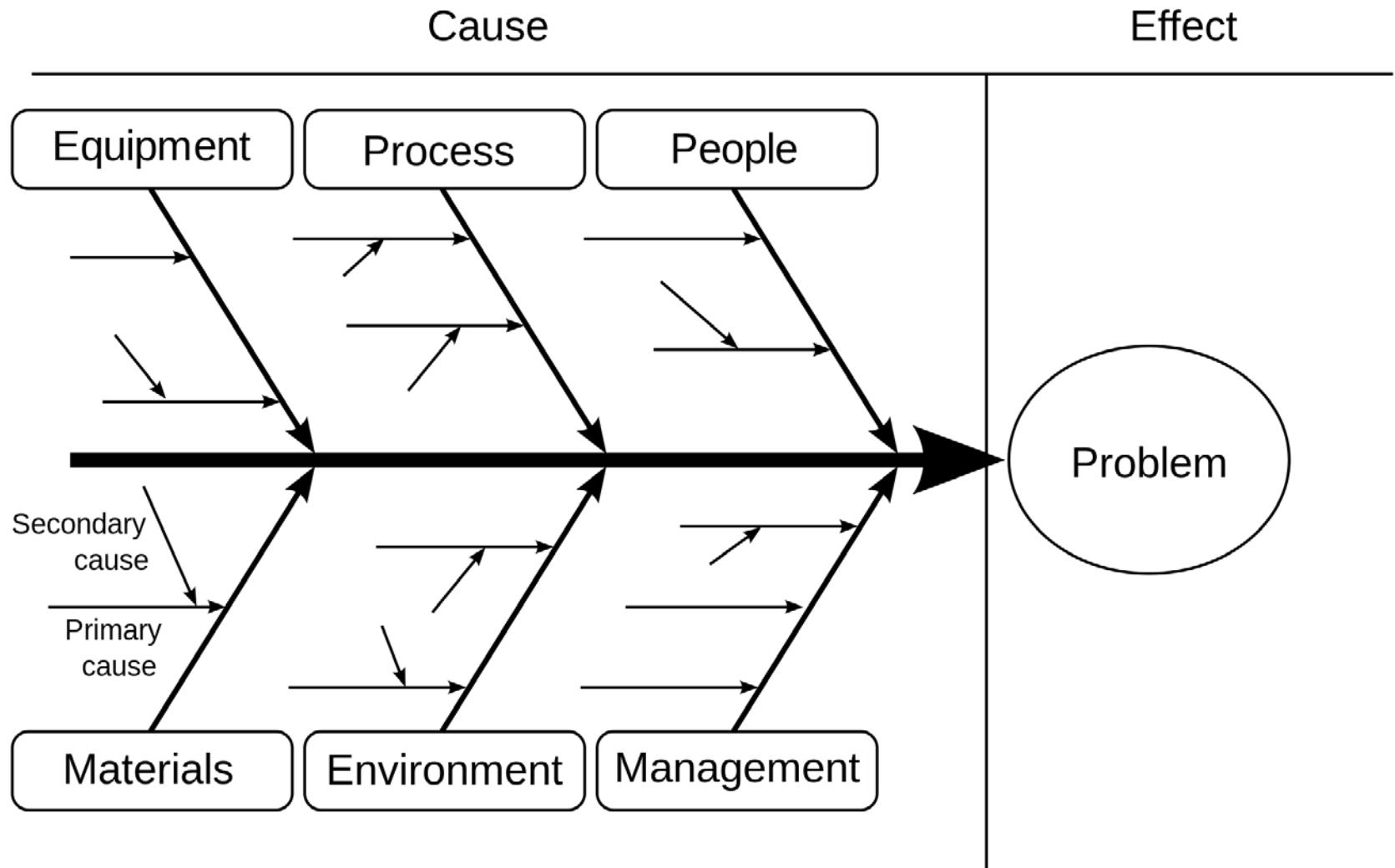


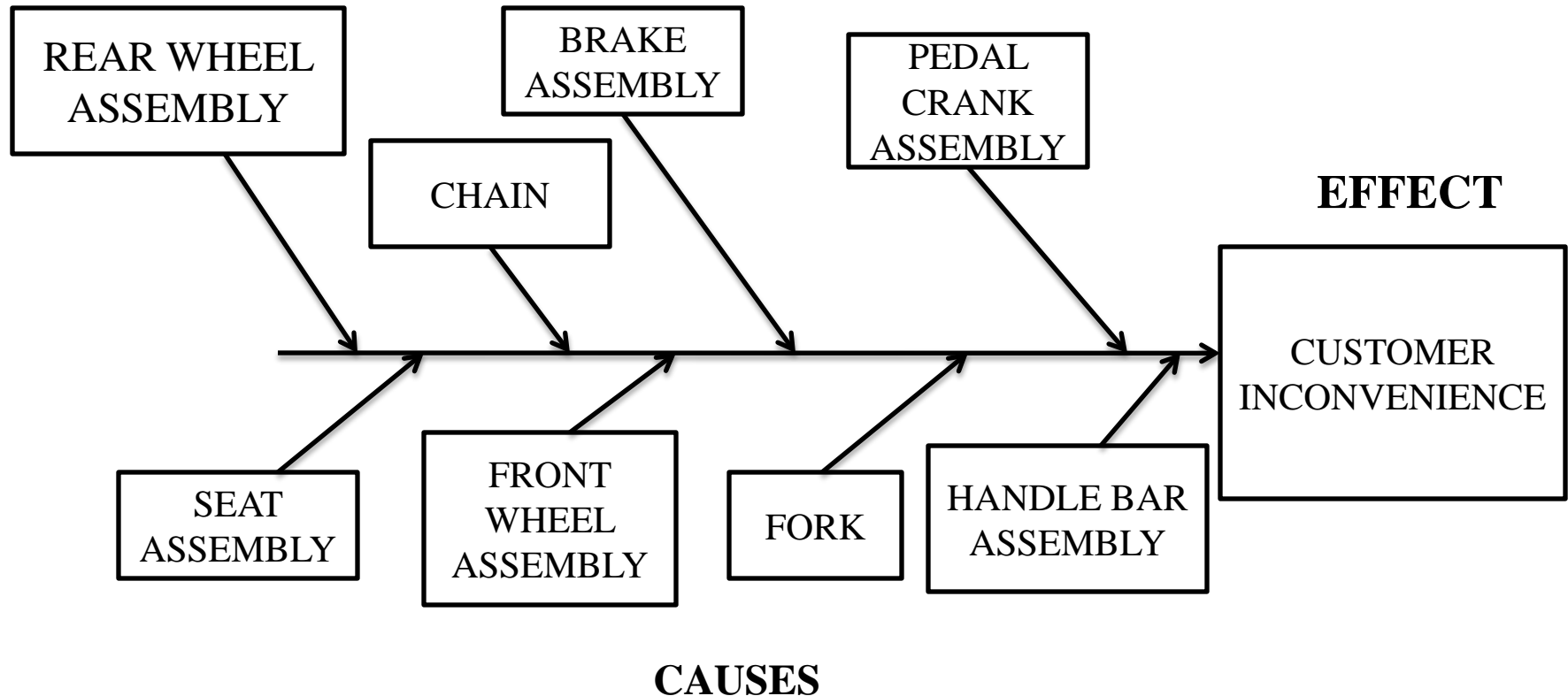
CAUSE-EFFECT DIAGRAM : Problem Solving Technique (Illustrated here for Engineering Design Process)

- 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



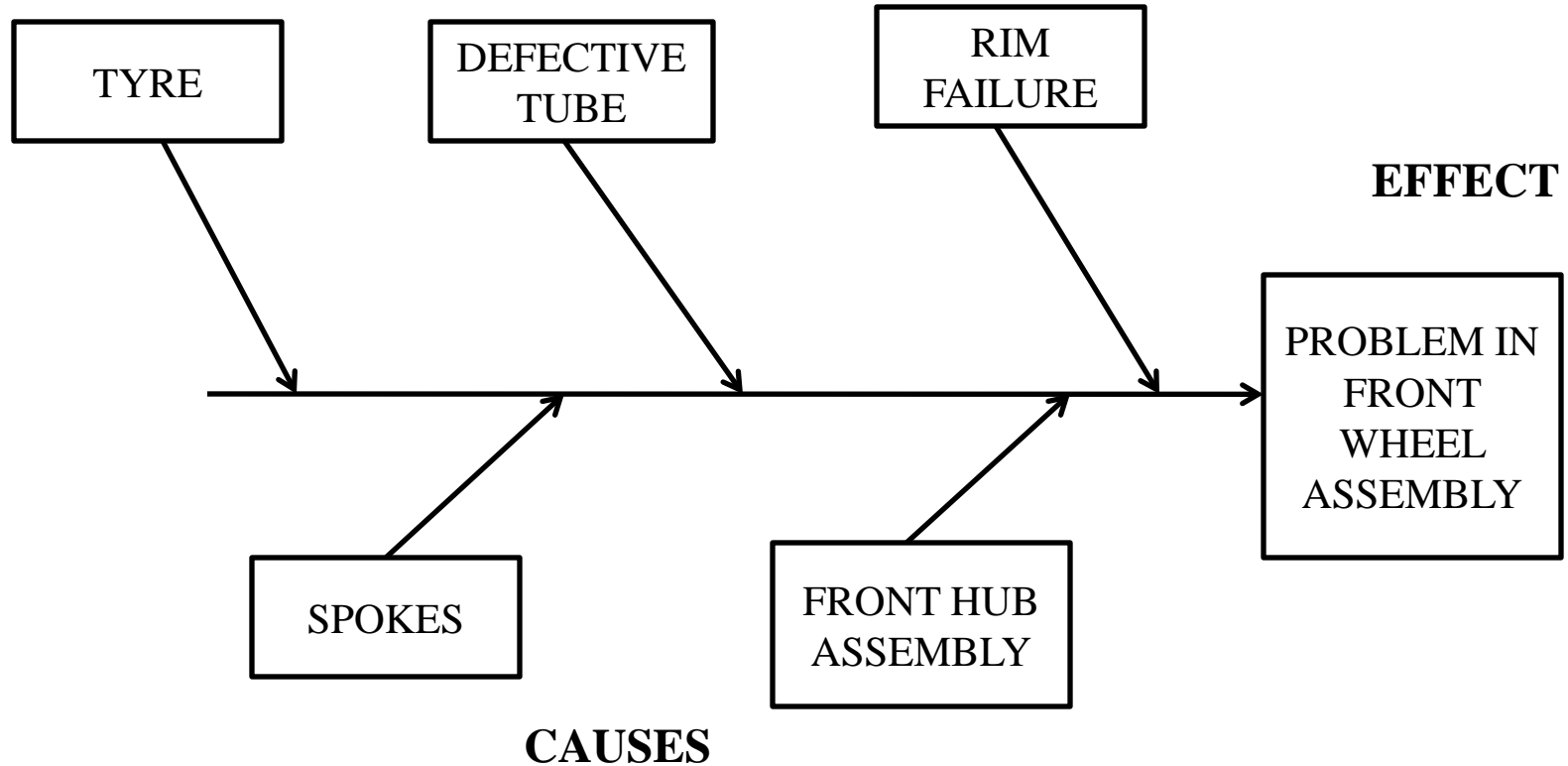
Example of Three-level C-E Diagram for Root Cause Analysis: Level 1



Cause identified : Front Wheel Assembly – In level 1

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

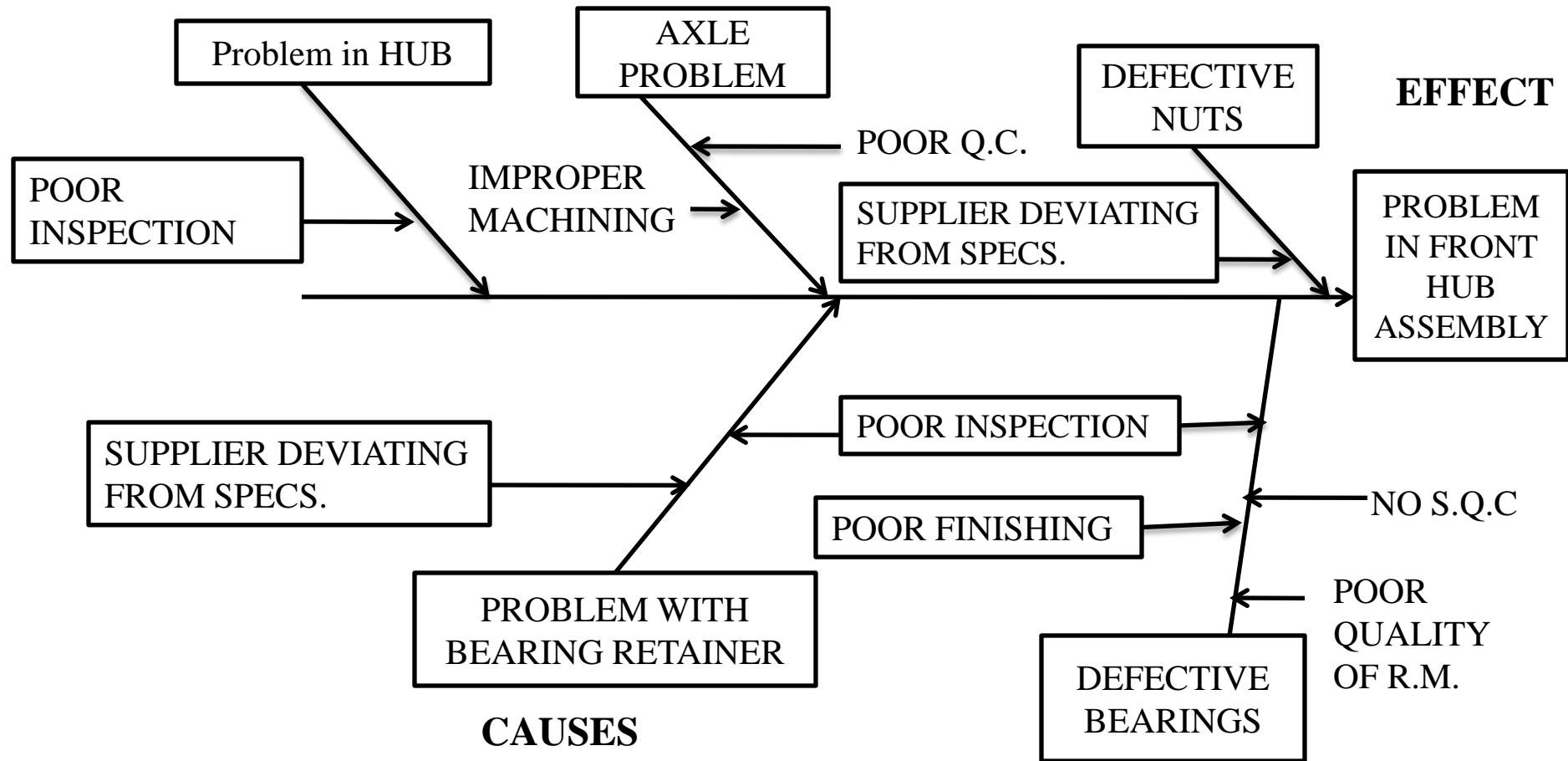
Example of Three-level C-E Diagram for Root Cause Analysis: Level 2



Cause identified : Front Hub Assembly – In level 2

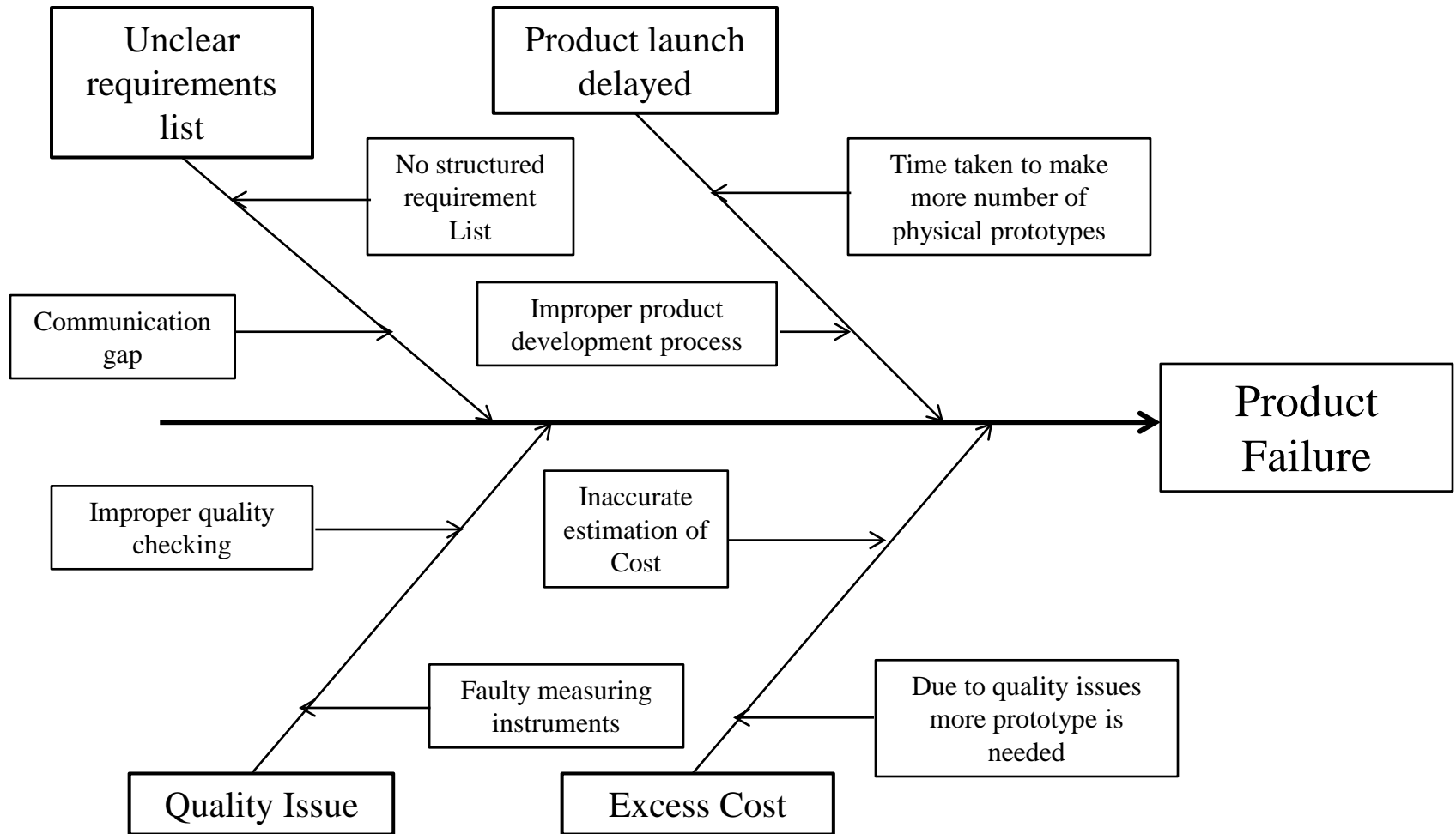
This in turn will be the effect in Level 3 and sub-sub-causes are explored

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

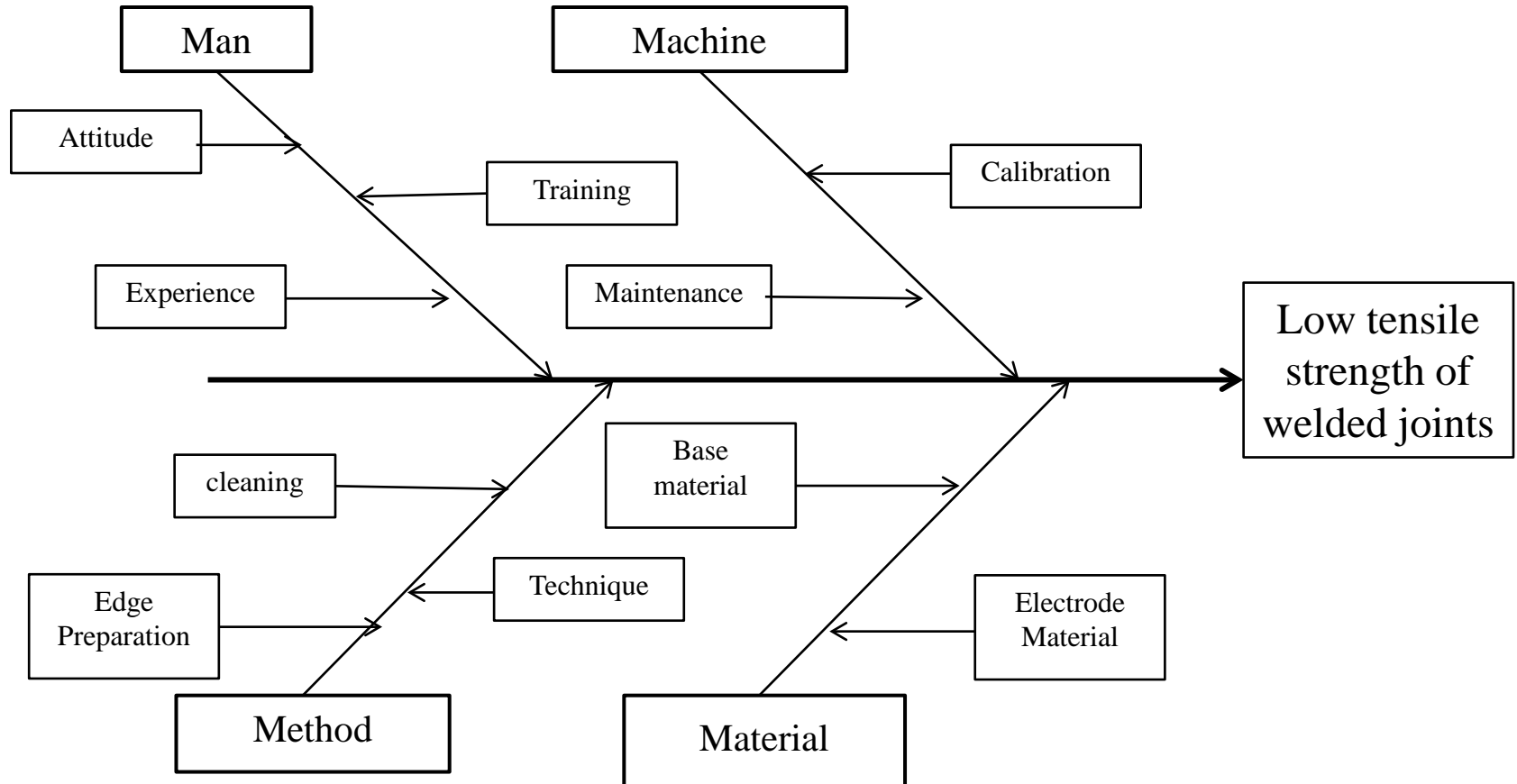
Under these main causes, there are several sub-causes. Each causes should be studied in details, eliminating one by one to point out the root cause(s), this process is known as process of elimination. Once the root cause(s) is marked, adequate steps should be taken to prevent the failure.

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

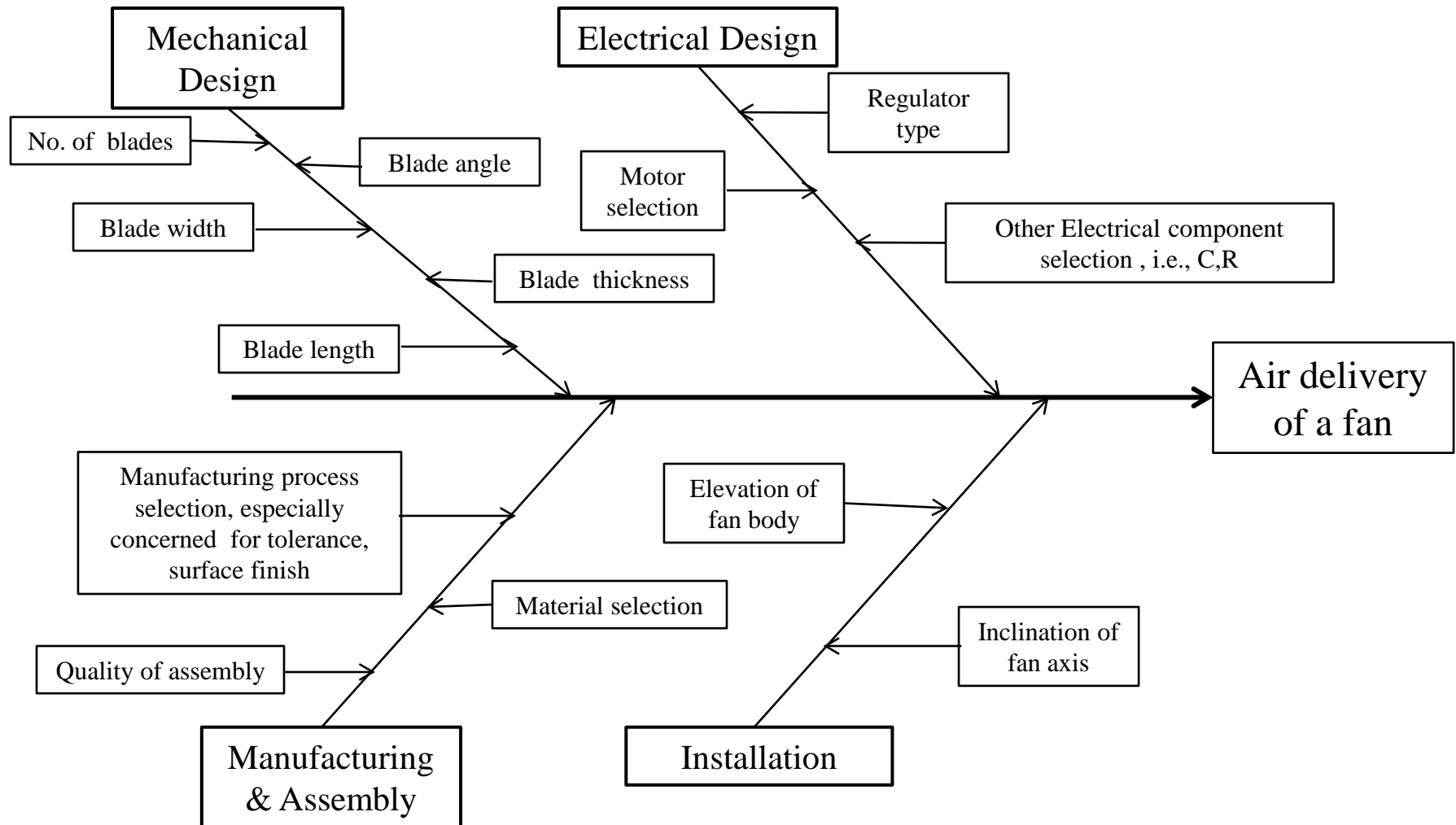
1. Man
2. Machine
3. Method
4. Material

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