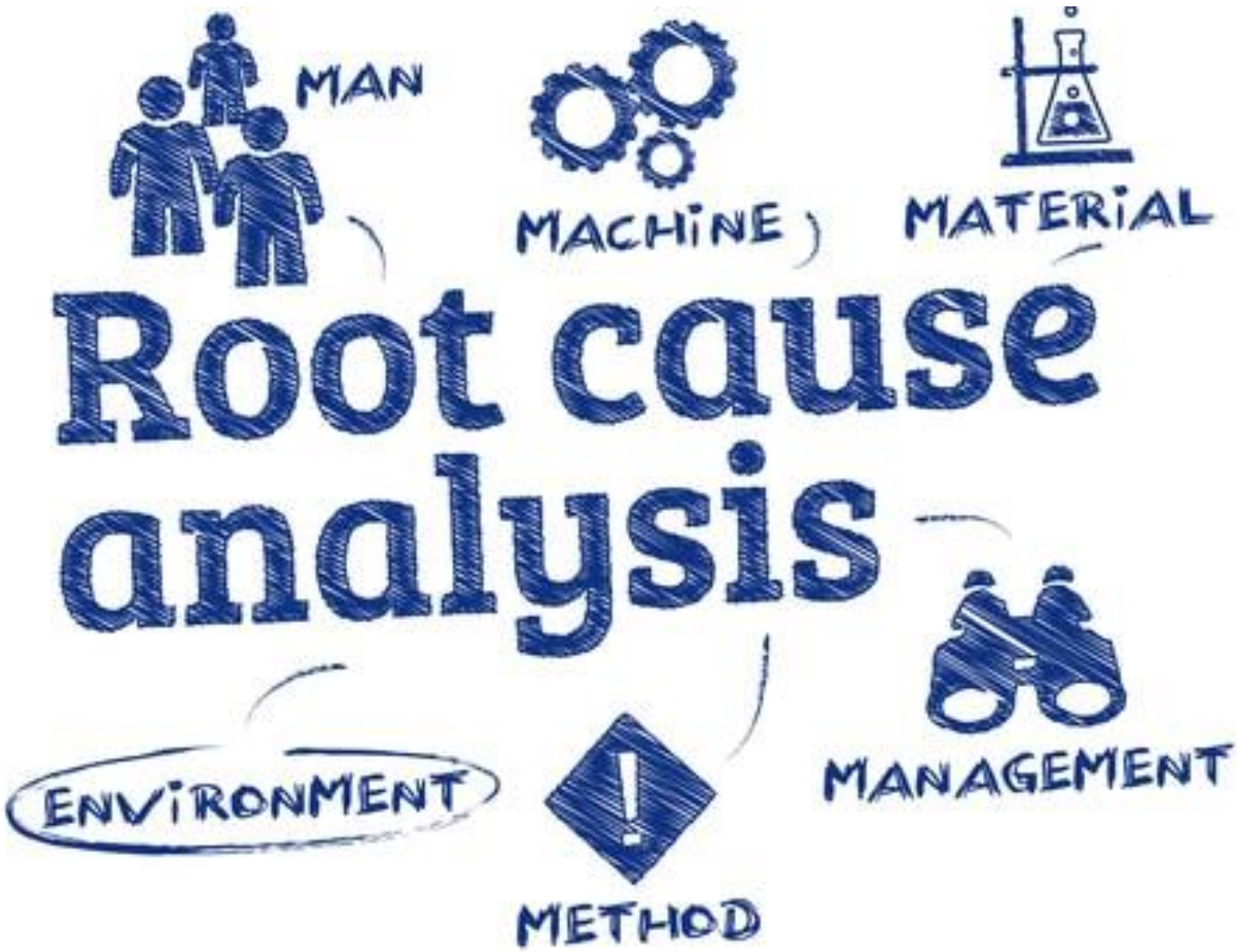
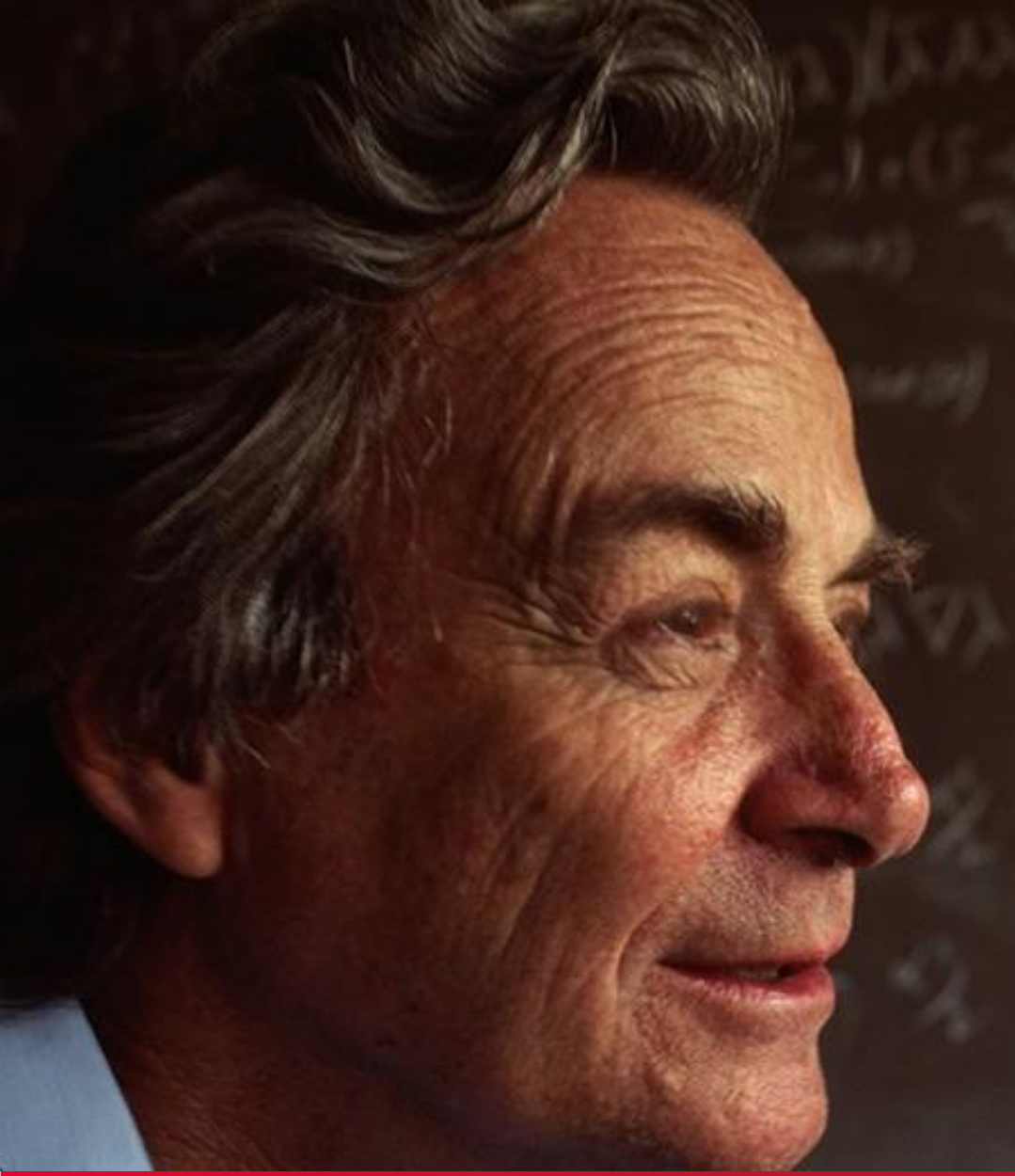
Level 5 – Continuous Improvement with Industry 4.0

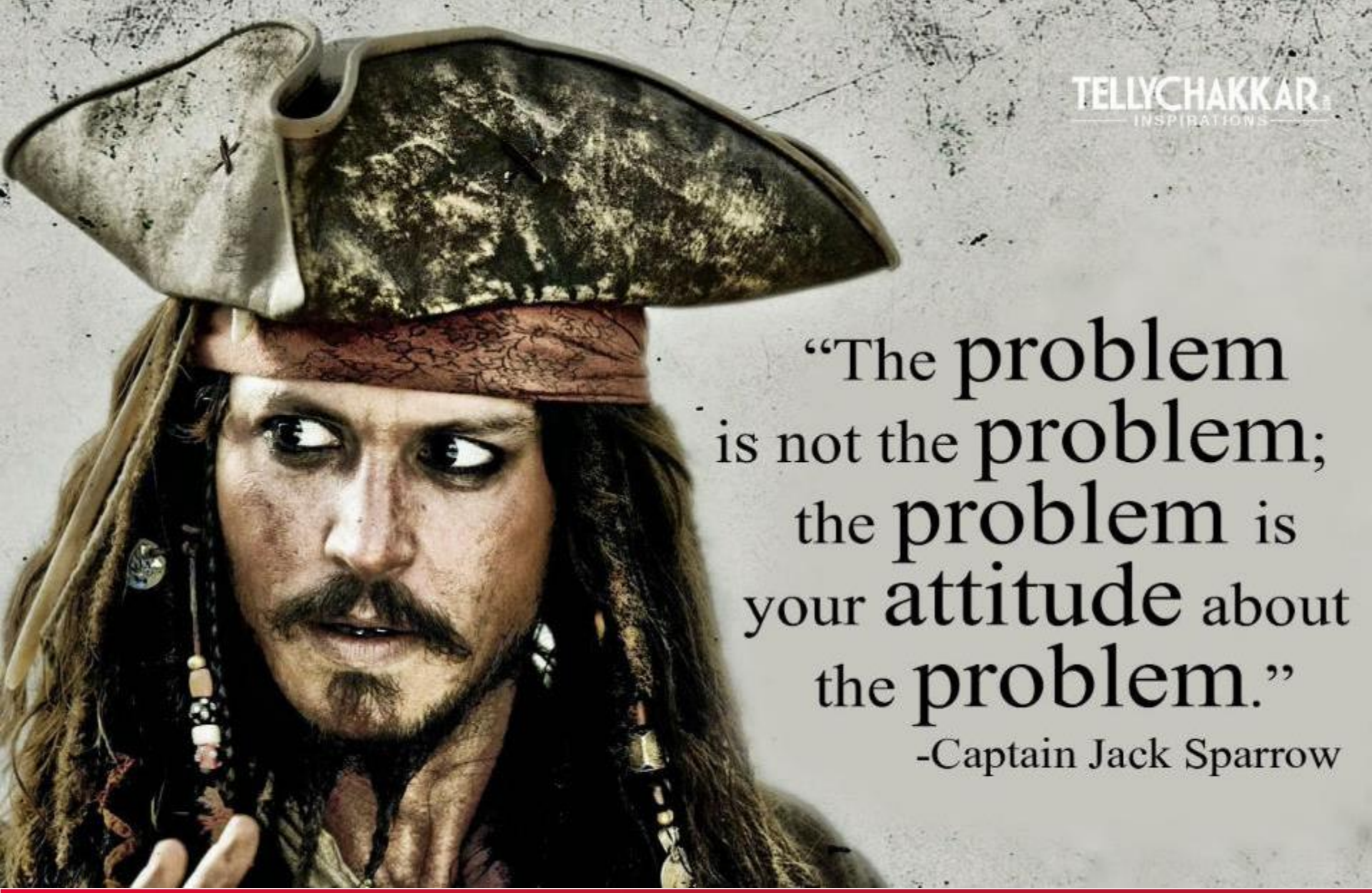




The famous physicist Richard Feynman was once asked by a journalist how he solved physics problems.

He replied that he had a very simple method.

- Write down the problem.
- Think very hard.
- Write down the answer.


TELLYCHAKKAR
INSPIRATIONS
"The problem is not the problem; the problem is your attitude about the problem."
-Captain Jack Sparrow

Root Cause Analysis (RCA) Goals

Identify…

1. What happened,
2. How it occurred & why it took place.
3. What we can do to prevent reoccurrence

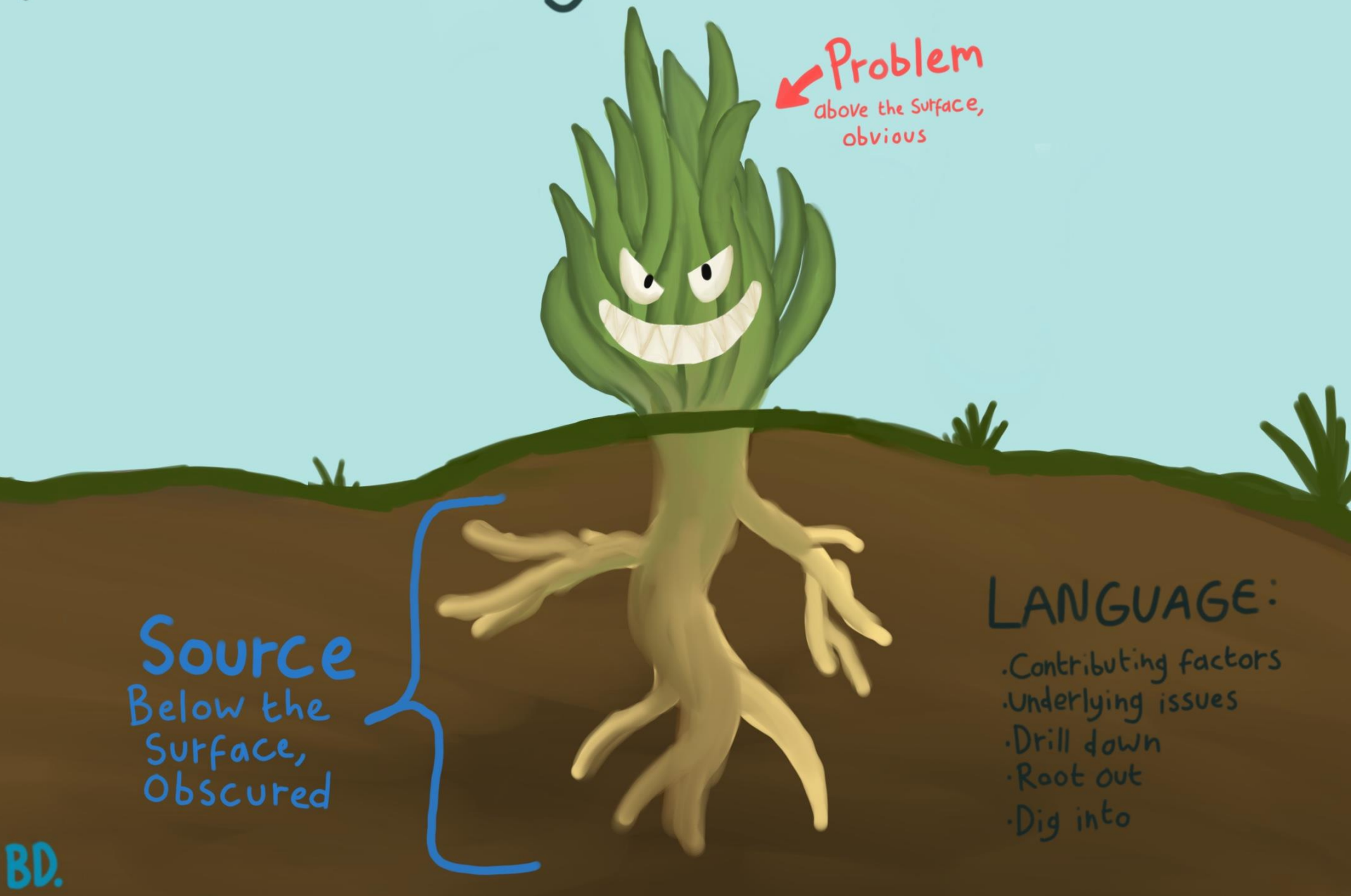
(Rooney Heuvel, 2004)

"Beneath every problem is a cause for that problem"

"If the root cause of a problem is not identified, then one is merely addressing the symptoms and the problem will continue to exist"

(Doggett, 2005)

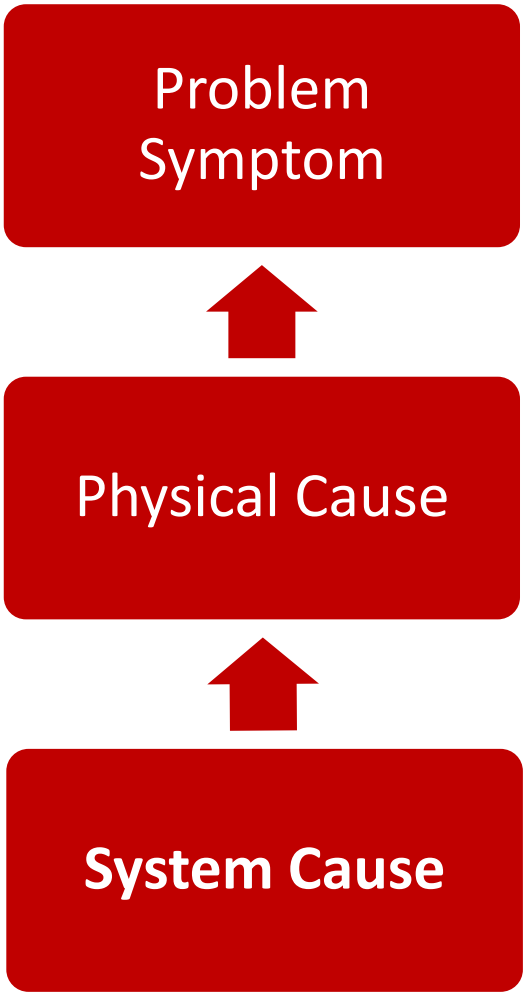
Root Cause Analysis (RCA)



Levels of Causes

Physical Cause
Specific physical item that, if corrected / replaced would resolve the problem.

System Cause
Possible underlying cause of physical failure



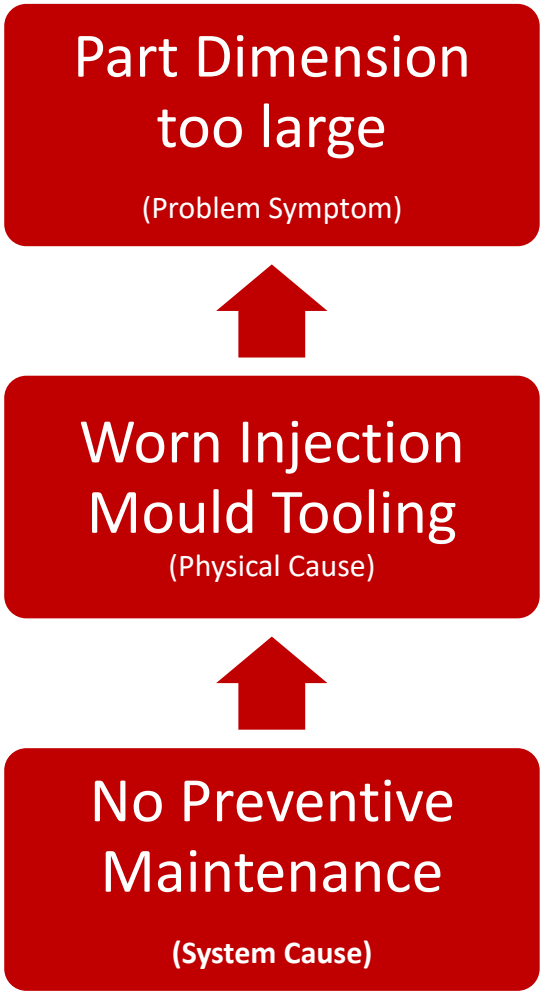
Levels of Causes

Physical Cause

Organisations have a tendency to stop at the physical cause, which may be appropriate.

System Cause

Seek system cause for problems with a high frequency, cost or risk of injury.



“A biased mind, which never sees the complete picture, cannot grasp the reality.”

Dali Lama

Cognitive Biases to Avoid

"A biased mind, which never sees the complete picture, cannot grasp the reality." **Dali Lama**

Two main areas of **Cognitive Biases** to be mindful of when undertaking RCA

1. Cognitive Laziness
Instead of seeking the optimum result, we seek the first sufficient result.

2. Overconfidence
Pursuing evidence supporting our own beliefs rather than allowing the evidence or data to represent the truth.

Cognitive Laziness

"A biased mind, which never sees the complete picture, cannot grasp the reality." **Dali Lama**

Recency Bias
Assuming the same cause for two recent problem symptoms and therefore, not performing a more rigorous investigation.

Availability Bias
Relying on the available data rather than collecting/generating more relevant and reliable data.

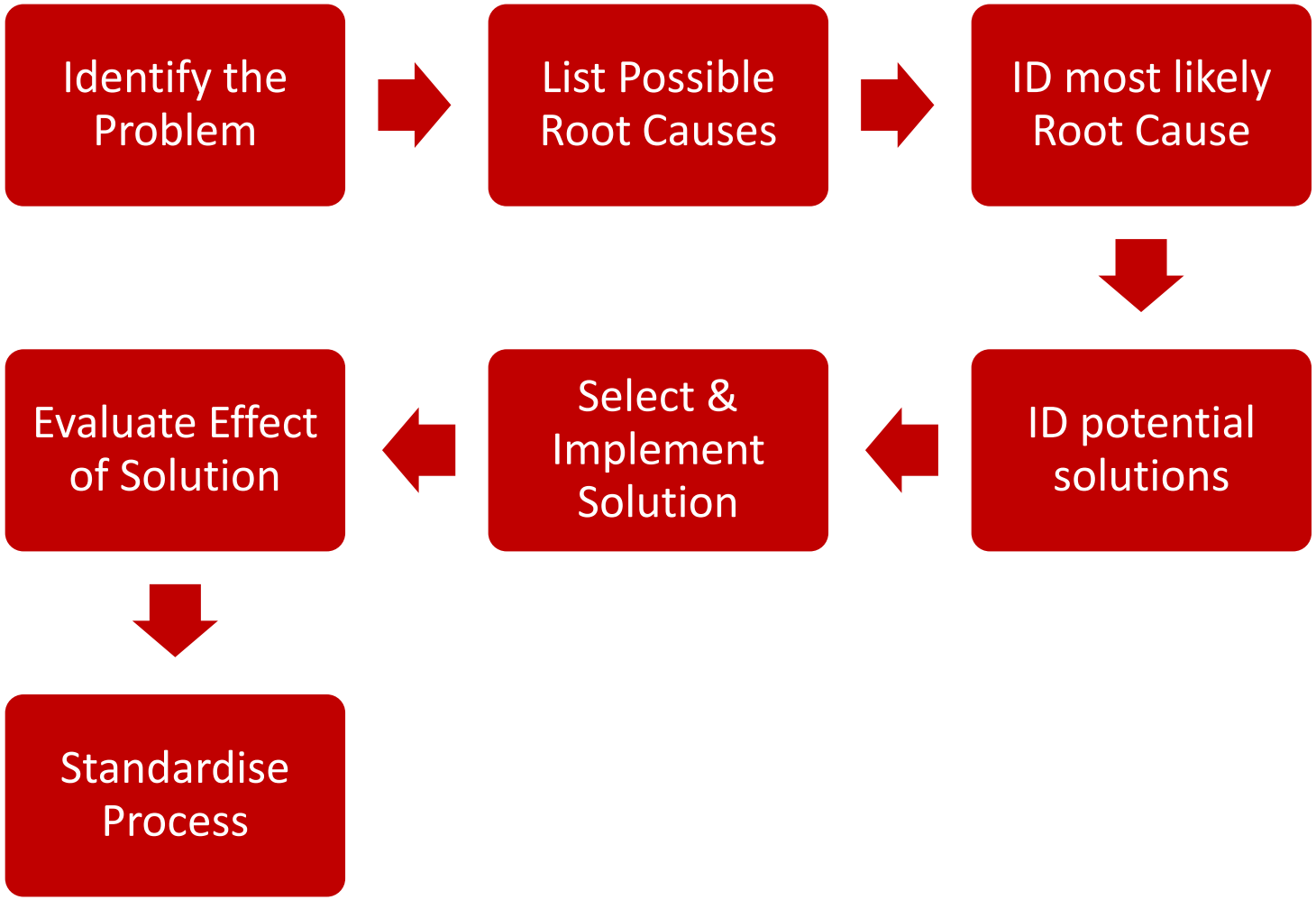
Overconfidence

"A biased mind, which never sees the complete picture, cannot grasp the reality." **Dali Lama**

Anchoring Bias
Latching on to the first data and its indications while ignoring possibly conflicting/contradictory new evidence.

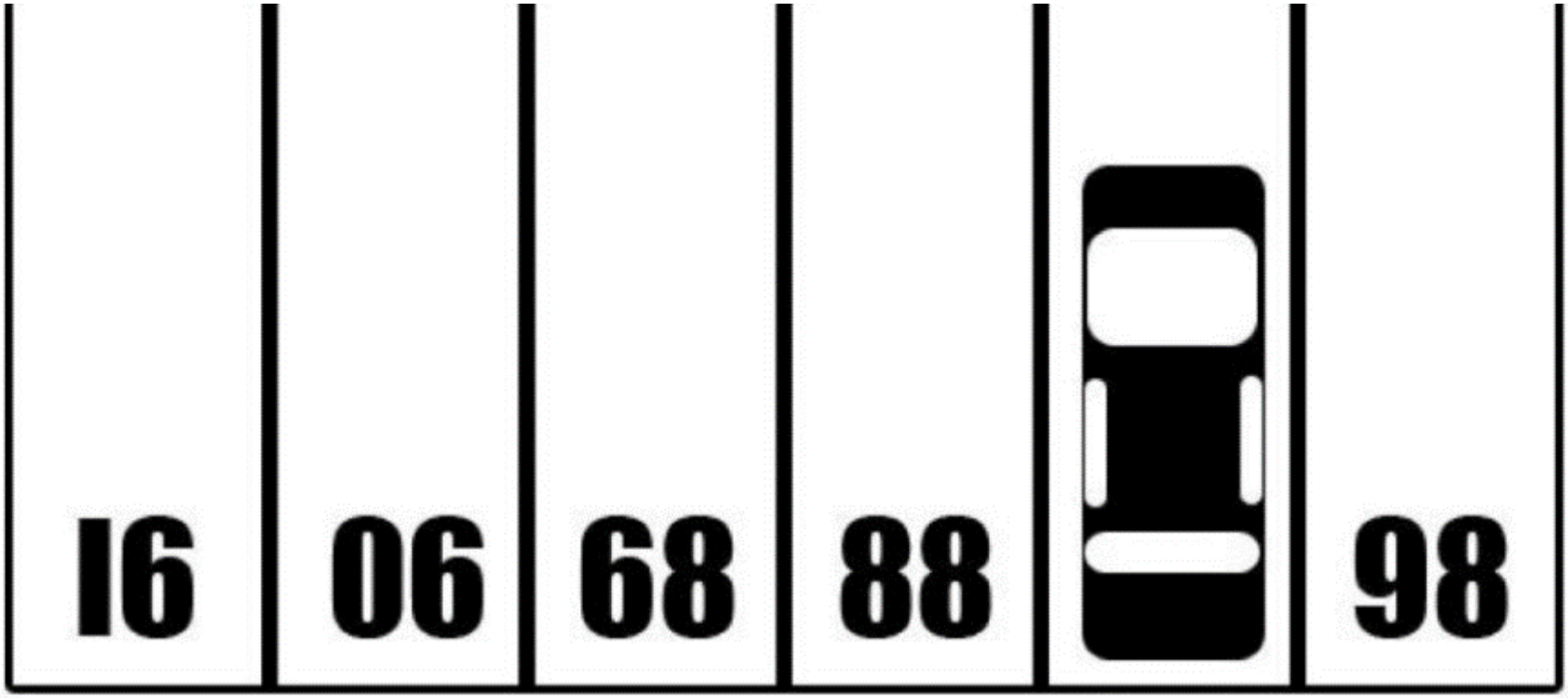
Confirmation Bias
Looking for and accepting only data which confirms our pre-existing assumptions of the cause.

7 Step Problem Solving Model (Westcott, 2016)



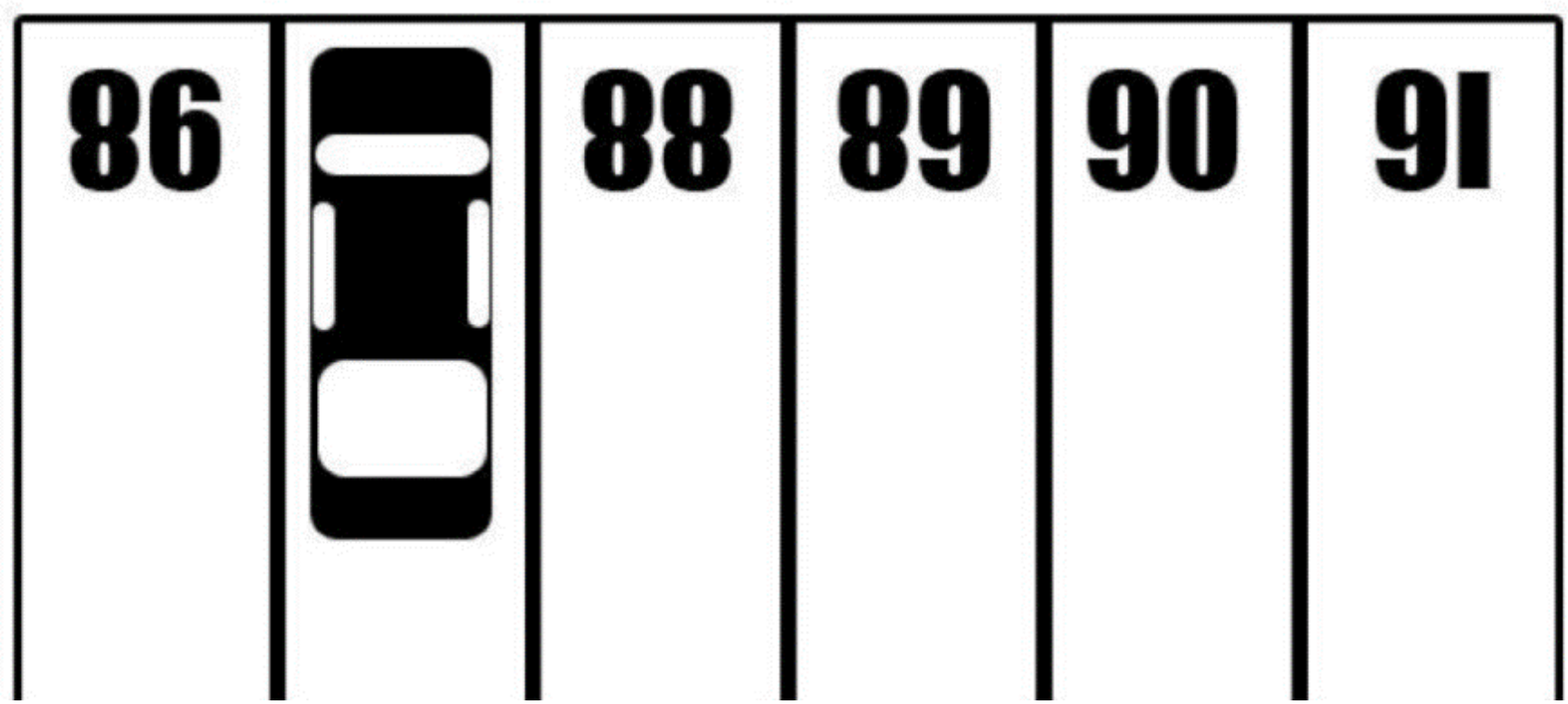
Thoughts?

What is the number of the parking space covered by the car?



Thoughts?

Solutions to existing problems often come from thinking outside of the box, seeing what others don't see.

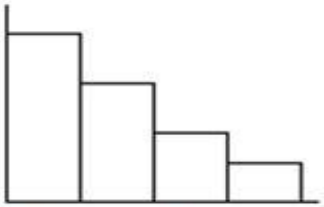


"If I had 60 minutes to solve a problem, I'd spend 55 minutes defining it, and 5 minutes solving it."

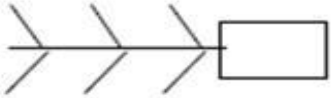
Albert Einstein

RCA Tools and Techniques

Brainstorming

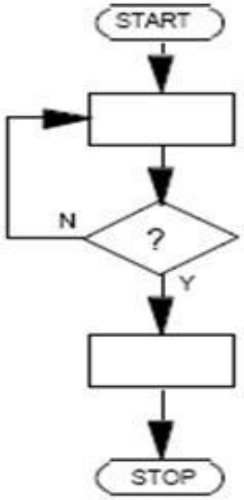


Pareto Chart



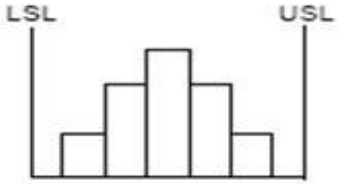
Fishbone Diagram

Scatter Diagram

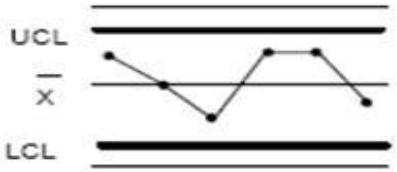


Flowchart

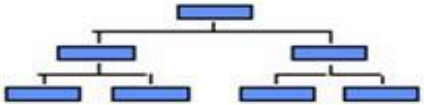
Run Chart



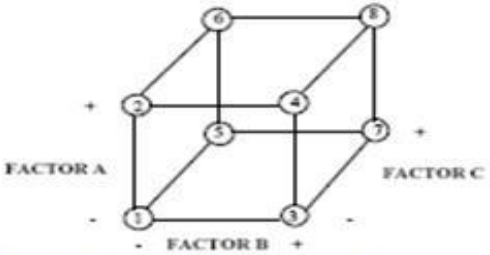
Histogram



Control Charts

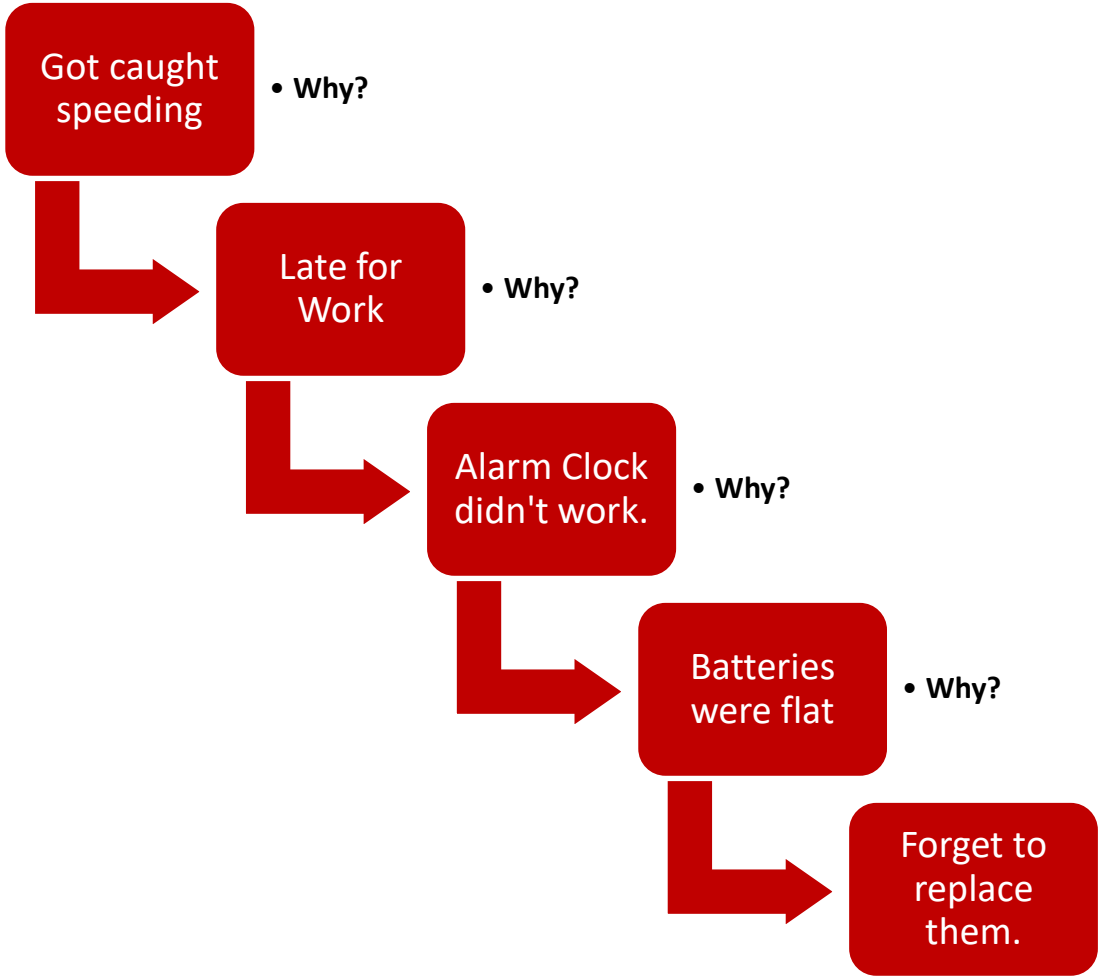


Tree Diagram



Design of Experiments

5 Whys



Get an Alarm Clock that plugs into the Mains or replace Batteries at scheduled times.

5 Whys

5 Why

Problem Description:

Why?	Why?	Why?	Why?	Why?

	Verification Actions	Corrective Actions	Preventive Actions
1st			
2nd			
3rd			
4th			
5th			

Why?	Why?	Why?	Why?	Why?

	Verification Actions	Corrective Actions	Preventive Actions
1st			
2nd			
3rd			
4th			
5th			

Why?	Why?	Why?	Why?	Why?

	Verification Actions	Corrective Actions	Preventive Actions
1st			
2nd			
3rd			
4th			
5th			

Action:	Owner:	Completion Date:	% Progress:

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MANUFACTURE
ADVANCED
DESIGN
ENGINEERING

Prifysgol Cymru
Y Drindod Dewi Sant
University of Wales
Trinity Saint David

Cronfa Gymdeithasol Ewrop
European Social Fund

Case Study - 5 Whys

Attendants at a large US West Coast marina had been complaining about the time-consuming nature of the process for collecting fees for short-term moorage (i.e., parking for boats) – it took time away from other activities that were potentially more profitable for the marina.

Through the marina's strategic planning, this process was targeted for improvement.

Level 5 – Continuous Improvement with Industry 4.0

Is it? Is it Not?

Introduction - Is it? Is it Not?

- **What is it?**
  - A problem-solving tool that explain the rational process for finding the possible root cause of the problem.
  - Helps user to avoid jumping to a false cause.

- **When to use it?**
  - Used to help define the problem.

- **How to use it?**
  - Add a description of the overall situation at the top of the page.
  - Do we have deviation from normal or specification?
  - Is cause of the deviation unknown?
  - Is it important to know the cause of the problem to solve it?

  - Can you explain all of the What, Where, When and Extent?

- If the answers from all above three questions are “YES” then we have a problem.

Introduction - Is it? Is it Not?

- Now simply as 'What is included here?' and 'What is not included here?'

- **Ask the questions to generate the Is-Is Not table:**
  - What Identity has deviation.
  - Where is the deviation.
  - When was the deviation in term of Timing (start & since).
  - What is the extent / scope of the deviation.

- **Top Tips!**
- *Is it? Is it Not?* analysis works by making you deliberately think about the problem and in particular the boundaries of what it is or is not. It thus helps to create focus in attention and consequently is more likely to lead to the right problem being solved.

- **Application of *Is it? Is it Not?***
  - *Is it? Is it Not?* can be used to identify the potential root cause(s) of the issues in service departments
  - *Is it? Is it Not?* can also be used for planning a solution, to help decide what to include and what to exclude.
  - *Is it? Is it Not?* can be used for decision analysis.

Task - Is it? Is it Not?

Problem Identification:

Specify the Problem:

		Is it?	Is it Not?	Possible Cause?	Does not Explain Is and Is Not Information	Does Explain Is and Is Not Information
What	Object? Deviation?					
Where	Location? Object?					
When	1st Occurrence? Since Time? Life Cycle?					
Scope	Quantity Affected? Size of Deviation? # of Deviations? Trend if any?					

Problem Analysis - Is it? Is it Not?

Problem Identification: *One wheel of the car is giving continuous abnormal sound.*

Specify the Problem:

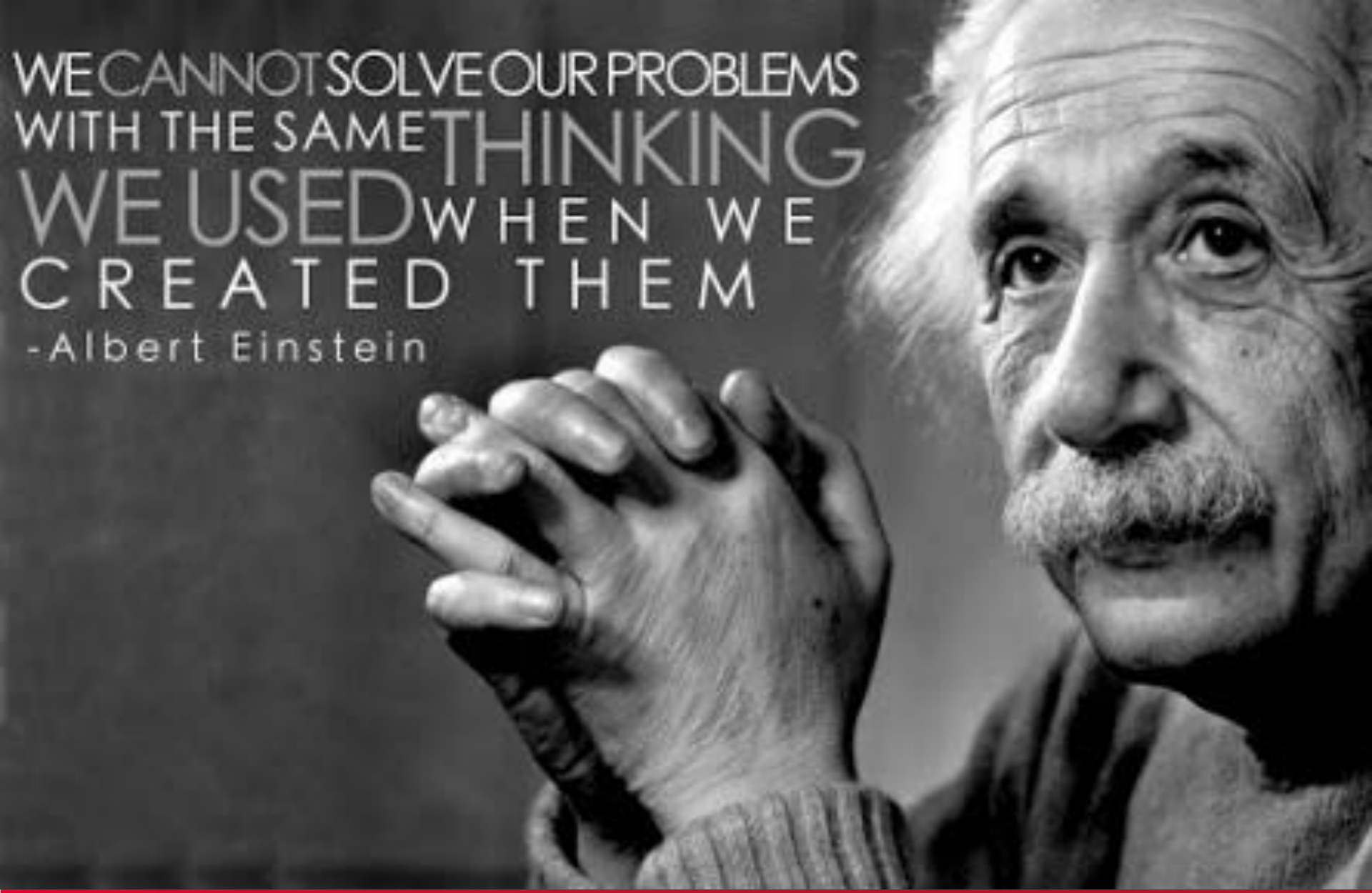
		Is it?	Is it Not?	Possible Cause?	Does not Explain Is and Is Not Information	Does Explain Is and Is Not Information
What	Object? Deviation?	*Wheel* *Abnormal continuous sound*	*Engine, Transmission etc,.* *Interrupted, periodic sound.*	*Unbalanced* *Air Pressure out of spec.*	*Verified – N/A* *Verified - N/A*	
Where	Location? Object?	*Front drive side.* *Tyre*	*Front Passenger side or back.* *Rim*	*Broken / Ripped Tyre.* *Punctured or Nail.*		
When	1st Occurrence? Since Time? Life Cycle?	*Two days ago.* *Coming back from Work.*		*Hit the curb.*		
Scope	Quantity Affected? Size of Deviation? # of Deviations? Trend if any?	*One Wheel* *1 Tyre* *1* *N/A*	*All Wheels* *4 Tyres* *4* *N/A*			

Problem Analysis - Is it? Is it Not?

IS - IS NOT Analysis

"IS – IS NOT" analysis is an efficient way to narrow the search for a root cause. "IS - IS NOT" analysis works by making you deliberately think about the problem and in particular the boundaries of what it is or is not. A major benefit of the "IS - IS NOT" analysis is its documentation of circumstances leading to the problem as well as those not associated with the problem.

	IS	IS NOT
Why	Why is this a problem?	Why is it not a problem?
Who	Who is affected by the problem?	Who is not affected by the problem?
	Who first observed the problem?	Who did not find the problem?
	To whom was the problem reported?	
What	What type of problem is it?	What other problems could have been observed but did not?
	What parts/products/processes have the problem?	What are the most similar parts/products/processes without the problem?
Where	Where was the problem observed?	Where could the problem be located but is not?
	Where does the problem occur?	Where else could the problem be located but is not?
When	When was the problem first noticed?	When could the problem have been noticed but was not?
	When has it been noticed since?	Where else has the problem been noticed?
How Much/Many	Quantity of problem?	How many could have the problem but don't?
	Impact of problem?	How big could the problem be but is not?
How Often	What is the trend?	What could the trend be but is not?
	Has the problem occurred previously?	



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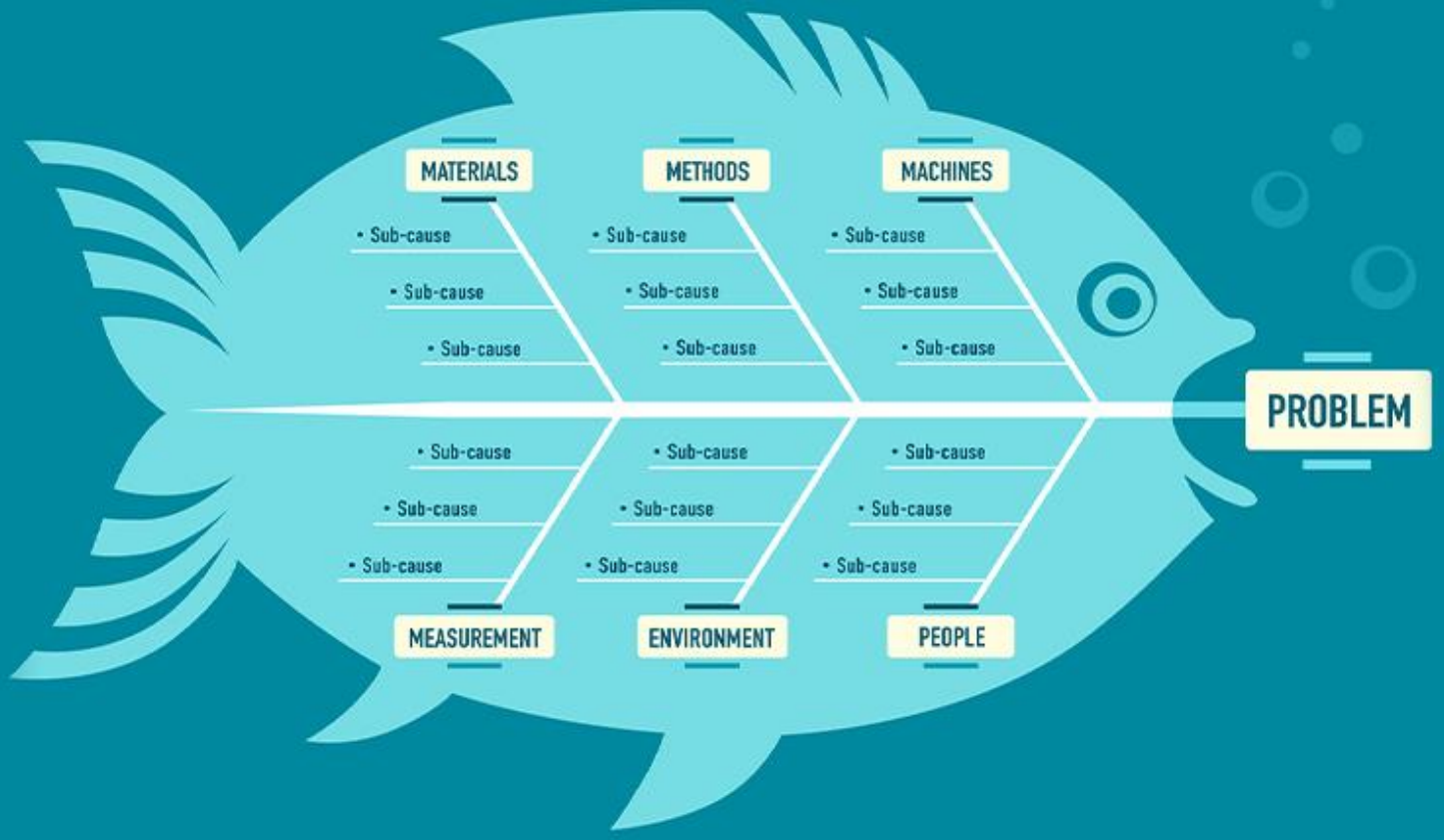
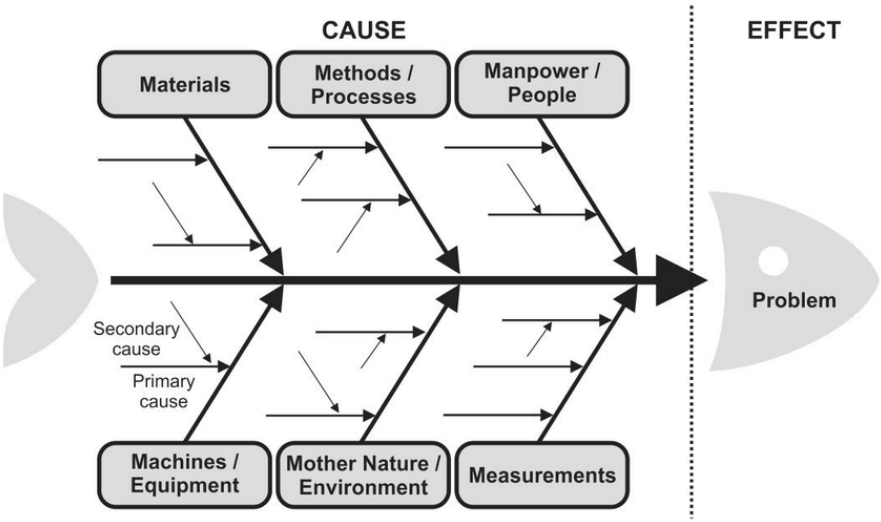


Level 5 – Continuous Improvement with Industry 4.0

Cause & Effect (aka Ishikawa Diagram, aka Fishbone Diagram)

Cause & Effect

- Identifies and organises the potential causes of a problem.
- Uses an easy and understandable format
- Used to identify the sources of process variation
- Is also called the Ishikawa Diagram or Fishbone Diagram

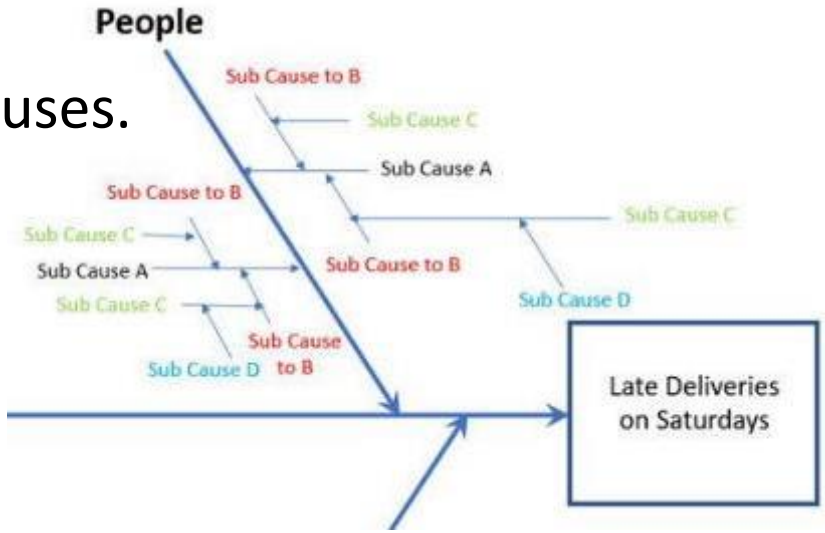


Cause & Effect

- Identifies the causes of an undesirable effect of a problem.
- It is also possible to identify the hierarchy of causes including possible root causes.
- Brings attention to the primary factors affecting the quality of a product or service
- These factors need to be optimised in order to reduce the amount of process variation.

Root Causes are normally;

- Those at the ends of the chains of causes.
- They do not have any sub-causes.



Cause & Effect

Often used during ‘brainstorming sessions’
Everyone gains insight into the cause and effect.
This makes the solution easier to find later on.

Cause & Effect

- Helps create ideas about the possible causes of a problem before it happens.
- An effect cause prevention tool
- Helps to identify the potential factors causing an effect to prevent future problems.
- Can also be used in product and process development.

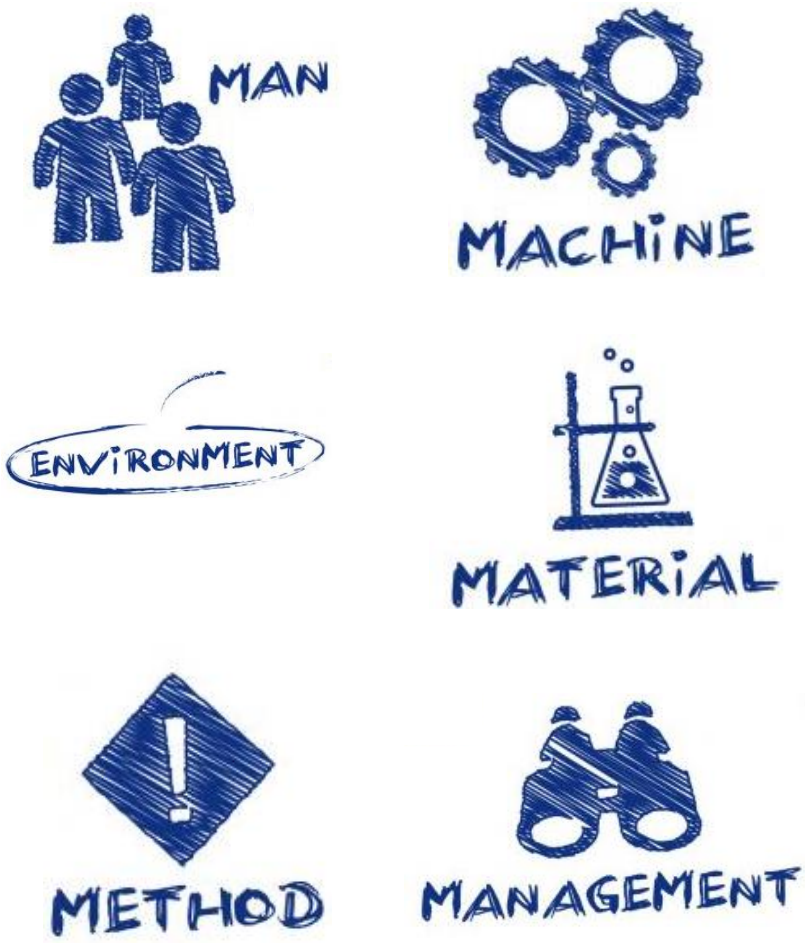
Cause & Effect -

Manpower (People)

- Anyone involved in the process and contributes to the effect.

Methods

- How the process is performed and the specific requirements for doing it, such as;
  - Policies
  - Procedures
  - Rules
  - Common Practices



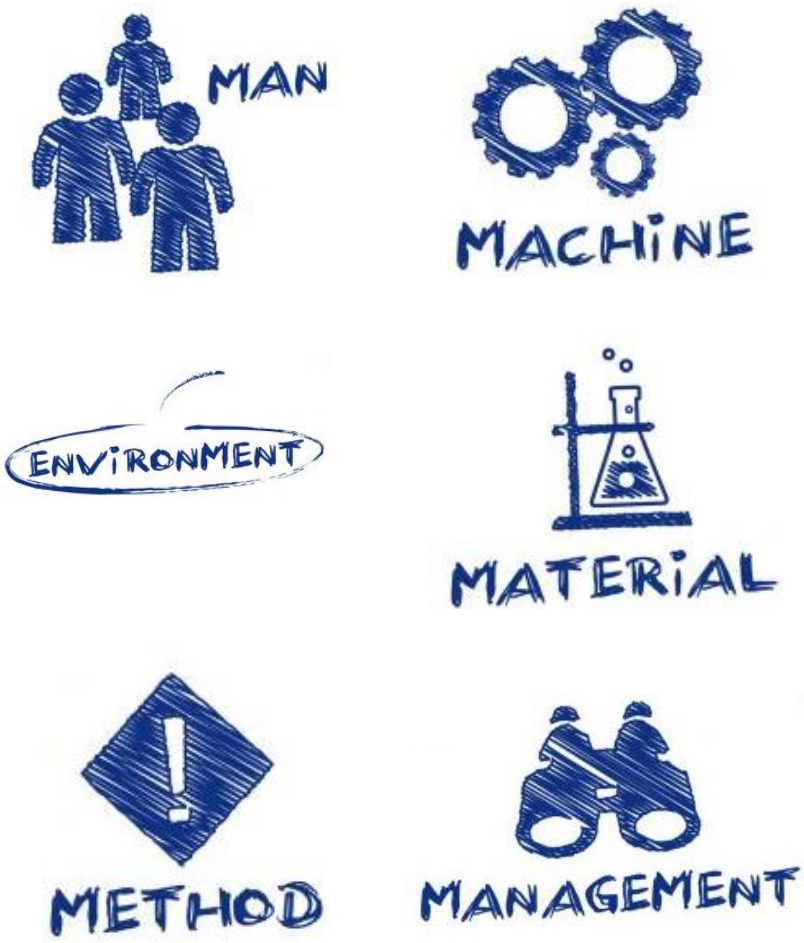
Cause & Effect -

Machines

- Includes the equipment and tools required to do the process.

Materials

- The material needed to produce the product or provide the service, including;
  - Raw Materials
  - Parts
  - Paper
  - Packing
  - Consumables



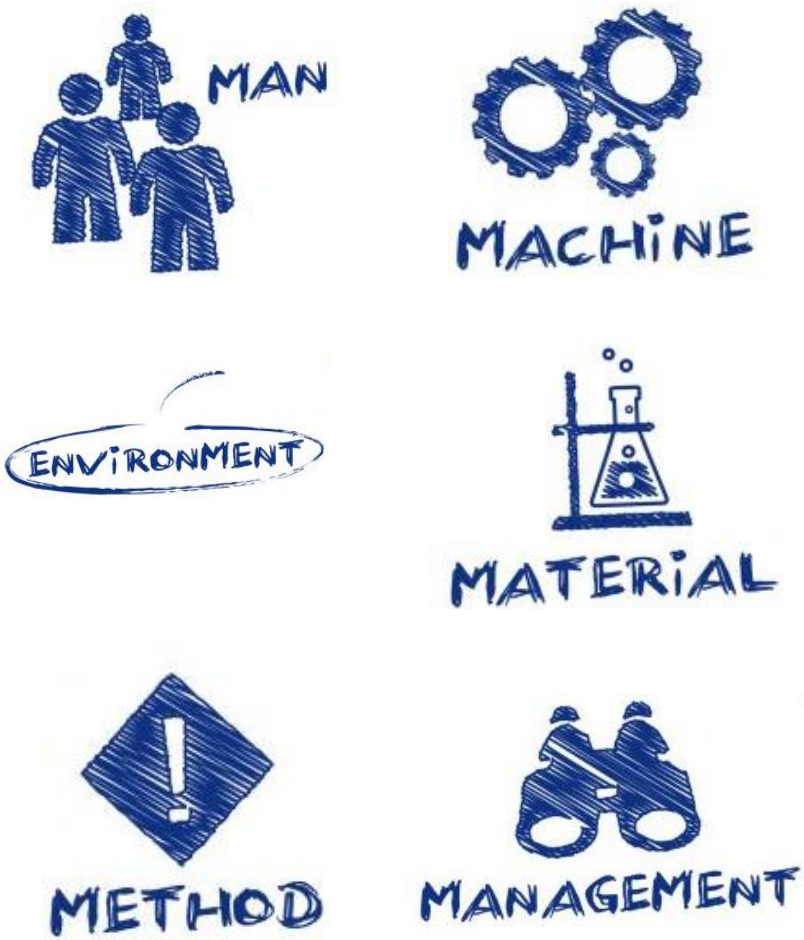
Cause & Effect -

Environment

- The conditions in which the process operates such as;
- Location
- Time
- Temperature
- Culture

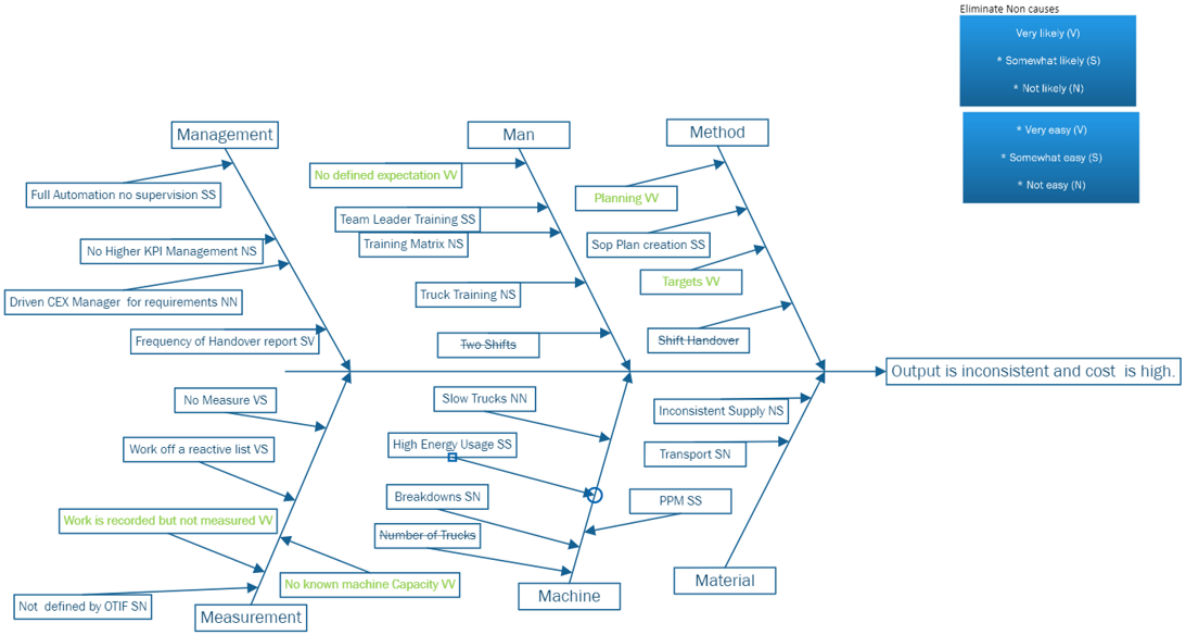
Management (Measurements)

- Includes the data that is used to evaluate the performance of the process.



Cause & Effect

Wrap line cause and effect diagram



Cause & Effect

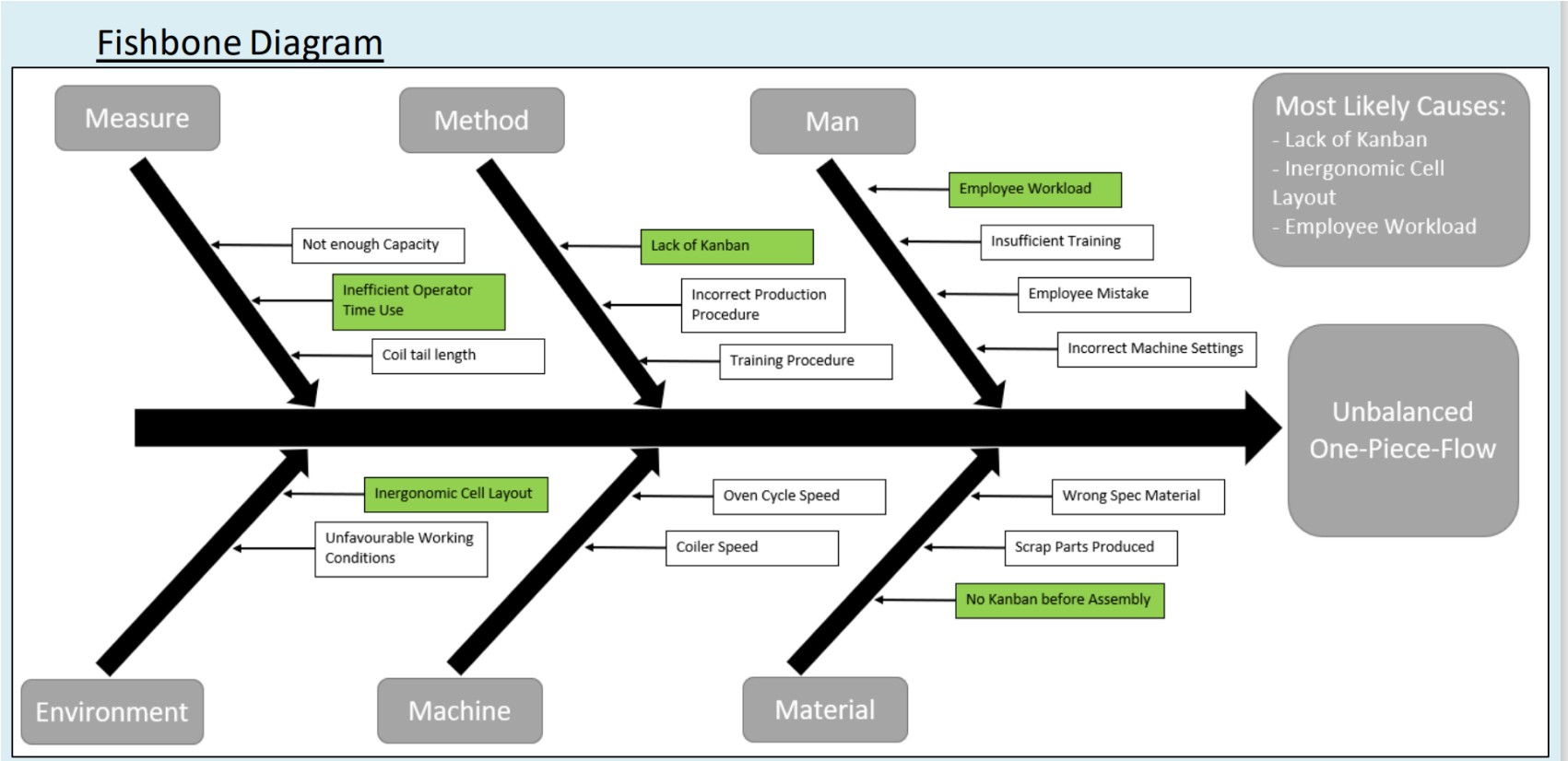
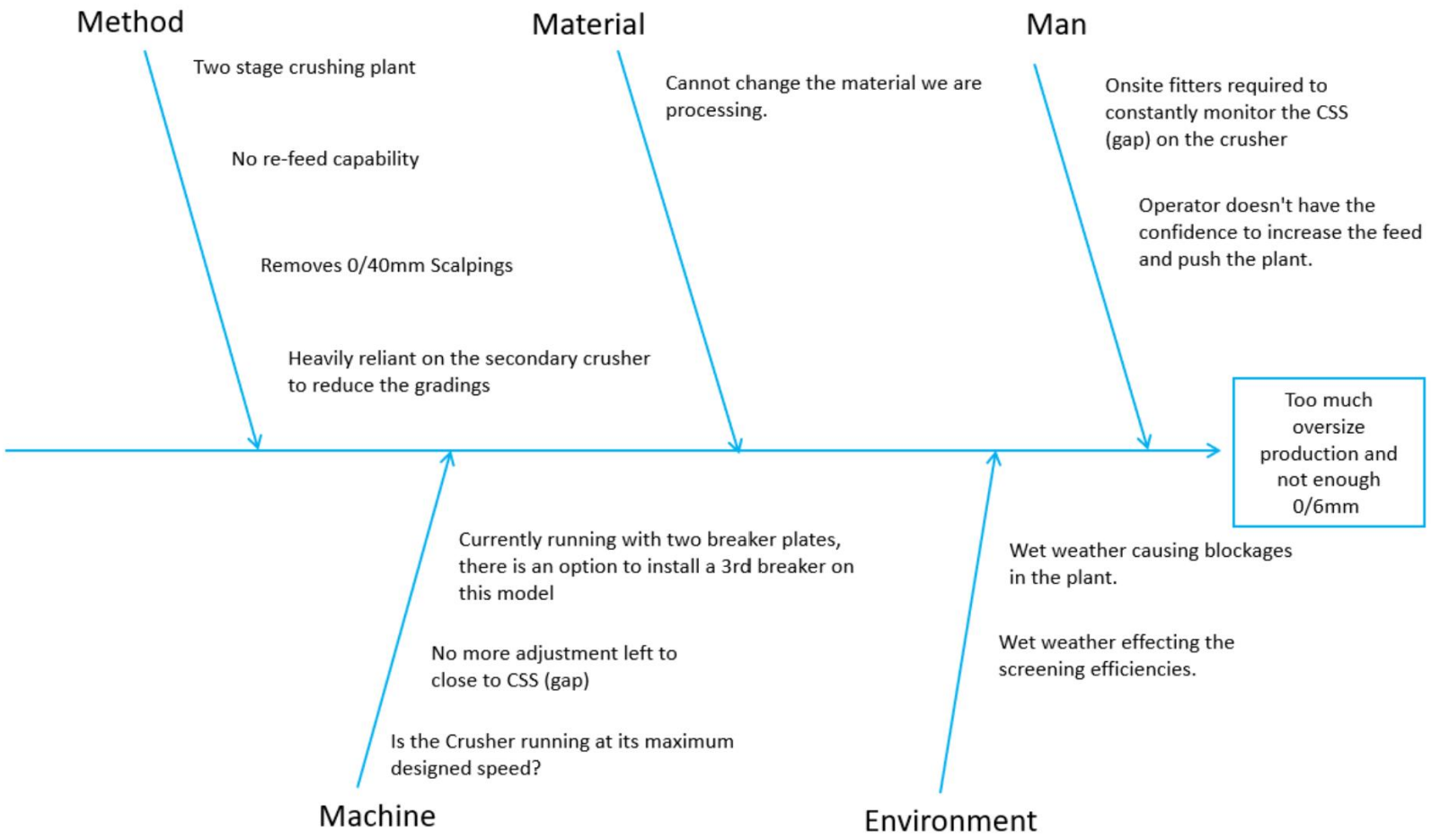
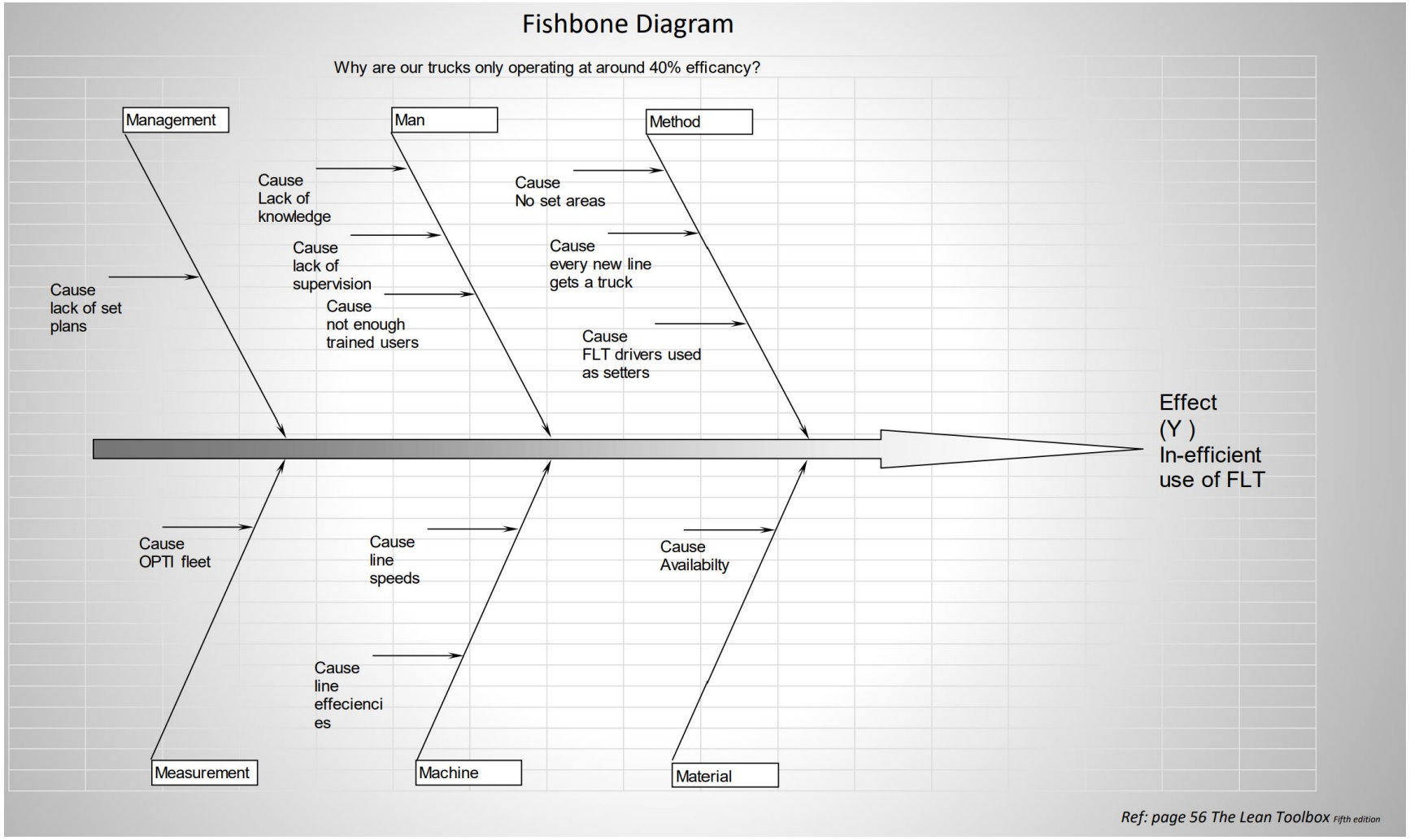


Figure 6 – Ishikawa Diagram

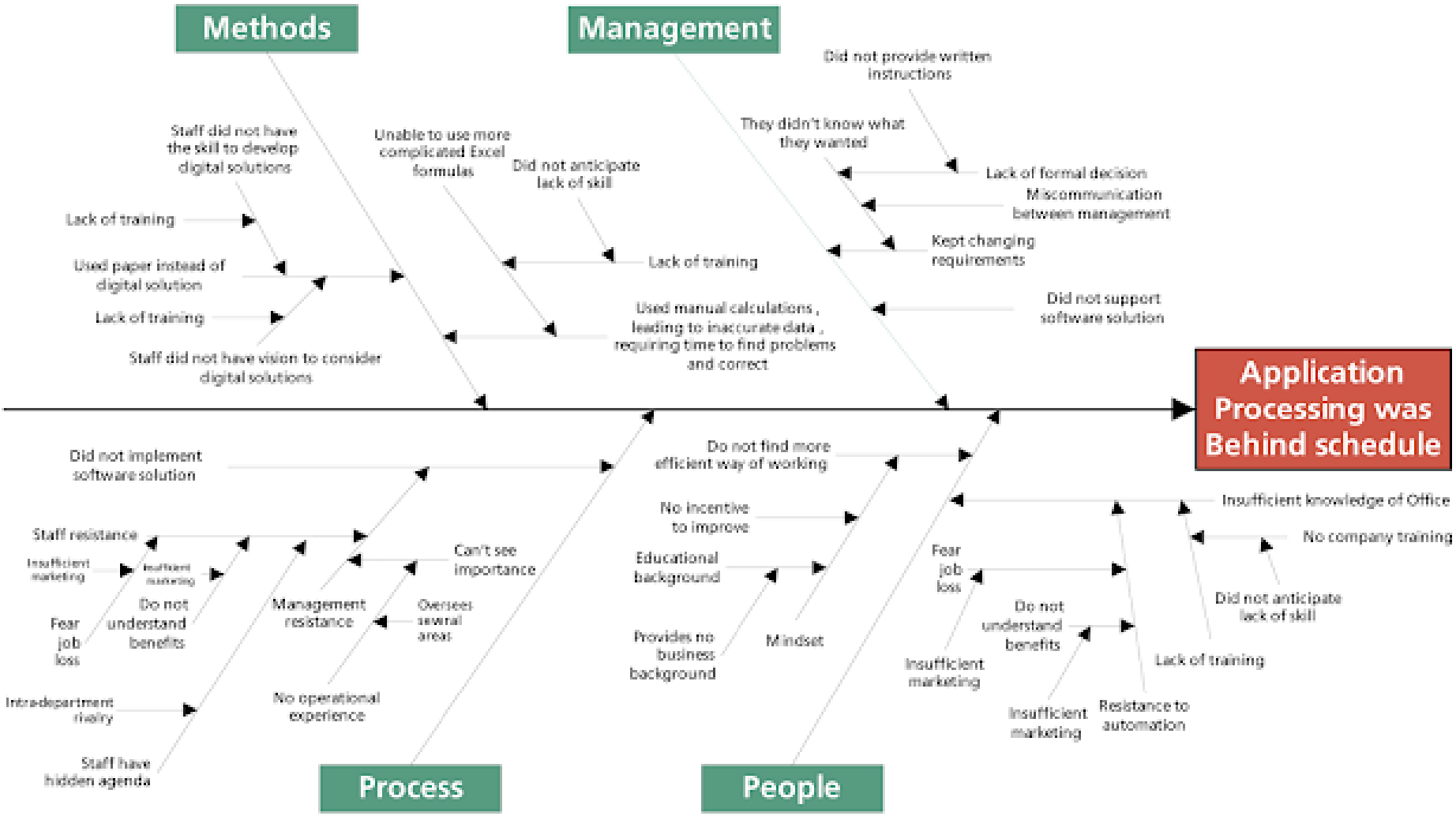
Cause & Effect



Cause & Effect



Cause & Effect



Cause & Effect – How to start

- ☐ Clearly define the effect of the problem
- ☐ Write it down in the centre right of a large piece of paper.
- ☐ Determine the major categories of causes.
- ☐ Write them on the branches of the diagram.
- ☐ Use brainstorming to log all possible causes under the appropriate branches.
- ☐ Use 5 Whys to search for root causes then add them to the diagram.

Cause & Effect – Care Points

- ☐ Take time to ensure the appropriateness of the recorded information.
- ☐ Update the chart as new causes become apparent.
- ☐ Mark or assign numbers near to the key causes to show relative priority.
- ☐ Collect data and investigate to verify the key causes are actual.
- ☐ Plan and implement actions to address the key causes.

Cause & Effect – Ways of finding more causes

- ☐ Keep asking questions to encourage everyone to participate.
- ☐ Involve other people, especially those who have experience in the process.
- ☐ Leave the chart on the wall for a few days and encourage passer—by to contribute.
- ☐ Take a break or do something to take the team's mind off the current thoughts.

Cause & Effect – Further information

- ☐ Clearly define the effect of the problem
- ☐ Write it down in the centre right of a large piece of paper.
- ☐ Determine the major categories of causes.
- ☐ Write them on the branches of the diagram.
- ☐ Use brainstorming to log all possible causes under the appropriate branches.
- ☐ Use 5 Whys to search for root causes then add them to the diagram.

Cause & Effect – Further information

- You could create sub-categories under the main categories.
- For example, under Man there might be;
  - Poor communication
  - Absenteeism
  - Lack of Training
  - ……

- You should, however, avoid writing real names of persons.

- Beware of adding causes which are actually solutions.
- A Cause and Effect Matrix could be used to prioritise the causes of the problem.

Decision Matrix

Criteria	Weighting	Options			
		Option A		Option B	
		Score	Total	Score	Total
Cost	4	3	**12**	2	**8**
Service	5	2	**10**	1	**5**
Contract	3	2	**6**	1	**3**
Totals			**28**		**16**

Cause & Effect – References

Doggett, A. M. (2005) Root Cause Analysis: A Framework for Tool Selection. *Quality Management Journal, 12(4*), 34-45

Rooney, J. J. & Heuvel, L. N. V. (2004) Root Cause Analysis for Beginners. *Quality Progress, 37(7*), 45-53

Westcott, R. T. (2006) *The Certified Manager of Quality / Organisational Excellence Handbook.* (3rd ed.) Milwaukee, WI: ASQ