Cause-and-Effect Diagram

Or

Fishbone Diagram

Cause-and-Effect diagram was invented by one of the Quality Gurus, Dr. Kaoru Ishikawa in mid 19th century. That’s why it is also known as Ishikawa diagram.

What is Cause-and-Effect Diagram or Fish Bone Diagram

- Cause-and-Effect Diagram is a chart that identifies potential causes for particular problem.

- They are often called Fish-bone Diagrams because they look like the bone structure of a fish.

- Cause-and-Effect analysis is a technique for identifying the causes (inputs) associated with a particular problem / effect (output). The main causes are then further divided into sub-causes to find out all the possible causes those are responsible for the effect (output).

- It is typically worked right to left, with each large ‘bone’ of the fish branching out to include smaller bones containing more detail.

- Cause and Effect analysis is usually carried out by a group who all have experience and knowledge of the cause to be analyzed.

- It takes each cause one by one and then studied to eliminate those causes which are not responsible for the main effect, this is known as process of elimination

Basic Use of the Cause-and-effect diagram

The Cause-and-Effect Diagram is basically used to investigate a problem or effect by exploring, identifying, and displaying all the possible causes.

Why to implement this diagram?

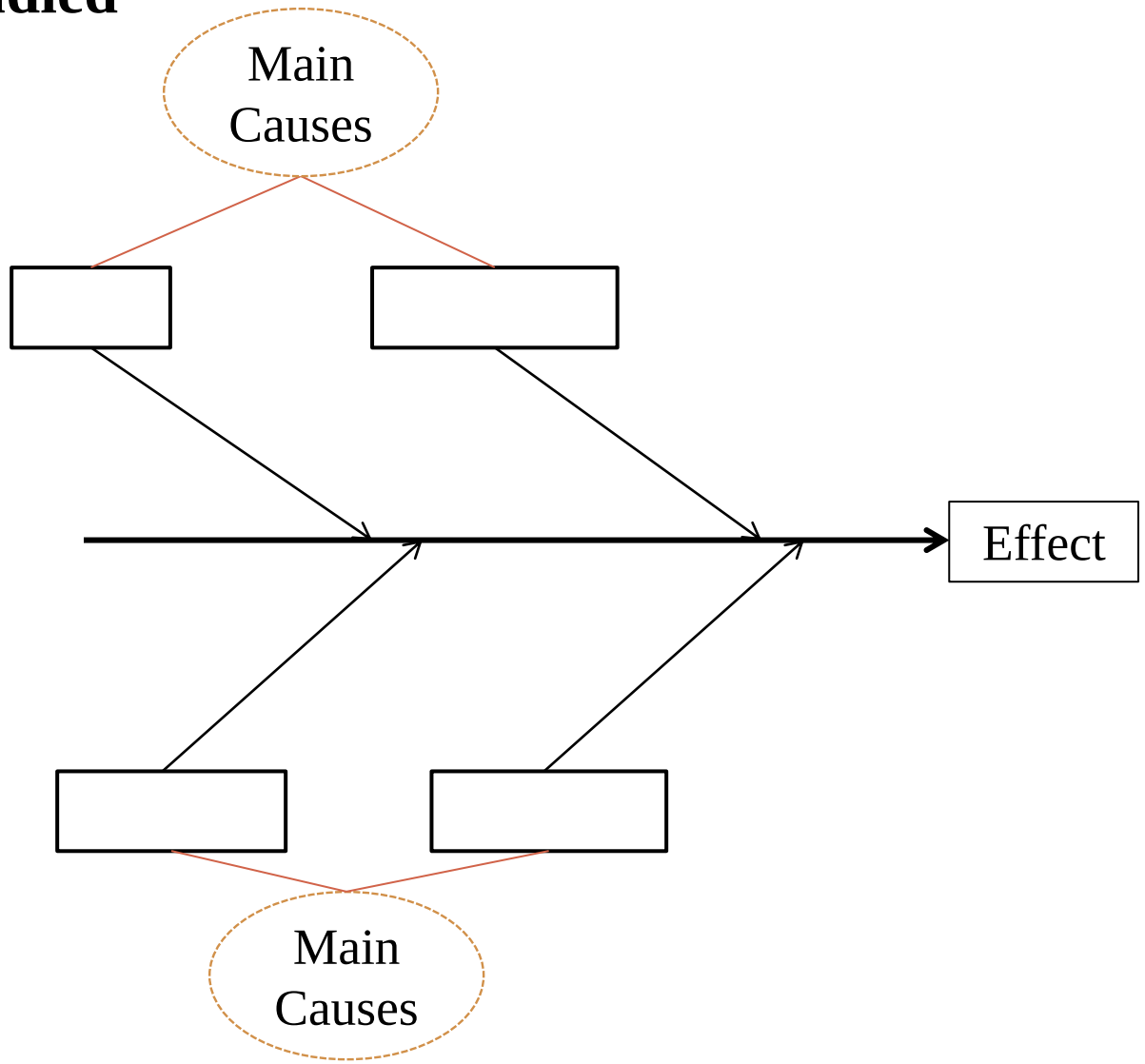
- It is a structured approach to determine all the possible causes for a particular problem.
- To find out all the causes, brain storming is an important part of it and it also encourages group participation.
- There is no complex mathematical equation involved. It is an orderly, easy-to-read format to relate cause-and-effect relationships.
- It indicates the parameters or causes by controlling which, the main problem can be avoided.
- It helps to construct new action plans to avoid a problem for more reliable performance.

Steps to draw a Cause- and-Effect Diagram

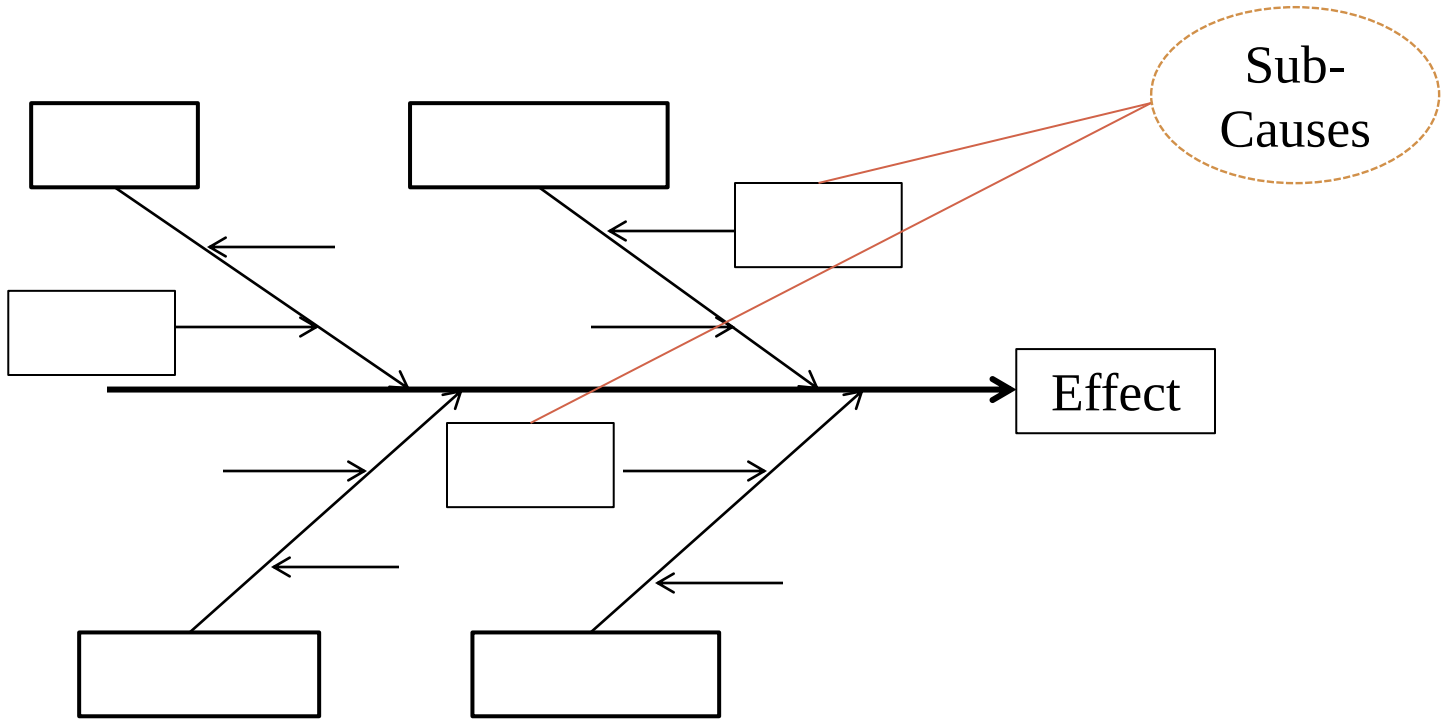
STEP 1: Identify the main Problem/Effect to be studied

STEP 2: Draw the Spine and at the end of it draw the Effect box.

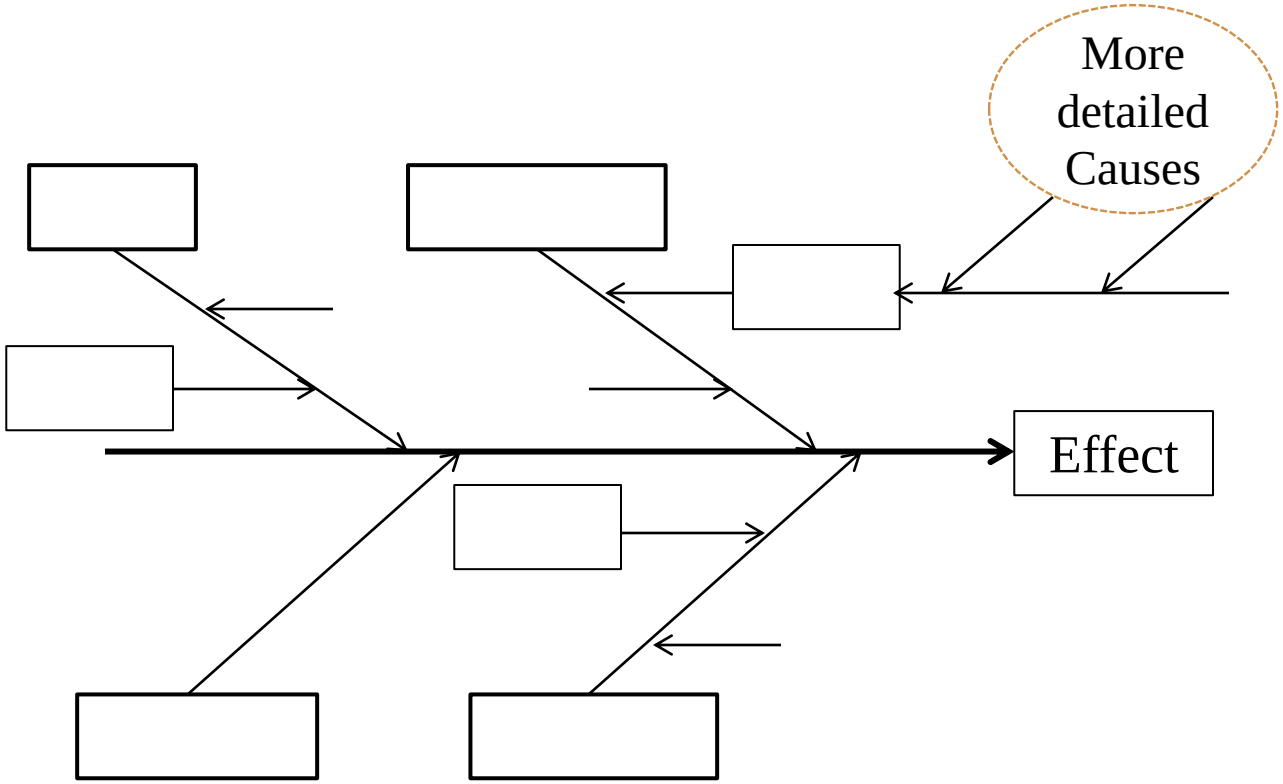
STEP 3: Identify the main CAUSES contributing to the effect being studied



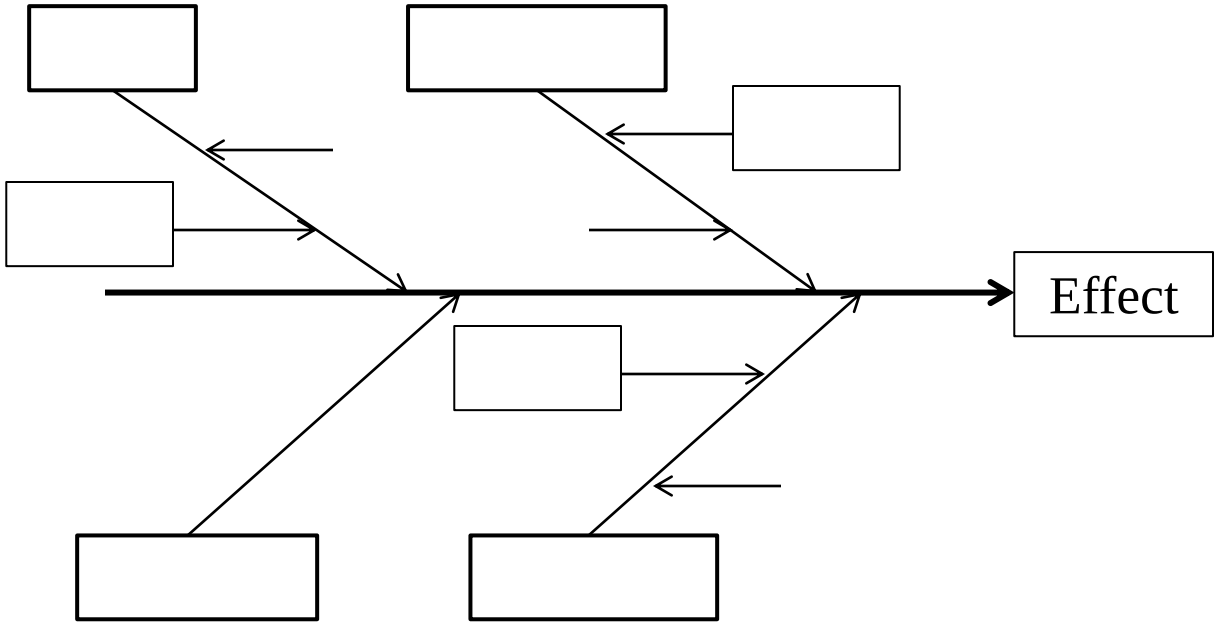
STEP 4: For each main cause, identify other specific and relevant sub causes which may affect the main problem



STEP 5: Identify more detailed levels of causes and continue organizing them under related Sub-causes.



STEP 6: Analyze the Cause-and-Effect diagram



CAUSE-EFFECT DIAGRAM : Problem Solving Technique (Illustrated here for Engineering Design Process)

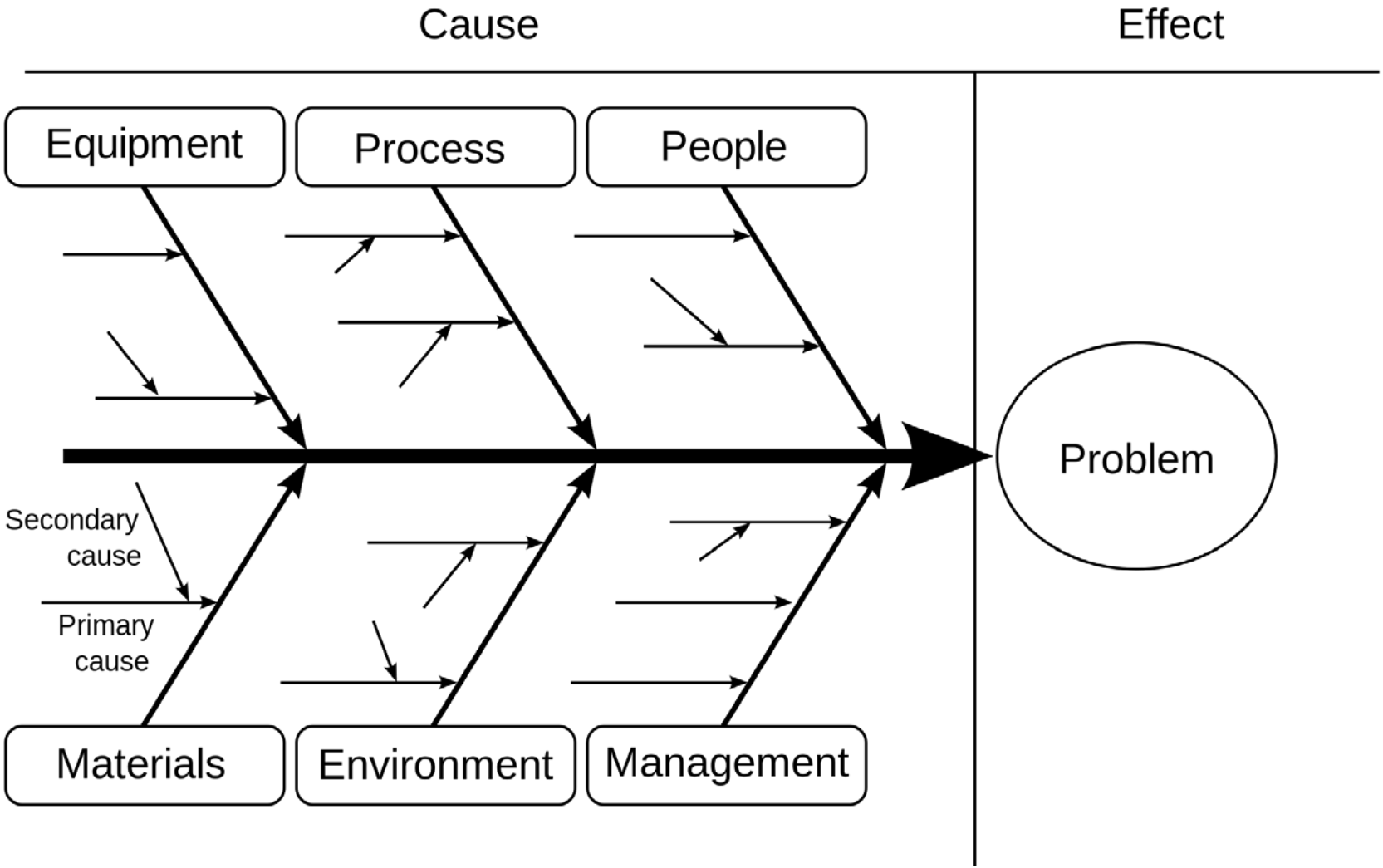
• Kaoru Ishikawa pioneered quality management processes in the Kawasaki shipyards and proposed this method.

• It helps to explore all the potential or real causes that leads to a single effect. Causes are represented with arrows and arranged according to their level of directness, depicting relationships and hierarchy of events. This is used for searching root causes, identify areas of potential problems, and compare the relative influence of different causes.

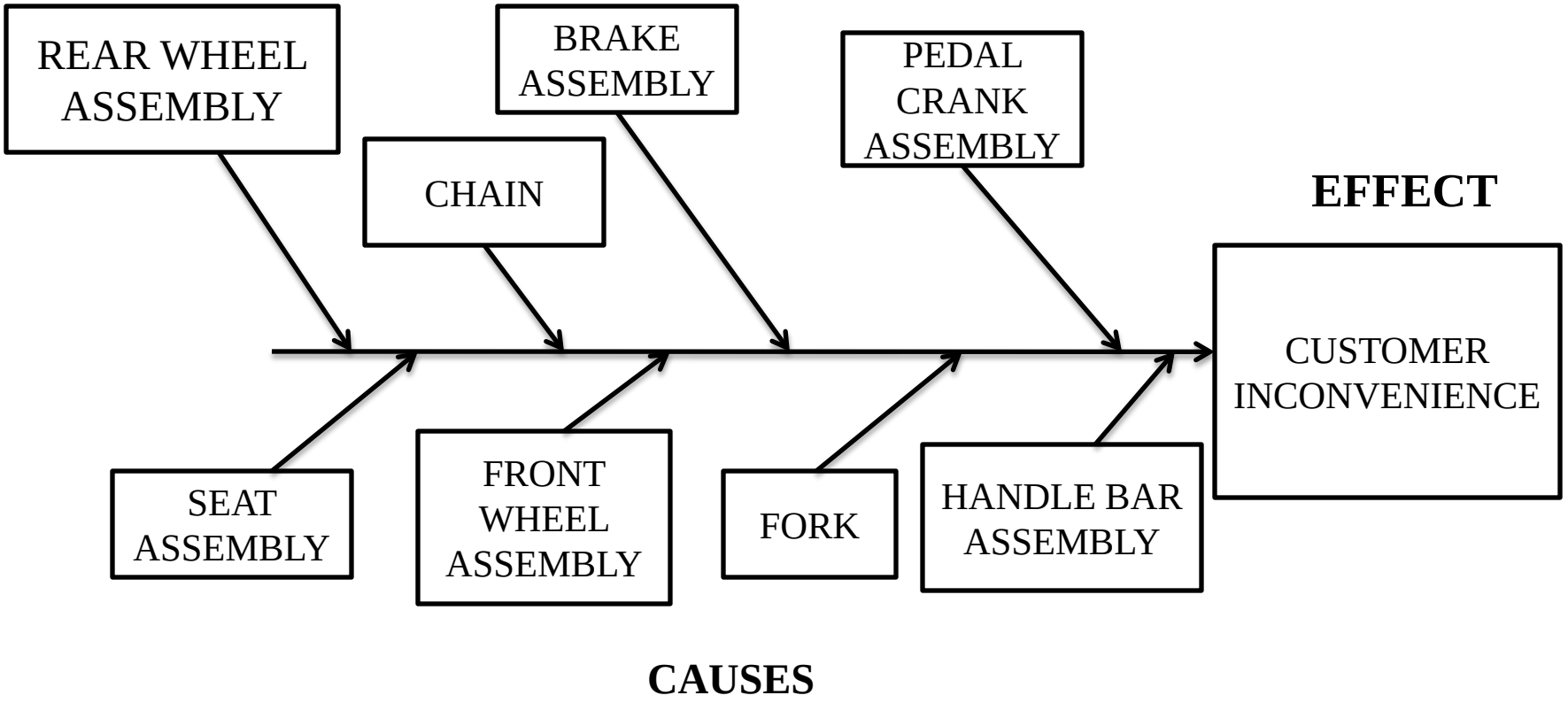
•This diagram, due to its shape, is also known as the fishbone diagram. It is commonly referred to as Ishikawa Diagram or Cause-Effect Diagram.

• This method eliminates the possibility(s), on actual examination / evaluation of the potential causes, if it is not the reason. Otherwise, it is further explored and Root Cause is ascertained and points to potential remedial need.

A GENERAL CAUSE-EFFECT DIAGRAM



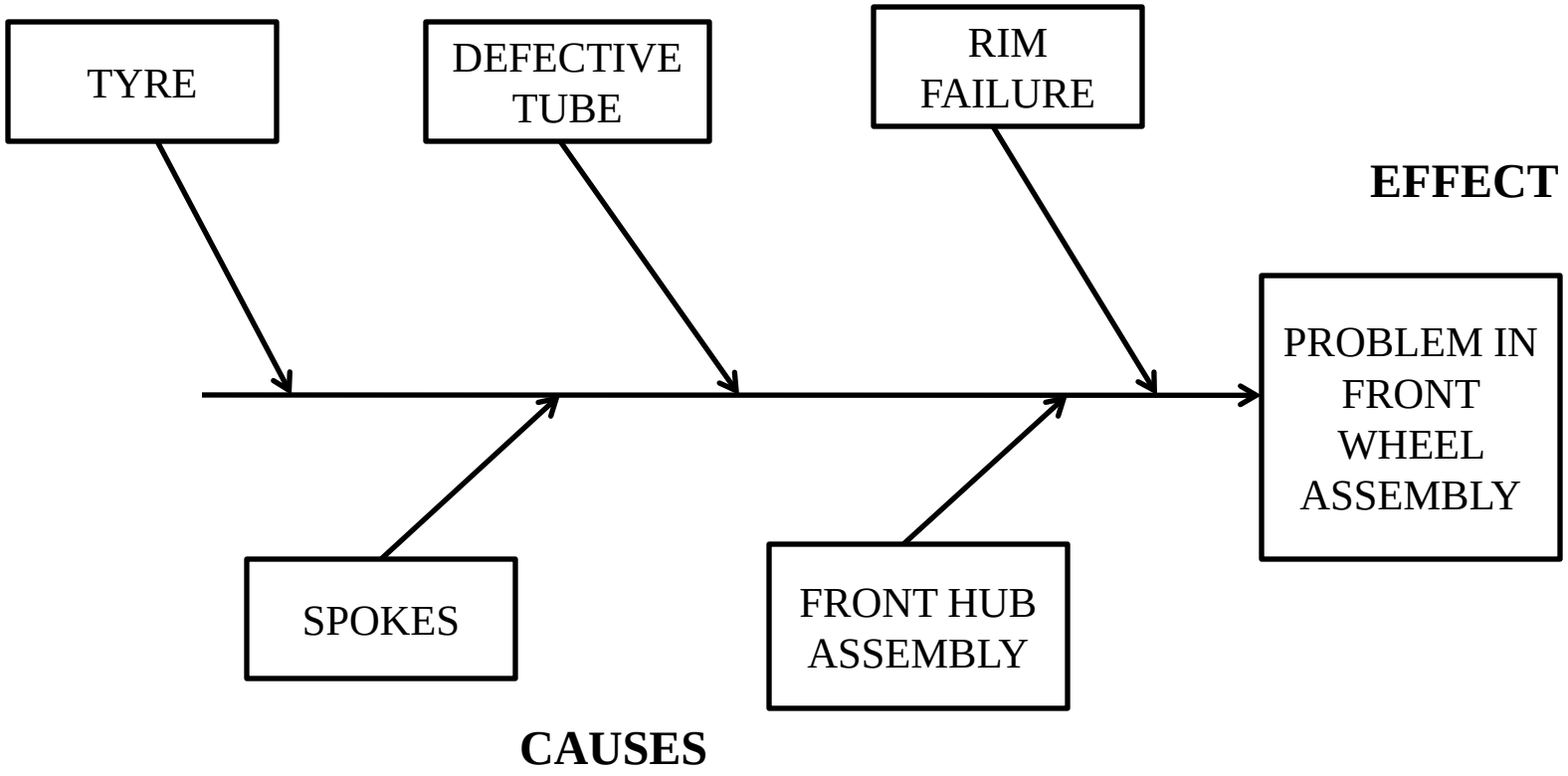
Example of Three-level C-E Diagram for Root Cause Analysis: Level 1



Cause identified : Front Wheel Assembly – In level 1

This in turn will be the effect in Level 2 and the sub-causes are explored

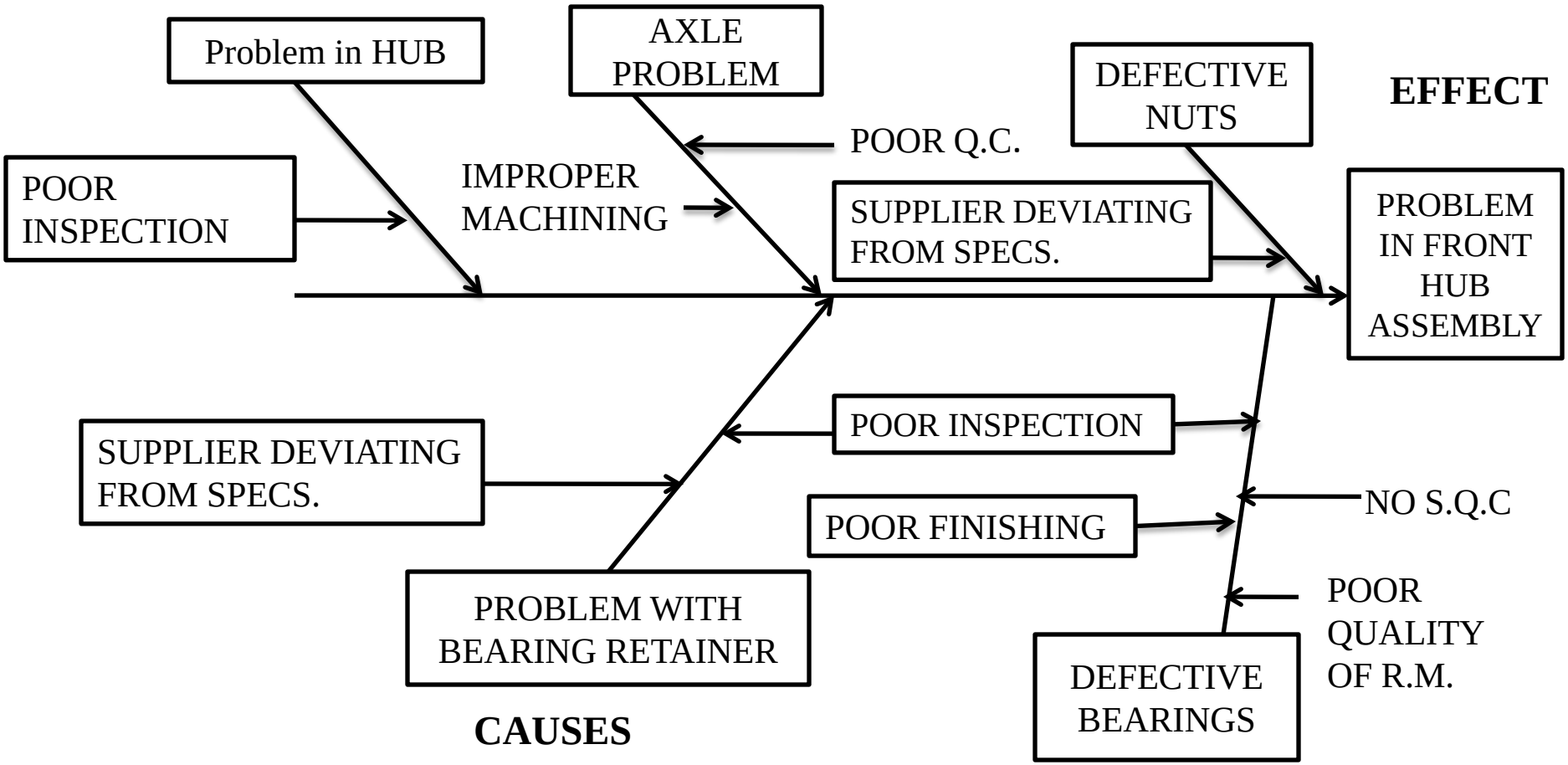
Example of Three-level C-E Diagram for Root Cause Analysis: Level 2



Cause identified : Front Hub Assembly – In level 2

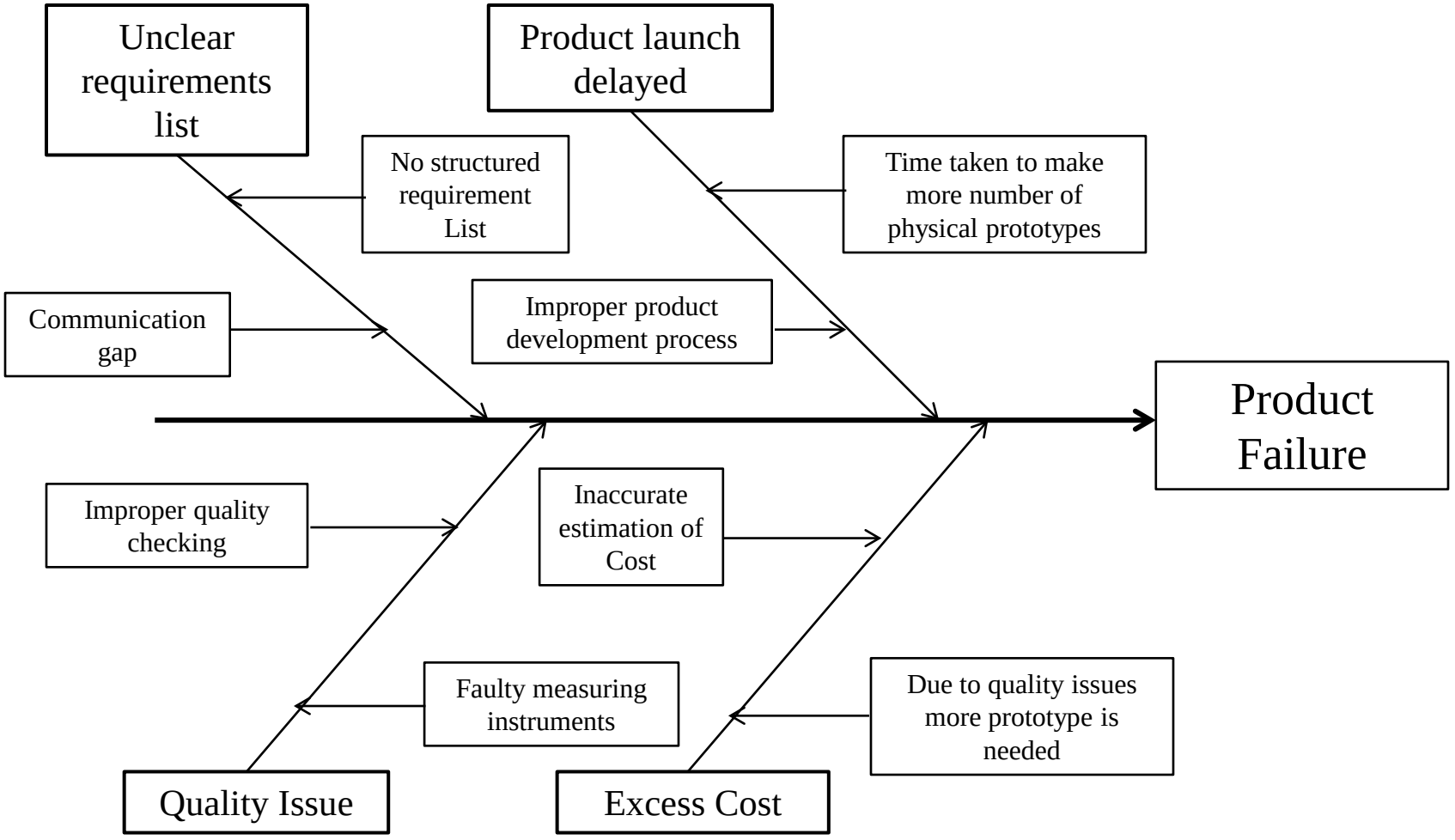
This in turn will be the effect in Level 3 and sub-sub-causes are explored

Example of Three-level C-E Diagram for Root Cause Analysis : Level 3



Root Cause identified : Defective Bearings

Example 1: A product launched in the market and it failed



Problem: A product fails in the early stage of its PLC (Product Life Cycle)

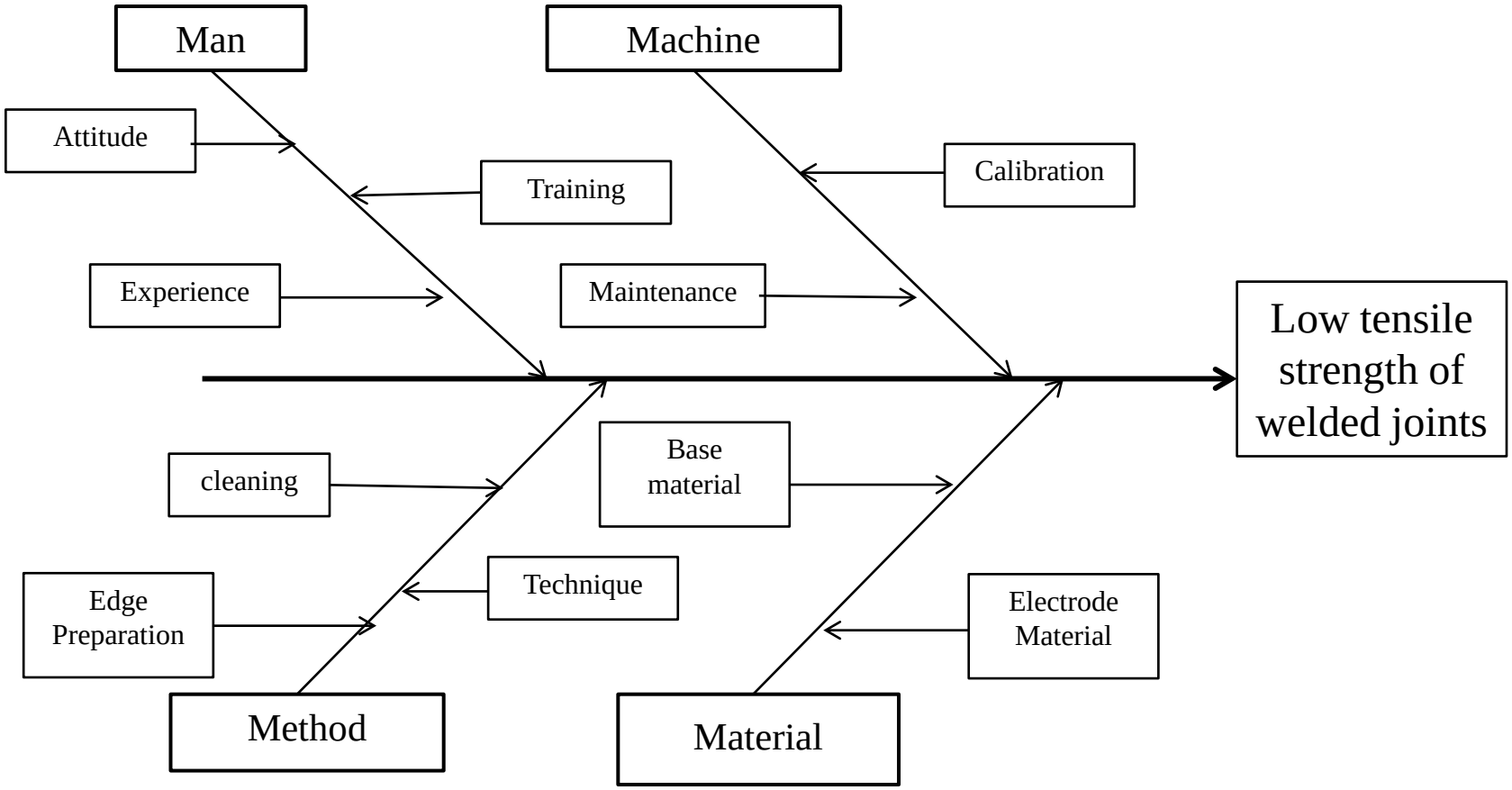
Through brainstorming four main causes are identified and it is presented in the form of Fishbone diagram.

1. Unclear Requirement list
2. Product launch delayed
3. Quality Issue
4. Excess Cost

Under these main causes, there are several sub-causes. Each causes should be studied in details, eliminating one by one to point out the root cause(s), this process is known as process of elimination. Once the root cause(s) is marked, adequate steps should be taken to prevent the failure.
For example, if communication gap between the various department is the root cause.

Action plan
The concurrent engineering is a possible solution to avoid it.

Example 2: Low tensile strength of welded joints



Problem: Low tensile strength of welded joints

The main causes for low tensile strength of welded joint are

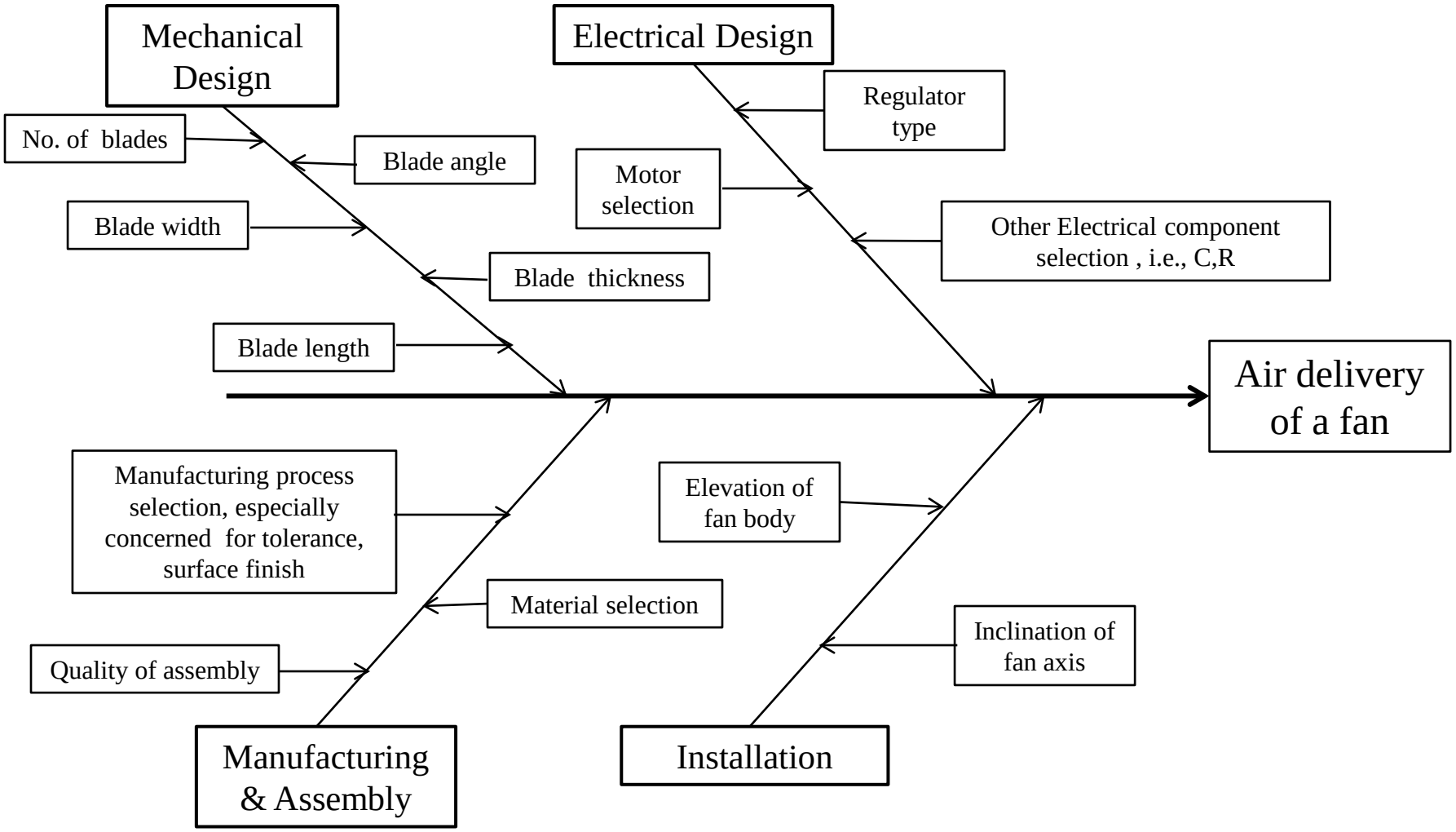
1. Man
2. Machine
3. Method
4. Material

After conducting the process of elimination, if it is found that under the main cause ‘method’, the sub-cause ‘edge preparation’ was not proper and that’s the main reason for weakening of the welded joint making it not up to the satisfactory mark.

Action plan

Proper edge preparation should be done before welding.

Example 3: Causes that affect the air delivery of a Fan



Problem: Poor air delivery of a Fan

To find out the root cause(s), Fishbone Diagram is an appropriate tool which relates all probable failure reasons in system and sub-system level.
Here, four main causes are indentified through brainstorming

1. Mechanical Design
2. Electrical Design
3. Manufacturing & Assembly
4. Installation

Each main causes are divided into their sub-causes. Each of the sub-causes should be verified according to their standard conditions. If any cause or sub-cause is found to be failed as per their standard conditions, then that will be the root cause(s) for poor air delivery of the fan. The root cause may be found as improper blade angle, too much elevation of fan from the floor etc. The root cause may be even a faulty mechanical design which is considered as a effect of different sub-causes.
If the improper blade angle is the root cause then this action should be taken.

Action plan

By changing the blade design air delivery of a fan can be improved