A COMPARISON OF CAUSE ANALYSIS METHODS AND SUGGESTION FOR AN EFFICIENT WAY OF USE

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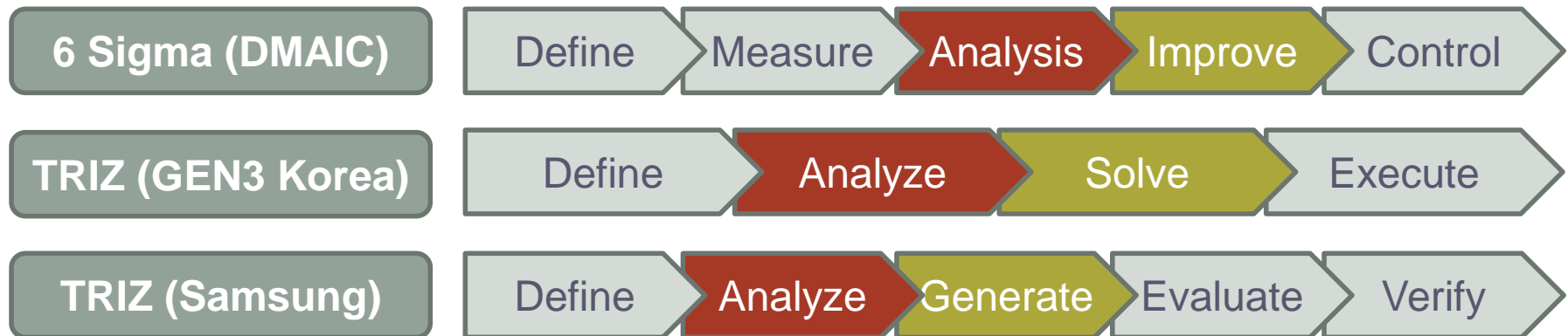Kumoh National Institute of Technology / sahonk@gmail.com

What would you do to solve this problem?

- In a welding process, **welding machines are stopping too often due to false alarms.**

- What would you do to solve this problem and improve productivity ?
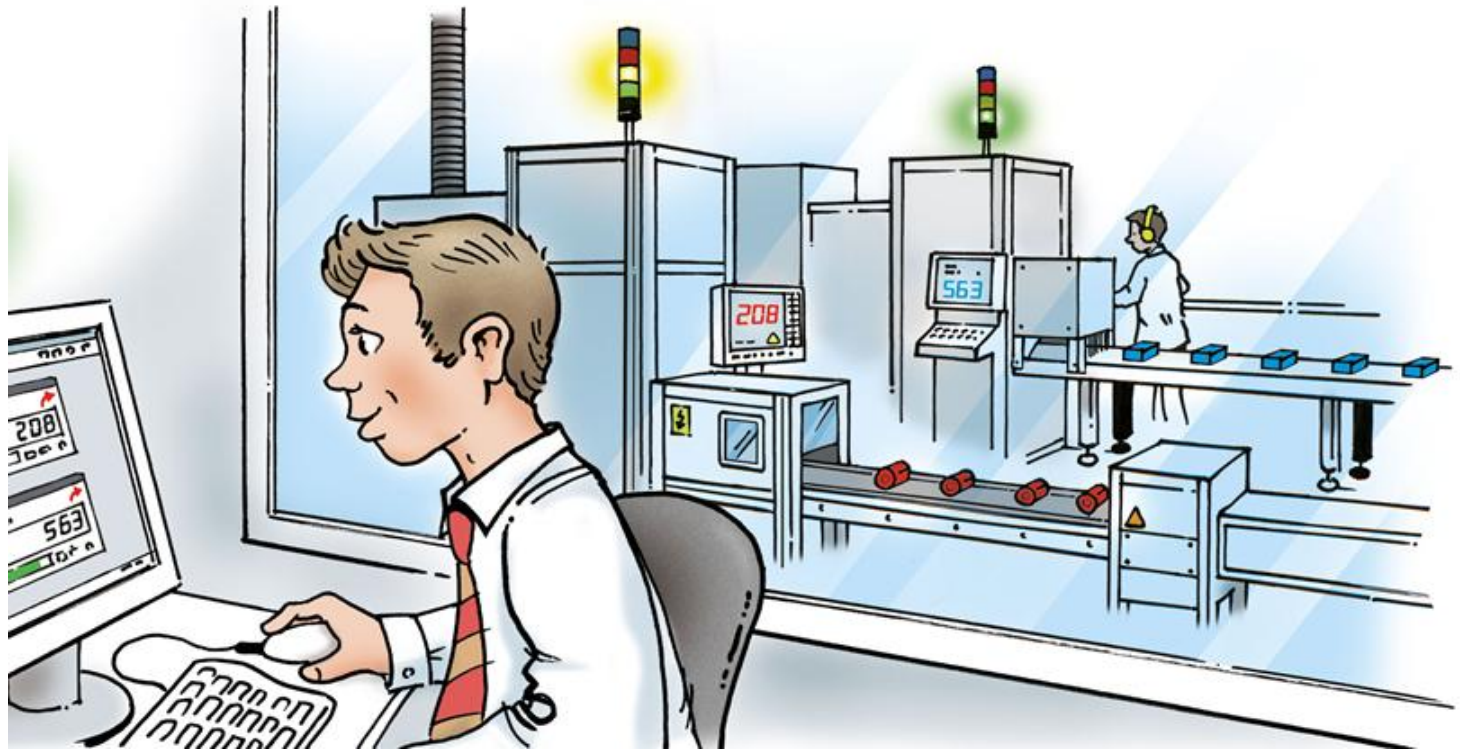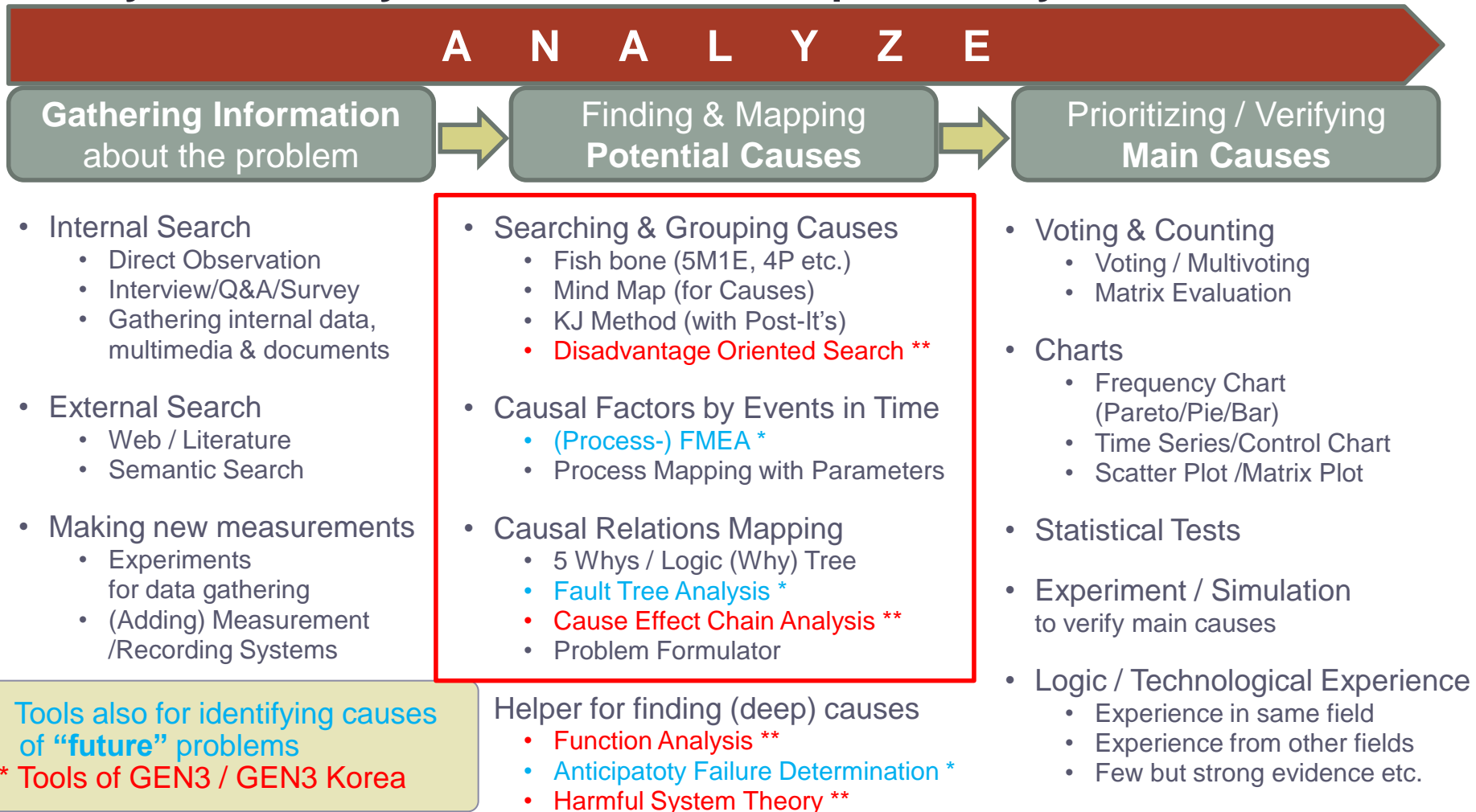
1. Cause Analysis Phase in innovation projects

- **To solve any problem, identification of the (root) causes are very important** because these real main causes can show us directions for effective solutions.

- That's why every innovation methodologies have **"Analysis" phase just before Solving phase** in the middle of the project.

6 Sigma (DMAIC)	Define	Measure	Analysis	Improve	Control
TRIZ (GEN3 Korea)	Define	Analyze	Solve	Execute	
TRIZ (Samsung)	Define	Analyze	Generate	Evaluate	Verify

- But the method of analysing the causes are all different for each methodology and for each individual.

Cause Analysis Tools

- **Many cause analysis tools for the 3 steps of Analyze Phase**

A N A L Y Z E

Gathering Information about the problem	Finding & Mapping Potential Causes	Prioritizing / Verifying Main Causes

Gathering Information about the problem

- Internal Search
  - Direct Observation
  - Interview/Q&A/Survey
  - Gathering internal data, multimedia & documents

- External Search
  - Web / Literature
  - Semantic Search

- Making new measurements
  - Experiments for data gathering
  - (Adding) Measurement /Recording Systems

Finding & Mapping Potential Causes

- Searching & Grouping Causes
  - Fish bone (5M1E, 4P etc.)
  - Mind Map (for Causes)
  - KJ Method (with Post-It's)
  - Disadvantage Oriented Search **

- Causal Factors by Events in Time
  - (Process-) FMEA *
  - Process Mapping with Parameters

- Causal Relations Mapping
  - 5 Whys / Logic (Why) Tree
  - Fault Tree Analysis *
  - Cause Effect Chain Analysis **
  - Problem Formulator

Helper for finding (deep) causes
- Function Analysis **
- Anticipatoty Failure Determination *
- Harmful System Theory **

Prioritizing / Verifying Main Causes

- Voting & Counting
  - Voting / Multivoting
  - Matrix Evaluation

- Charts
  - Frequency Chart (Pareto/Pie/Bar)
  - Time Series/Control Chart
  - Scatter Plot /Matrix Plot

- Statistical Tests

- Experiment / Simulation to verify main causes

- Logic / Technological Experience
  - Experience in same field
  - Experience from other fields
  - Few but strong evidence etc.

* Tools also for identifying causes of **"future"** problems
** Tools of GEN3 / GEN3 Korea

Cause Analysis Tools – 1. Tools for Searching & Grouping Causes

Fish Bone Diagram

Mind Map (for Causes)

KJ Method (with Post-It's)

Disadvantage Oriented Search

Cause Analysis Tools – 2. Listing Causal Factors by Events in Time

Process Mapping with Parameters

Inputs	Type
• Pump speed	C
• Seal water	U
• Gear wear	U
• Dow temp	C
• Polymer visc	C

Pumping
Pump material from autoclave

Outputs
• Polymer Rate
• Polymer temp
• Polymer pressure

Inputs	Type
• Filter type	U
• Filter porosity	U
• Filter fouling	U
• Dow temp	C
• Jackbolt torque	C

Filtration
Filter out contaminants

• Polymer temp
• Polymer press
• Gels
• Dirt

Inputs	Type
• Die Heat temp	C
• Die type	C
• Spin spray	C
• Exhaust rate	U
• Polymer rate	C

Extrusion
Extrude through die

• Strand rate
• Strand diameter

(Process-) FMEA

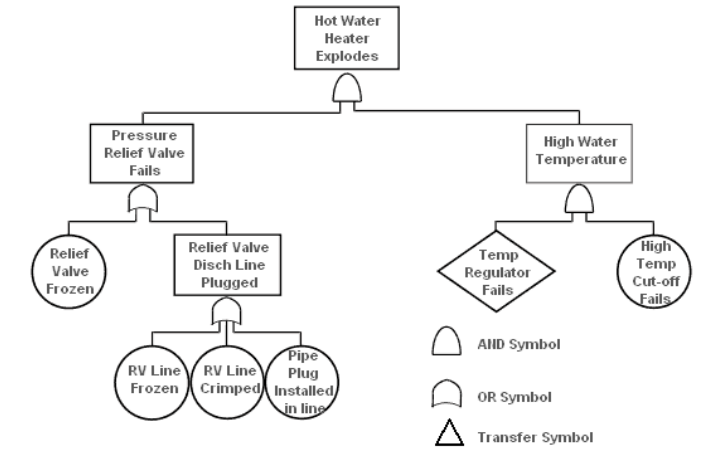| Process Step	Key Process Input	Failure Modes - What can go wrong?	Effects	Causes
Cutting	Shear Speed	Speed too high	Burrs	Incorrect set point
			Damage to blade and material	Poor calibration
		Speed too low	Insufficient cut	Incorrect set point
			Rounded edge	Poor calibration
				Galling of blade
Punching	Punch Speed	Speed to high	Damage to punch	Incorrect set point
				Poor calibration
		Speed to low	Deformation of material	Incorrect set point
			Incorrect feature size	Poor calibration
		Variable Speed	Variable feature sizes	Current variation

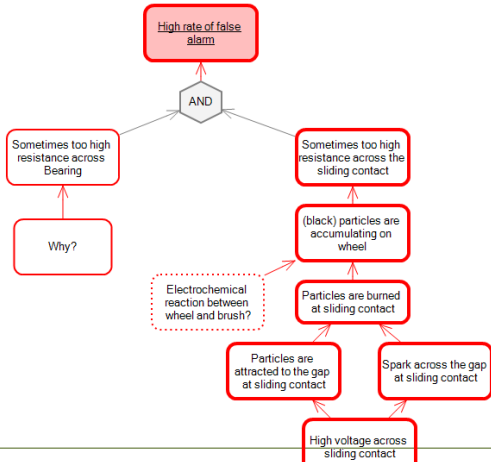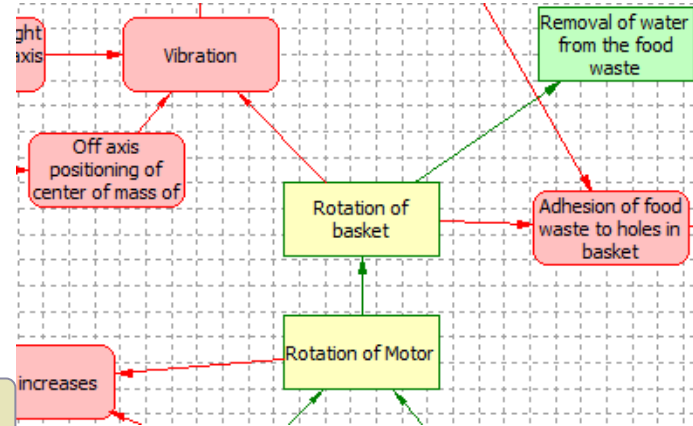# Cause Analysis Tools – 3. Causal Relation Mapping Tools

5 Whys

Issue	Monument deteriorates
Why?	Used Harsh Chemicals
Why?	Too many Pigeon(Poop)s
Why?	Too many spiders
Why?	Too many midges

Logic (Why) Tree

Why does it take so much time to close negotiations with our cable providers?

Because we prevent a timely close
- Because we prevent reaching a **preliminary agreement**
- Because we prevent **closing** on the preliminary agreement

Because the **suppliers** prevent a timely close
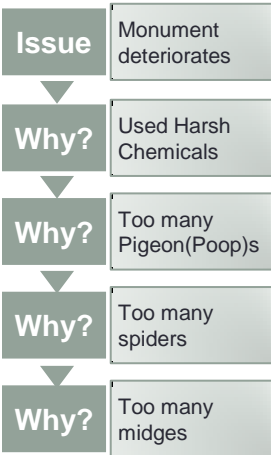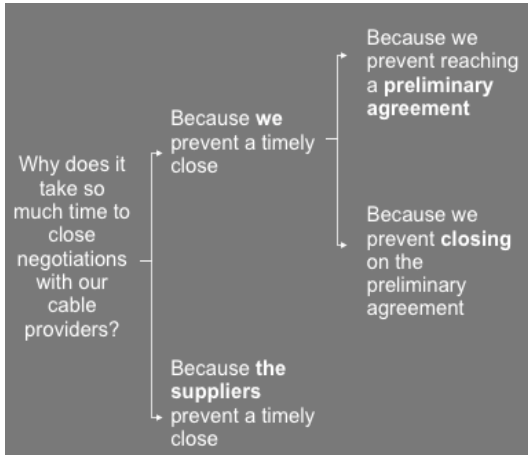
Fault Tree Analysis

Cause Effect Chain Analysis *

Problem Formulator **

*   Tools of GEN3 / GEN3 Korea
** Tools in software IWB of Ideation

Cause Effect Chain Analysis – How to draw

• Drill down the cause chains
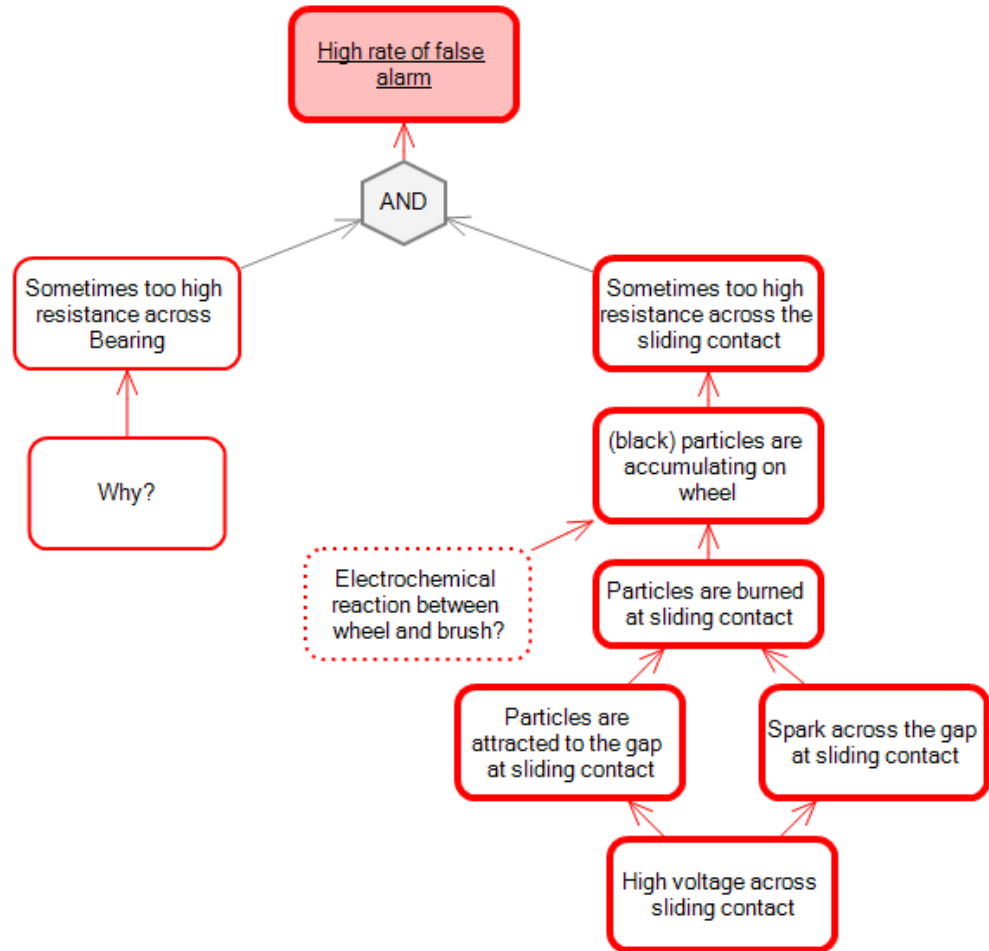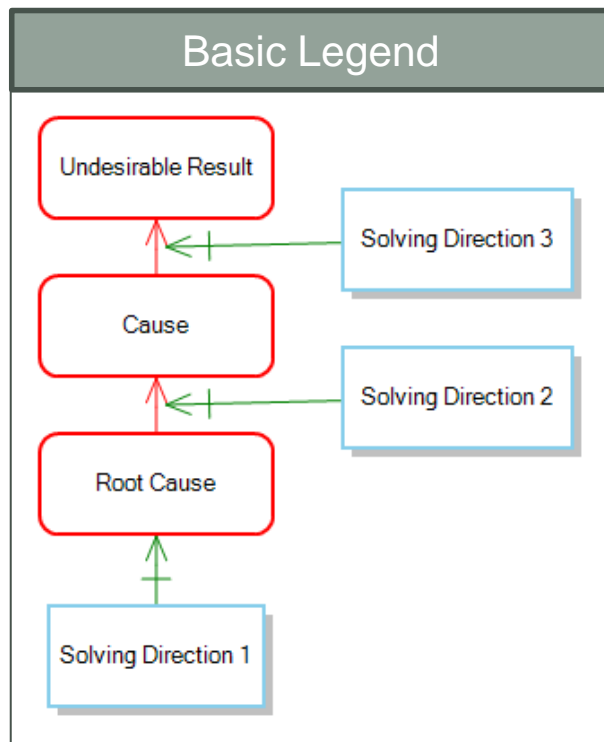
Cause Effect Chain Analysis – Expressing Contradiction etc.

- Express the contradictions
- Identify and do verifications
- Highlight the main chain/causes
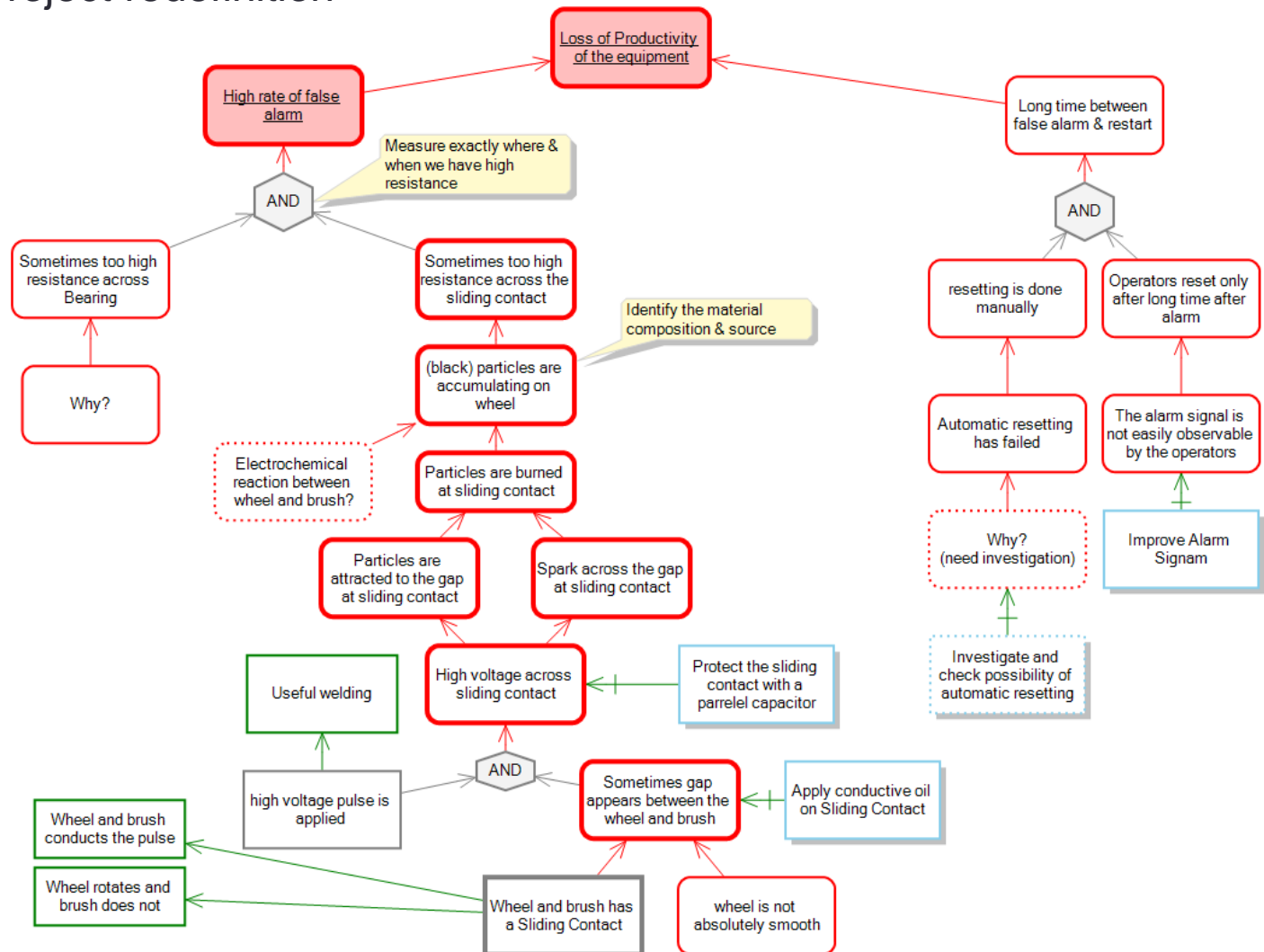- Generate solving directions for each (main) chain/causes
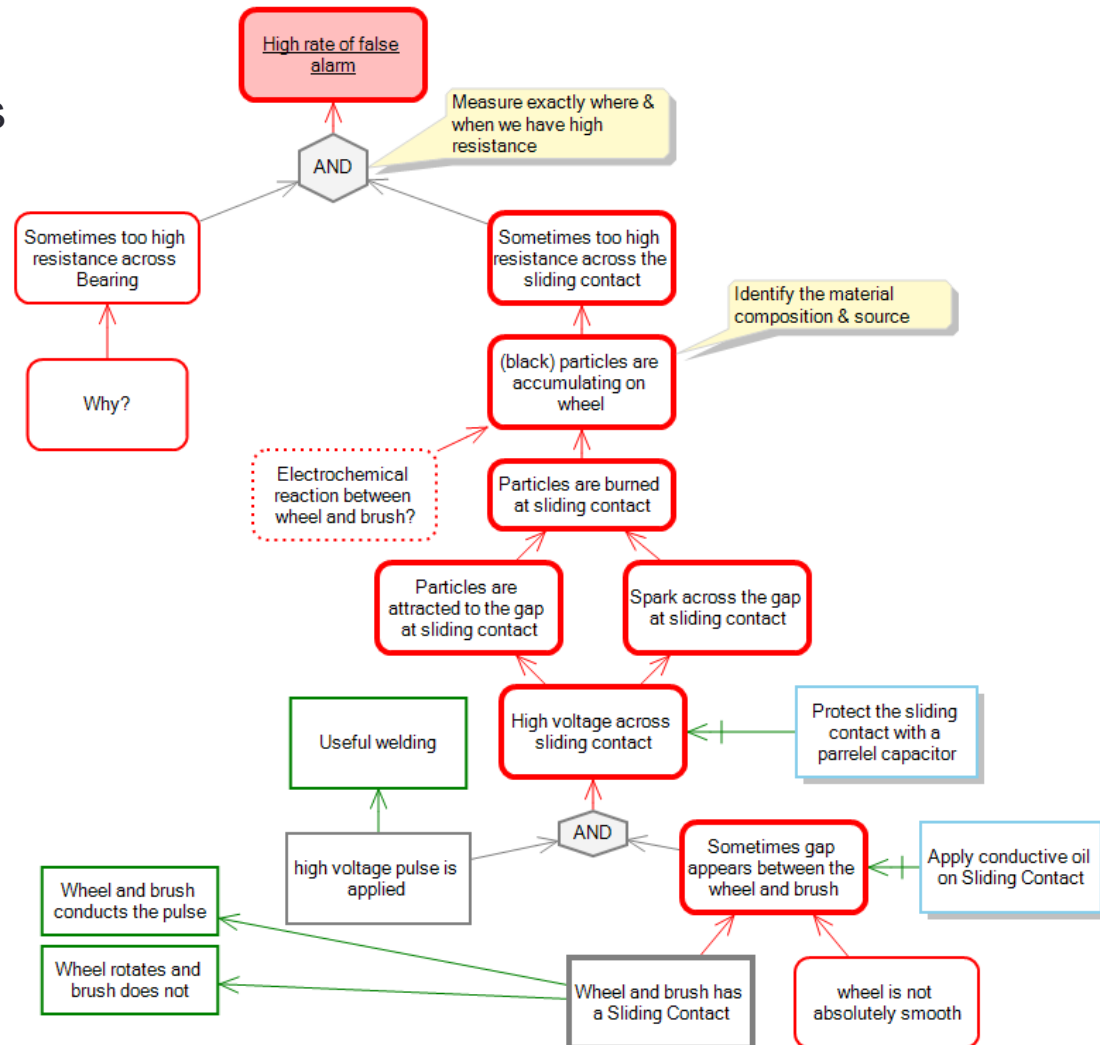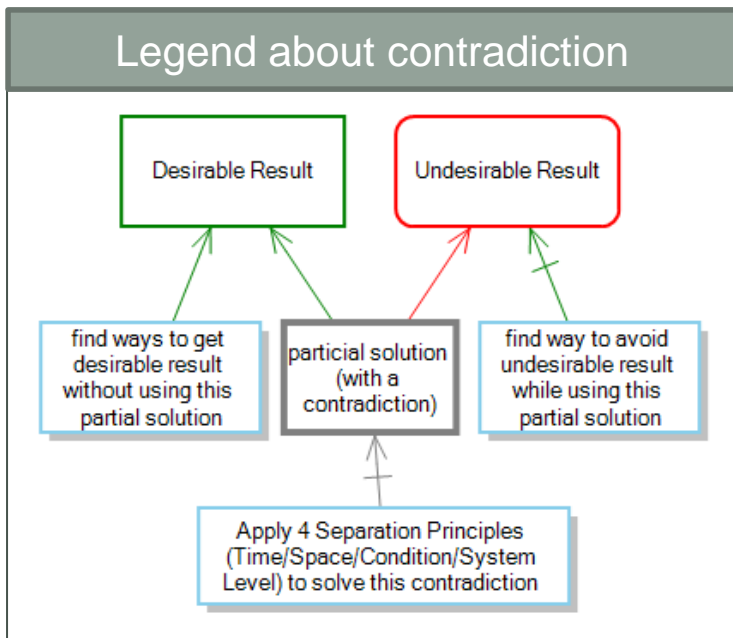
Cause Effect Chain Analysis – Expressing Contradiction etc.

- Generate more solving directions
  for each (main) contradictions
- This is equivalent to the PC-TC Model (or X model)
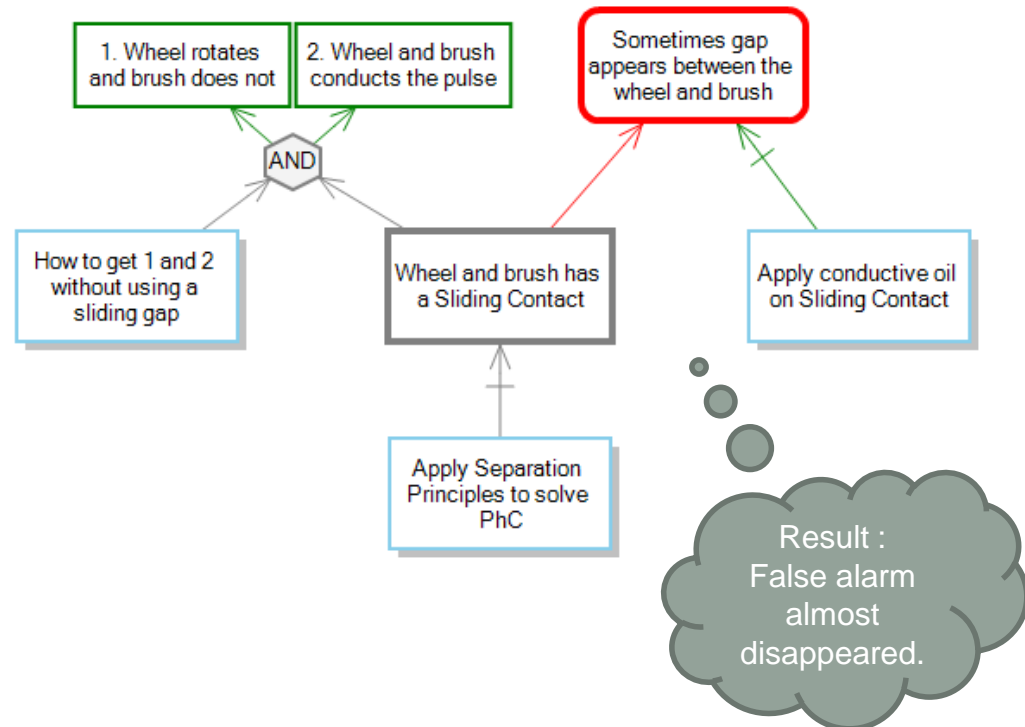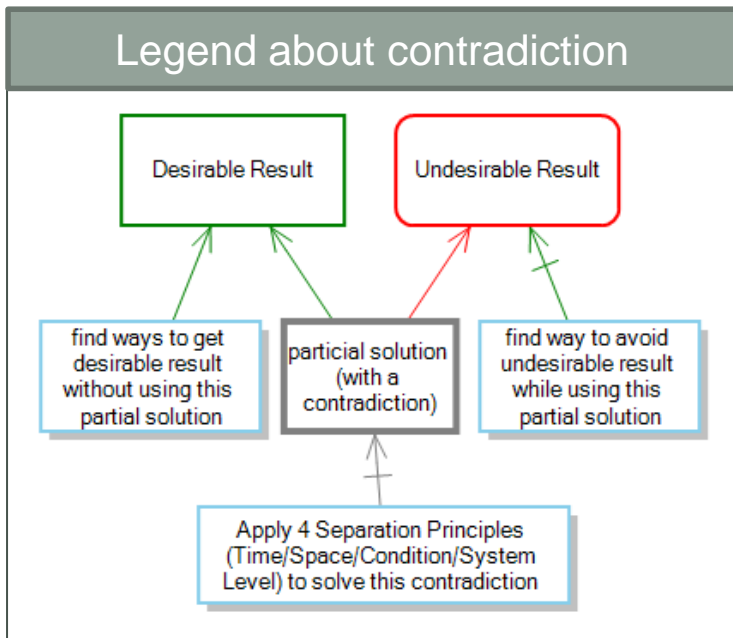
Cause Effect Chain Analysis – Using in Project Reconsideration

- Also useful in project redefinition

Cause Effect Chain Analysis – Pitfalls & Tips for better result

Pit falls

- only a word in a box

- Inappropriate entry in a red box
  - a purpose of upper red box

  - a synonym with upper/lower red box
  - a category name of lower red boxes

- Unable to find enough causes

- Do not know where to focus and where to omit or stop.

- Low viewability / readability

Tips

- a sentence (or phrase) in each box (unless the meaning is clear)
- Use only recommended entries
  - Cause and purpose is different. (purpose can be represented as an upper green box = desirable result)
  - don't use synonyms (it's redundant)
  - category names are not recommended but sometimes useful for readability
- Tips for finding right causes
  - Investigate and Understand the mechanisms of useful/harmful functions
  - Function Analysis, Formulas, Process map of failure mechanism can be helpful.
- Focus on actionable directions.
  - Avoid going into uncontrollable causes.
- For better readability use follwings
  - consistent direction/colors, highlights, thick/dotted lines etc

Thank you

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