

Content-10: Root Cause Analysis

Orientation

What can this unit help you with?

You may use this unit if you

- Have to find out the root causes of any problem identified in a factory in the context of chemical management;
- Have to comprehend the underlying causes behind a symptom or a problem and find their relationships;
- Are asked to identify and describe a problem and suggest a long-term solution to prevent the problem from recurring;
- Want to solve any problem in all spheres of your life because once you know the methods, the application process is more or less all the same.

Intended results of the unit

- Students are capable of using the two most widely used tools for root cause analysis;
- Students can manage to dig deep into the root causes for any given problem;
- Students have a deeper understanding of root cause analysis and the significance of using it for a sustainable solution;

Input

Root Cause Analysis, a popular and widely-used technique, helps people answer why a problem occurred in the first place. It seeks to identify the origin of a problem using a specific set of steps, with associated tools, to find the primary cause of the problem, rather than addressing the casual causes so that it can be determined what exactly happened, why it happened and figure out the way to reduce the likelihood of its occurrence.

Unless You Uproot the Weed, It Will Grow Again!

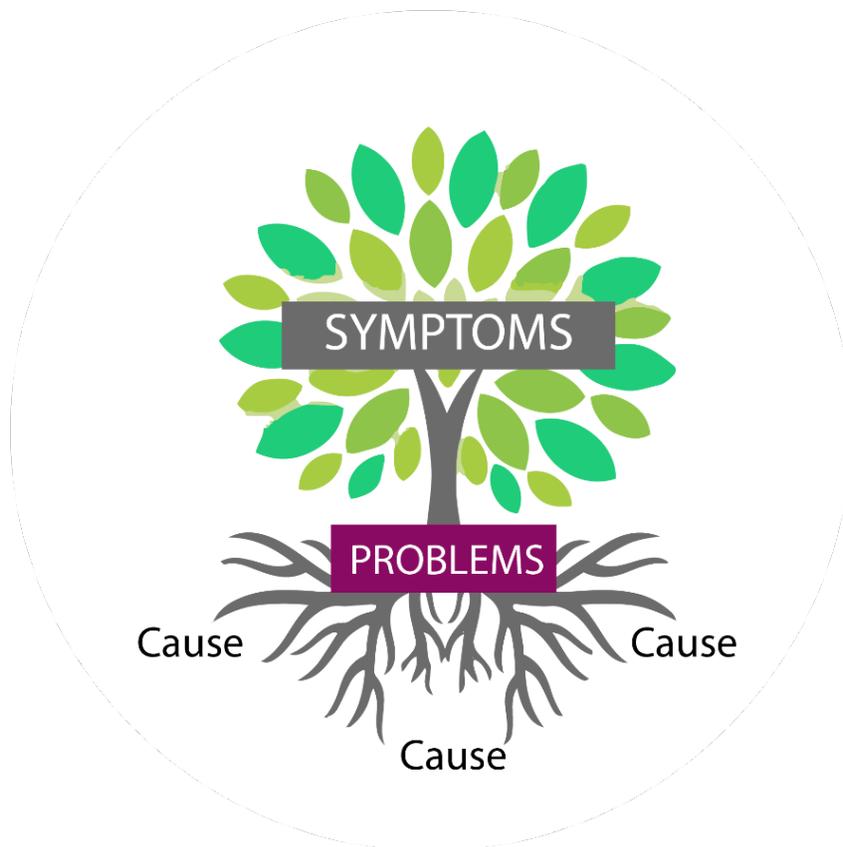


Figure 1: Symptoms, problems and their root causes. (Source: Kazi Farhan Hossain Purba)

Only treating the symptoms of a problem does not give any proper solution. Problems are just like a deeply rooted weed. Unless it is uprooted, it will grow repeatedly, which means action should be taken on the root, not the symptoms. Root Cause Analysis gives an opportunity to work on the underlying roots of a problem and prepare a sustainable solution against them.

A Story of Solid Rocket Booster and Roman Horses' Ass!

In order to relate to the concept of root cause analysis in the context of planning interventions, we will see an interesting example first, then learn to use two different tools to dig out the root causes of factory problems.

US railway gauge is 4 feet 8.5 inches or 1.4351 meters. If we want to know why, the superficial reason can be railways in the US were built with the same gauge as those in the UK. But it is not quite satisfactory enough. We can ask again and know that it happened because the same people who built the railways also built the trams in the UK. Not being fully satisfied, we can ask again and know that they used the same lathe and tools for trams as for horse carriage with the same wheel stand. Asking another 'why', we can know that it is because wheel stands had to be adjusted to existing routes in the long-distance roads in the UK. Finally, asking the fifth why we can get a satisfactory root cause: the routes were created by Roman chariots that had the wheel stand to make space for horses towing the Roman chariots!

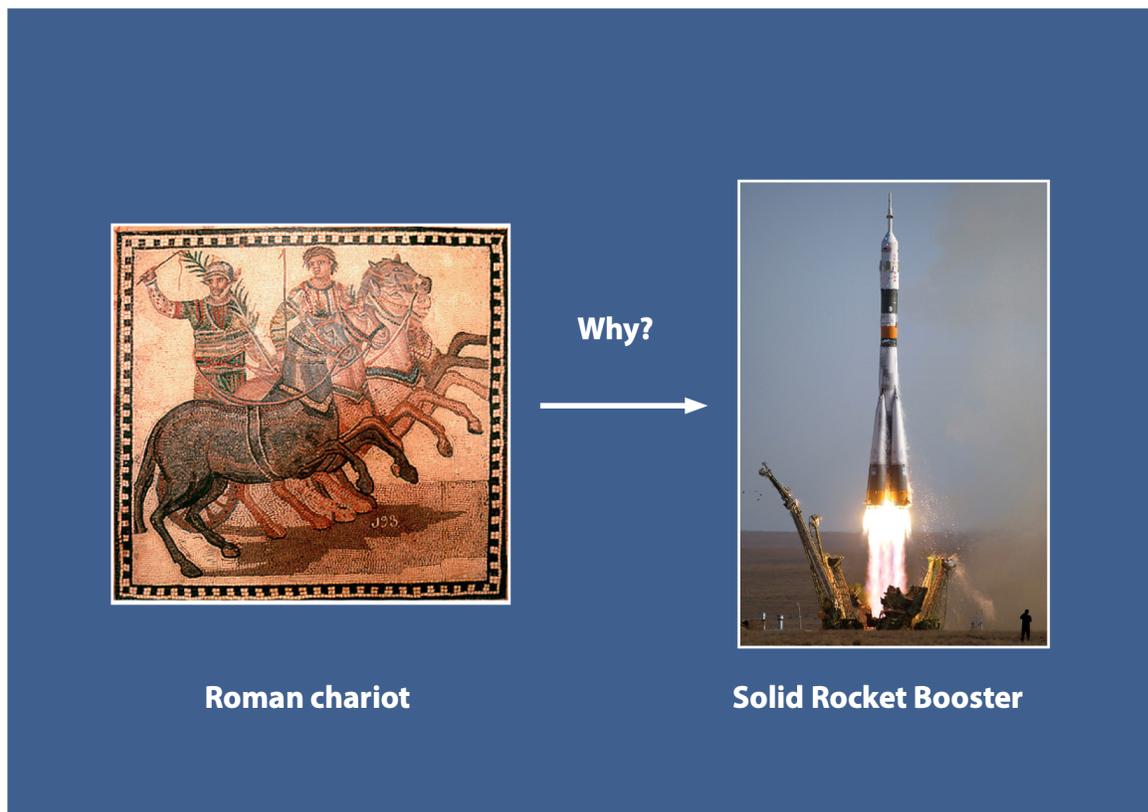


Figure 2: Roman chariots and Solid Rocket Boosters have a strange relationship.

Image source: Unsplash.com, Collage done by Marie Akoury for Edutex

But what could that have to do with the space shuttle? Solid Rocket Booster (SRB) is an essential part of the Space Shuttle produced by M/s Thiokol in Utah. The engineers wanted bigger SRB and failed. But why? The SRB had to be transported by railroad from the plant to the NASA launch base. The railway passes through the railway tunnel. And the tunnel size is a little larger than rail gauge. That means an important feature of one of advanced means of transport has its root in the size of Roman horses 'ass! Apart from root cause analysis, it is hard to imagine that Roman horses 'ass is the reason of the size of the US railway gauge to be 4 feet 8.5 inches, and it is indirectly linked to the transport that goes for space expeditions. Similar to this, in every given situation, including chemical management, a symptom or a problem statement can also be rooted as deep as this!

Tools for Root Cause Analysis

Some tools are available to analyse the root causes such as Pareto chart, the five whys, fishbone diagram, scatter diagram, Failure Mode and Effects Analysis (FMEA). Here we will talk about the most widely used tools: The five whys and the Fishbone diagram which will come handy in analysing root causes of a critical situation or identified gap.

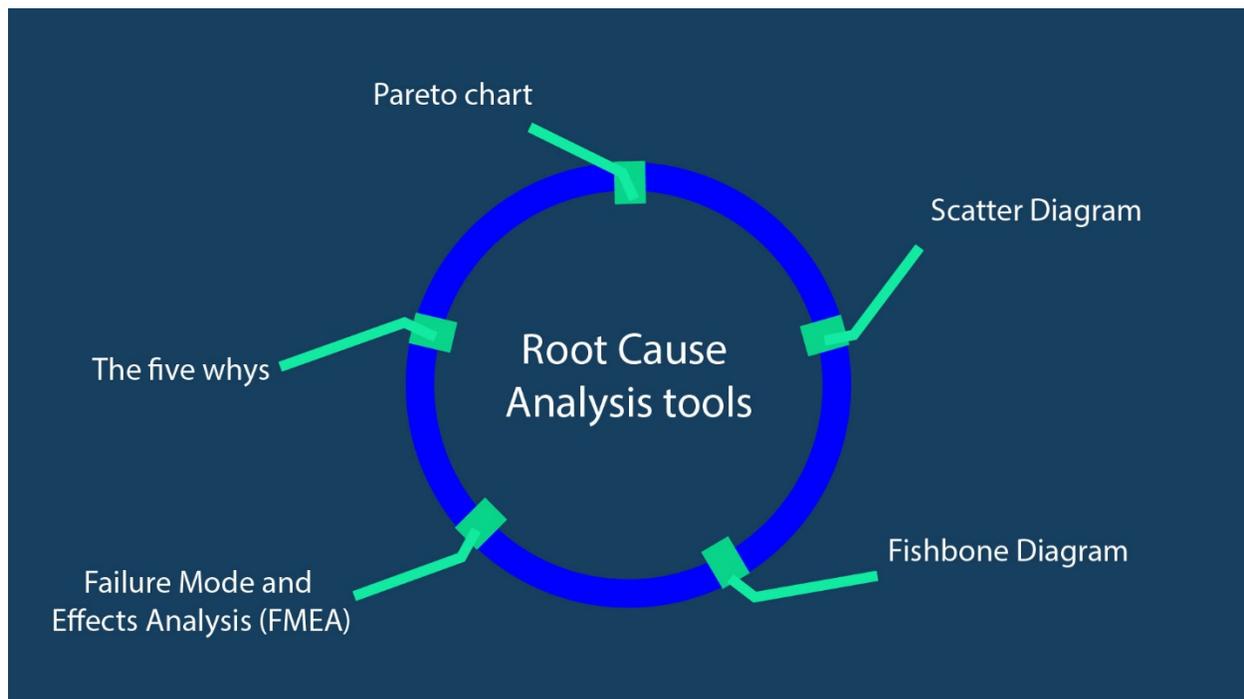


Figure 3: Root Cause Analysis tools. (Source: Kazi Farhan Hossain Purba)

Let's Begin with the Five Whys

The five whys is an interrogative technique used to explore the cause-and-effect relationships underlying a particular problem. The primary goal of the technique is to determine the root cause of a defect or problem by repeating the question "Why?"

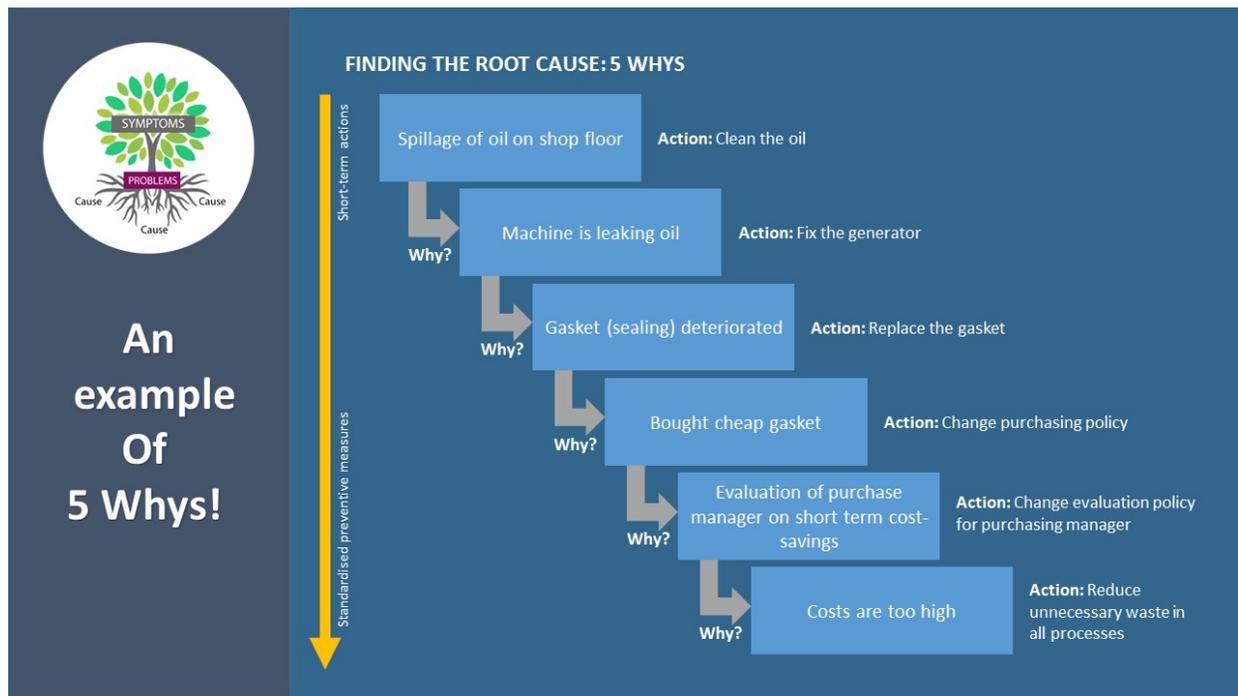


Figure 4: An example of 5 Whys. (Adapted from REMC GIZ by Kazi Farhan Hossain Purba)

Here we can see an example of implementing 5 Whys.

The identified problem is the spillage of oil on the production floor. The immediate action can be cleaning the oil, but it's just a short-term solution. It's just like cleaning the weeds rather than uprooting them permanently. So, we need to dig deep into the root cause.

After asking **why** we get to know that machine is leaking oil. Action for that can be fixing the generator.

If we continue to ask **why** we find the answers and actions respectively: Gasket (sealing) deteriorated, Action: Replace the gasket; Bought cheap gasket, Action: Change purchasing policy; Evaluation of purchase manager on short term cost-savings, Action: Change evaluation policy for purchasing manager; Costs are too high, Action: Reduce unnecessary waste in all processes.

We can see that the first level of actions gives short term solutions. On the other hand, the action against the deepest-rooted cause gives the most sustainable solution. So, for this example, the bottom line is, if we can reduce the unnecessary waste in all processes, we can ultimately

find a sustainable and a relatively permanent preventive measure for the spillage of oil on the production floor.

Fishbone Diagram

Now we'll get familiar with Fishbone Diagram/ Ishikawa Diagram, a useful tool developed by Professor Kaoru Ishikawa, which is also known as cause-and-effect diagram. The structure of this diagram looks like a fishbone.

To use the tool, we need to follow these steps:

- 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.

We will continue to ask "Why?" and generate more profound levels of causes.

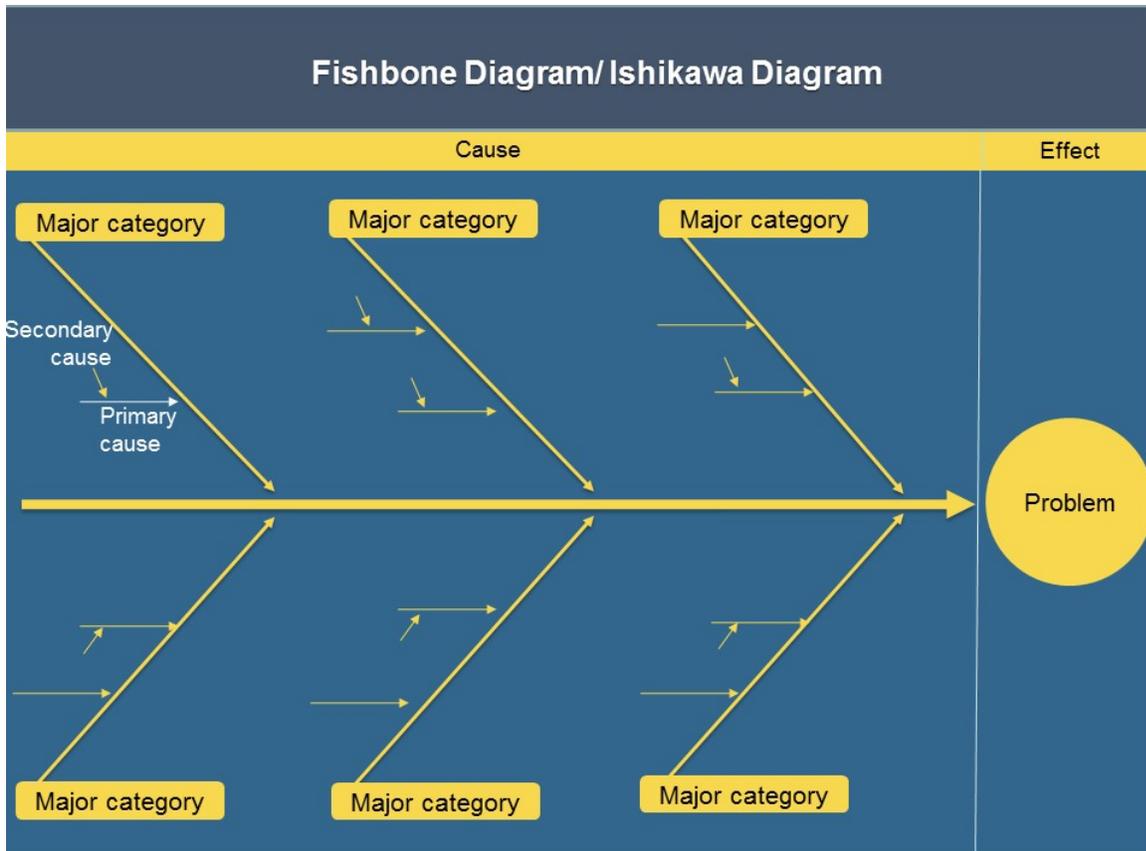


Figure 5: The structure of Fishbone Diagram. (Source: REMC GIZ)

Here in the structure, you can see that there's a problem section which has a cause-and-effect section where we have brainstormed all the major or main cause categories, then primary causes and the secondary causes of each major categories. Generally, the main categories are Man, machine, material, methods, measurement, environment.

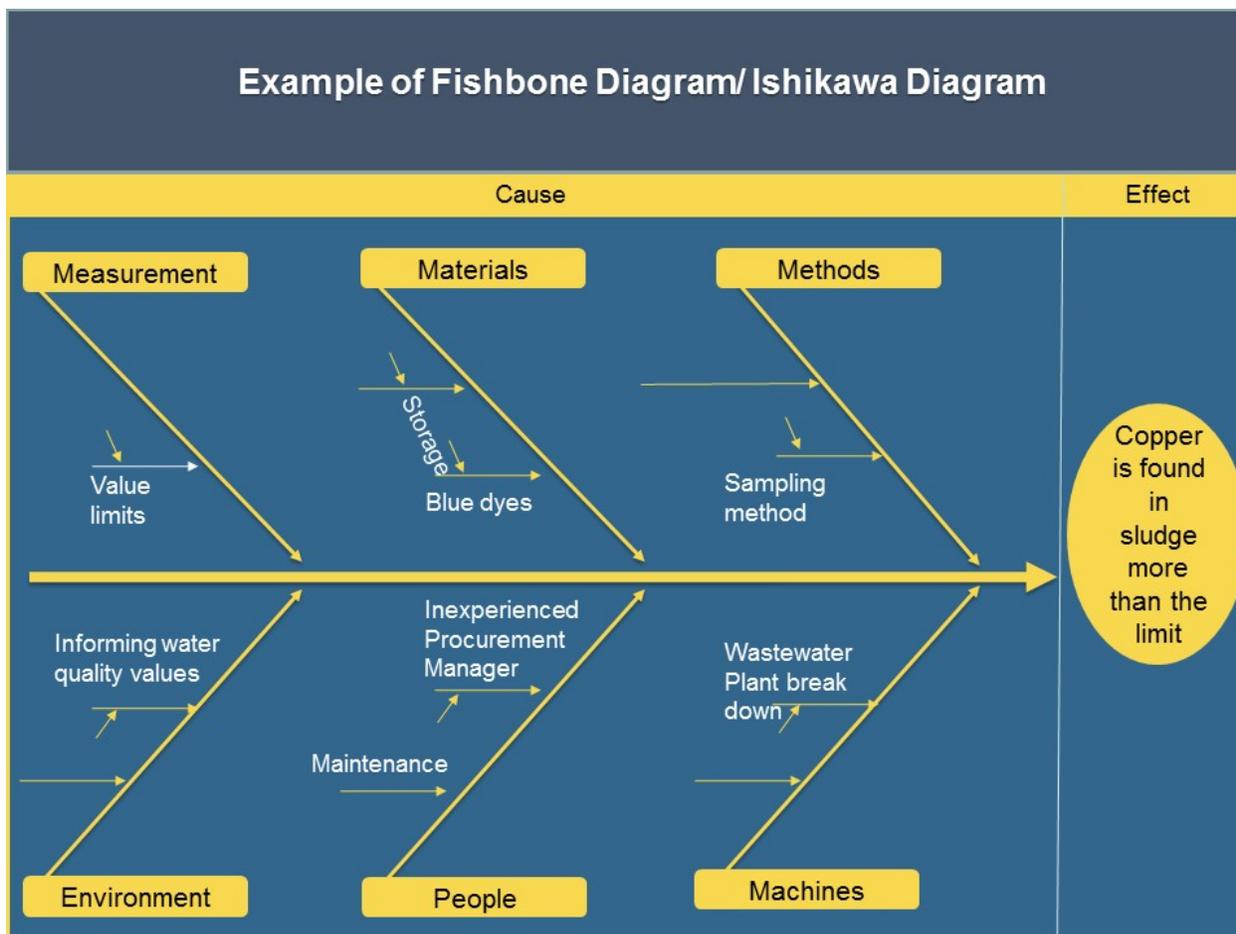


Figure 6: An example of Fishbone Diagram. (Source: REMC GIZ)

Here's an example of a Fishbone diagram!

Here the problem statement or the effect is 'Copper is found in the wastewater sludge more than the limit.'

Now the main categories of causes like Measurement, materials, methods, etc., are written down and brainstormed. Then we have to brainstorm the possible sub-causes. For example, the sub-cause or the primary cause of the main category of cause-'Methods' and 'Machines' are Sampling method and Wastewater plant break down, respectively. In this way, you can brainstorm more sub-causes, i.e. secondary causes, in other words, the sub-cause of those sub-causes and continue.

Why Root Cause Analysis is Extremely Important for Us?

One of the most important benefits of Root Cause Analysis is that it finds the fundamental errors in any development process, enabling us to enact the most appropriate measures to fix the problems that stops them from recurring ahead. In the chemical factory, the sooner the identification of a problem and finding a solution is better. As a result of that, there is a lesser rework and fewer defects. Besides that, Root Cause Analysis offers us the following benefits:

- **Reduction of cost:** The cost of fixing defects increases later the defects are found in the process. So, it is always easy and cheap to solve problems by solving the root causes.
- **Profound identification of causes:** To stop recurring effects, Root Cause Analysis helps answer questions and find the real (root) cause of the problem and not just the obvious cause.
- **Improve safety and reliability:** As Root Cause Analysis helps reduce the number of defects in the future, it can be beneficial to chemical factories where product reliability and safety are mainly important.
- **Enhance time to market:** On finding the root cause of a defect and taking the subsequent corrective action, releases of the product take less time in testing like Manufacturing Restricted Substances List (MRSL), Restricted Substances List (RSL) tests and the product is released in the market sooner with lesser uncaught defects.

Didactic elements

Quizzes and self-tests:

True-false

1	The action taken against the deepest-rooted cause gives the most sustainable solution.
<input type="checkbox"/> Correct <input type="checkbox"/> False	<input checked="" type="checkbox"/> Correct <input type="checkbox"/> False
2.	The 5 Whys method isn't necessarily repeatable; three different people applying this tool to the same problem may come up with three totally different answers.
<input type="checkbox"/> Correct <input type="checkbox"/> False	<input checked="" type="checkbox"/> Correct <input type="checkbox"/> False

Open Questions:

1	For which purposes can you use 5 Whys in your factory?	
	<i>Open text</i>	<p>The 5 whys is an interrogative technique used to explore the cause-and-effect relationships underlying a particular problem. The primary goal of this technique is to determine the root cause of a defect or problem by repeating the question "Why?". Using this root cause analysis tool, we can analyse the underlying causes of an identified problem of the hotspots/critical areas of a factory and determine action for each cause. Using this technique, we continue to ask "Why?" and generate more profound levels of causes. Finally, by taking action against the deepest-rooted cause, we get the most sustainable solution for our identified problem.</p>
2	Please describe how you can use The 5 Whys to solve your real-life problems.	
	<i>Open text</i>	<p>First, I will identify the main problem which I want to solve. I will find the symptoms or effects of that problem. Then I will brainstorm the causes underlying that problem or symptom by asking the question 'Why?'. The more 'why's I'll ask, the more profound answers I'll get. When I'll get the most deeply rooted cause, I'll take action against it and make sure it doesn't happen again. Thus, I'll be able to solve my problem from the root, using the 5 Whys tool.</p>

1	Which of the following statements describes the benefits of Ishikawa diagram? (Choose multiple)	
	<p>£ It is a visual tool which is very easy to understand and to analyse.</p> <p>£ It helps you identify the root cause of the problem.</p> <p>£ It involves an in-depth discussion of the problem.</p> <p>£ It is based on opinion rather than evidence.</p> <p>£ It prioritises further analysis and helps you to take corrective action.</p>	<p>ç It is a visual tool which is very easy to understand and to analyse.</p> <p>ç It helps you identify the root cause of the problem.</p> <p>ç It involves an in-depth discussion of the problem .</p> <p>ç It prioritises further analysis and helps you to take corrective action.</p>

Sorting tasks:

Sort the words to the correct sentences:

structure	symptom	head
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1. Only treating the ___ of a problem doesn't give any proper solution.
2. The ___ of the diagram looks like a fishbone. That's why it is so-called.
3. The defined problem statement is in the ___ part of the Fishbone Diagram.

Answers:

1. symptom
2. structure
3. Head

Sort text to elements:

The 5 Whys	Ishikawa Diagram

- a. Finds the root causes by asking multiple layers of repeated questions
- b. Looks like a fishbone
- c. Developed by Professor Kaoru Ishikawa
- d. Quick to perform
- e. Time consuming

Answer:

The 5 Whys	Ishikawa Diagram
<p>Finds the root causes by asking multiple layers of repeated questions</p> <p>Quick to perform</p>	<p>Looks like a fishbone</p> <p>Developed by Professor Kaoru Ishikawa</p> <p>Time consuming</p>

Imagine the situation below:



1 of 1 photo

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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

Image source: [European Commission, Safety Gate: Rapid Alert System for dangerous non-food products.](#)

Eastside Ltd. is in the garment manufacturing business with world reputed brands for a long time. But recently their products are failing in the RSL test and getting listed on RAPEX for the presence of the aromatic amine 4-Aminoazobenzene from Azo colorants. This is greatly hampering their business by downgrading their image to the buyers. To keep their business and preserve their good will, they are desperately trying to find out why this RSL failure is occurring. For the company, you have to do the following tasks:

- Figure out the root causes
- Suggest possible solutions

Hotspots

Which of these persons came up with the idea of Fishbone Diagram?

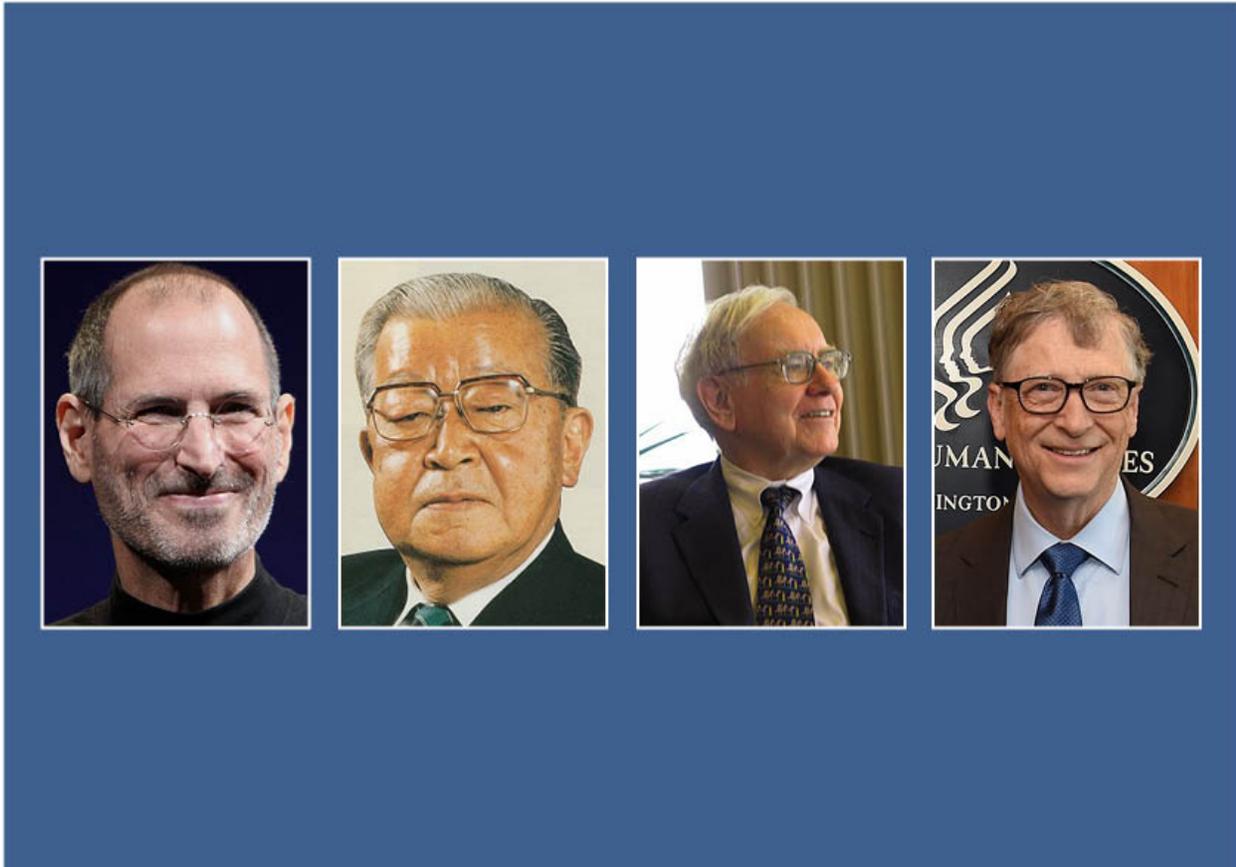


Photo sources:

Wikipedia.com, Collage done by Marie Akoury for Edutex

Answer:



Figure 7: Kaoru Ishikawa

References/additional literature/links

- (1) Resource Efficient Management of Chemicals (REMC), Promotion of Social and Environmental Standards in the Textile Industry, GIZ Dhaka: <https://www.sia-toolbox.net/solution/resource-efficient-management-chemicals-textile-and-leather-sector-companies>
- (2) More information on root cause analysis and its processes can be found here: https://www.mindtools.com/pages/article/newTMC_80.htm#:~:text=Root%20Cause%20Analysis%20is%20a,understanding%20and%20solving%20a%20problem.&text=As%20an%20analytical%20tool,%20RCA,and%20factors%20leading%20to%20them.
- (3) More information on the Importance of Root Cause Analysis during incident investigation can be found here: <https://www.osha.gov/Publications/OSHA3895.pdf>
- (4) More about the importance of root cause analysis can be found here: <https://www.techarcis.com/why-is-root-cause-analysis-extremely-important/>
- (5) To know more about the 5 Whys and how to use it, you can go to this link: <https://kanbanize.com/lean-management/improvement/5-whys-analysis-tool>
- (6) To know more about how to use Fishbone diagram, you can go to this link: <https://www.cms.gov/medicare/provider-enrollment-and-certification/qapi/downloads/fishbonerevised.pdf>

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How did the technical elements of the unit work for you? Did you have any difficulties?

Didactical Elements

How did the didactical structure of the learning unit work for you? Do you have any comments or suggestions to make it better?

Open

Do you have any other comments on this unit?

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