE DIAGRAMS

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>• It is a visual tool which is very easy to understand and to analyse.</td>
<td>• Graphically speaking, all causes look equally important.</td>
</tr>
<tr>
<td>• It helps you identify the root cause of the problem.</td>
<td>• Sometimes effort is wasted in identifying causes which have little effect on the problem.</td>
</tr>
<tr>
<td>• It helps you to find bottlenecks in the process.</td>
<td>• Is based on opinion rather than evidence.</td>
</tr>
<tr>
<td>• It helps you identify ways to improve the process.</td>
<td>• This process involves a democratic way of selecting the cause, i.e. voting down the causes, which may not be an effective way of identifying causes.</td>
</tr>
<tr>
<td>• It involves in-depth discussion of the problem which educates the whole team.</td>
<td>• If the discussion is not controlled properly it may deviate from its objective.</td>
</tr>
<tr>
<td>• It prioritises further analysis and helps you take corrective action.</td>
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</table>
# SELECTING A ROOT CAUSE ANALYSIS METHOD

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
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</thead>
<tbody>
<tr>
<td><strong>5 Whys</strong></td>
<td><strong>Subjective</strong></td>
</tr>
<tr>
<td>Quick to perform</td>
<td>Subject to errors in determining more complex root causes</td>
</tr>
<tr>
<td><strong>Fishbone Diagram</strong></td>
<td><strong>Time consuming</strong></td>
</tr>
<tr>
<td>Visual</td>
<td>Needs guidance and consensus</td>
</tr>
<tr>
<td>Identifies complex root cause(s)</td>
<td></td>
</tr>
<tr>
<td>Identifies bottlenecks</td>
<td></td>
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<tr>
<td>Identifies improvements needed</td>
<td></td>
</tr>
<tr>
<td>Consensual definition of a root cause</td>
<td></td>
</tr>
<tr>
<td>In-depth discussion of the problem</td>
<td></td>
</tr>
<tr>
<td>Prioritises further analysis and corrective action</td>
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</table>
GROUP WORK

Consider the following situation in the factory. You see a worker handling Azo dyes without using personal protective equipment (PPE). There is a high chance that the worker may suffer from immediate lung problems.

**Group A**: What actions do you suggest using the 5 Why method?

**Group B**: What actions do you suggest using the Fishbone diagram?
Assessing Alternatives
EVALUATING ALTERNATIVES - SWOT ANALYSIS

A basic, analytical framework that assesses what a ‘solution’ can and cannot do, for factors both internal (the strengths and weaknesses), as well as external (the potential opportunities and threats).

**Strengths**
We have specialized staff to know how to set up, operate and maintain a photovoltaic plant.

**Weaknesses**
The set-up of a photovoltaic plant will require high investment and we do not have budget for new investments until 2019.

**Opportunities**
The government subsidies photovoltaic plants. We can enhance our reputation as environmentally friendly company.

**Threats**
Weather conditions (sunny days) might be unpredictable in our geographical area.

Invest in own photovoltaic plant
EVALUATING ALTERNATIVES – DECISION TREE

- Graphical representation of possible solutions to a decision based on certain conditions.
- Allows you to approach the problem in a structured and systematic way to arrive at a logical conclusion.
- Represents a documented record of the inputs that were available, the way you performed your evaluation and the reasons for the final decision.

Have an alternative to treat wastewater?

Yes

Have sufficient funding for it?

Yes

…

No

…

No

…

No

Have an alternative to treat wastewater?

Yes

…

No

…

No

…

We want to invest in own Wastewater Treatment Plant
EVALUATING ALTERNATIVES – COST BENEFIT ANALYSIS

- Quick and simple technique that you can use for non-critical financial decisions.

- Straightforward tool for deciding whether to pursue a project.

- You can include financial and intangible items into your analysis.

- Where decisions are mission-critical, or large sums of money are involved, this approach lacks complexity.
A university asks you to participate in a pilot project on waterless dyeing. If the project is successful, you will be able to save water and chemicals, plus the time from drying. The dyeing process is twice as fast as your current process.

The project is subsidised heavily, however your investment still is at 1 Million USD. Could this be of interest for you? Use one of the methods to evaluate this case.
Problem Solving
# PROBLEM SOLVING: MAIC METHODOLOGY

<table>
<thead>
<tr>
<th>Measure</th>
<th>Analyse</th>
<th>Improve</th>
<th>Control</th>
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<tbody>
<tr>
<td><strong>1) Describe the Problem</strong></td>
<td><strong>4) Identify the Root-Cause</strong></td>
<td><strong>5) Analyse Existing Data</strong></td>
<td><strong>9) Determine Best Solution</strong></td>
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<td>IS</td>
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<td>What</td>
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<td>Where</td>
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<td>Extent</td>
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<td><strong>2) Measure the Magnitude of a Problem</strong></td>
<td><strong>6) Construct List of Verified Facts</strong></td>
<td><strong>7) Compare Causes to Facts</strong></td>
<td><strong>10) Pilot Solution</strong></td>
</tr>
<tr>
<td>VOLC, SO2, BIO, O2A, CFS, FLUX, SEASPRAY, BB, ENMS, BB, DIAM</td>
<td>All natural</td>
<td>Fact 1</td>
<td>Fact 1</td>
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<tr>
<td>Fact 2</td>
<td></td>
<td>Cause 1</td>
<td>x</td>
</tr>
<tr>
<td>Fact 3</td>
<td></td>
<td>Cause 2</td>
<td>o</td>
</tr>
<tr>
<td>Fact 4</td>
<td></td>
<td>Cause 3</td>
<td>x</td>
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<td><strong>3) Determine when the problem started</strong></td>
<td><strong>8) Collect additional data until root cause is identified</strong></td>
<td><strong>11) Verify Solution Works</strong></td>
<td><strong>12) Control Plan</strong></td>
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Open To Questions
Each participant to feedback with one key learning from this session.

Take notes in your workbook, exercise (16-4).
Based on the GIZ REMC Toolkit; adapted by MADE-BY and STS on behalf of Rewe Group, Tchibo GmbH and GIZ in cooperation with develoPPP.de and the Partnership for Sustainable Textiles

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