



DMAIC Guide

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DMAIC

D

Define

M

Measure

A

Analyze

I

Improve

C

Control

DMAIC

D

Understand the problem and improvement goal, complete project definition, motivate the team.

M

Understand the current state and the current performance of the process, and identify the potential causes of the problem.

A

Verify and filter the causes basing on data.

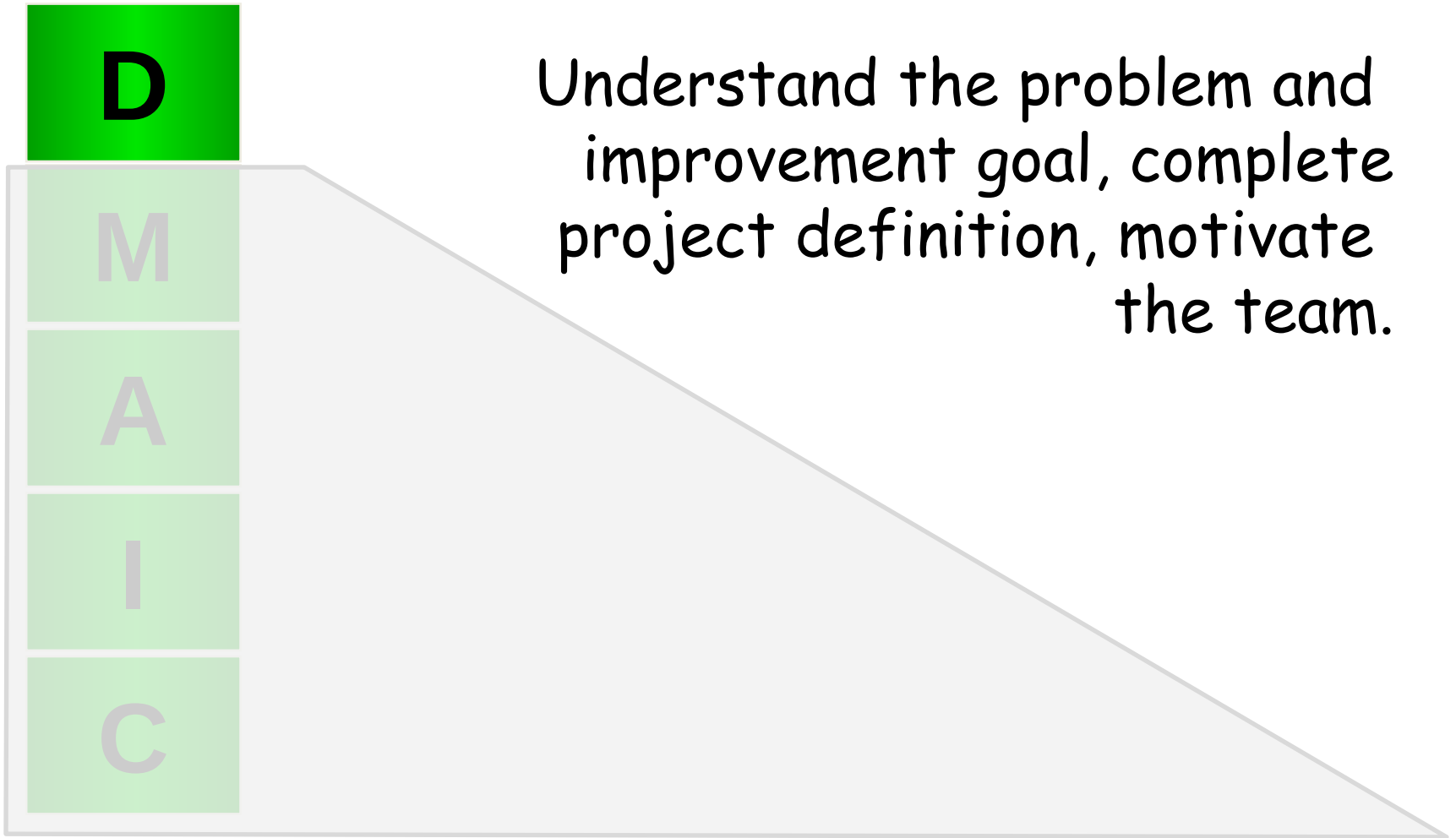
I

Prioritize the causes according to the magnitude of their effects and generate solutions.

C

Implement and verify the solutions and develop necessary controls for the sustainability of the solutions.

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Define Phase Recipe

1. Understand the problem and the objective
 - i. Complete Project Charter exactly
 - ii. Prepare Project Definition Phase report
2. Review with the customer (Process Owner)
 - Reconcile with the customer on the content of the Project Charter
3. Formalize
4. Kick-off the project

1. Understand the Problem and the Objective

I. Complete “Project Charter” exactly and correctly

➡ Exactly:

- Fill in all fields of the charter to include all required information
- If there is a field that is intentionally left blank, put a sign or explanation indicating that it was intentionally left blank.

➡ Correctly:

- Ensure that the information filled in is correct by conducting the necessary investigations, research and studies

PROJECT CHARTER

Content:

- Problem Definition
- Project Metric
- Scope
- Objective
- Financial Benefit
- Other Benefits
- Date of Completion
- Project Team Members
- ...

1. Understand the Problem and the Objective

II. Prepare the Project Definition Phase Report

- Compile research results, information and findings that serve as a reference for completing the Project Charter
- Prepare a “**Project Definition Phase Report**” containing both Project Charter and summary of the information compiled

«For process improvement projects, the “Project Definition Phase Report” is usually a 5-6 page report including the cover page and the Project Charter»

2. Review with the customer (Process Owner)

- ✦ Thoroughly review the content of the Project Charter and the Project Definition Phase Report with the customer (process owner, champion, and other relevant managers)
 - ➡ If there is a need for correction in the content of the charter/report, complete the corrections by doing the necessary work.
 - Ensure that there is nothing missing or misunderstood in the content of the Charter/Report (between you and the customer)
 - ➡ Reconcile and shake hands after corrections are complete
 - The project charter is the contract between the customer and the contractor
 - Do not start a project without fully understanding in which case the project will be completed successfully

Understand exactly what the customer wants and expects

3. *Formalize*

- ✦ Circulate the Project Charter accordingly with your own document circulation procedures
 - ➡ Get it approved by all interested parties

4. *Kick off the Project*

✦ Have a Project Kick-off Meeting

- Have all the project team members, team members' managers and other relevant managers (champion, process owner, ...) attend this meeting
- In this meeting:
 - Raise awareness: inform team members and their managers about the work being undertaken (never assume they are already aware).
 - Demonstrate your leadership (encourage champion and process owner to help with this)
 - Explain the project blueprint
 - Motivate the team towards the goal.

Definition Phase Outputs

➤ Project Charter

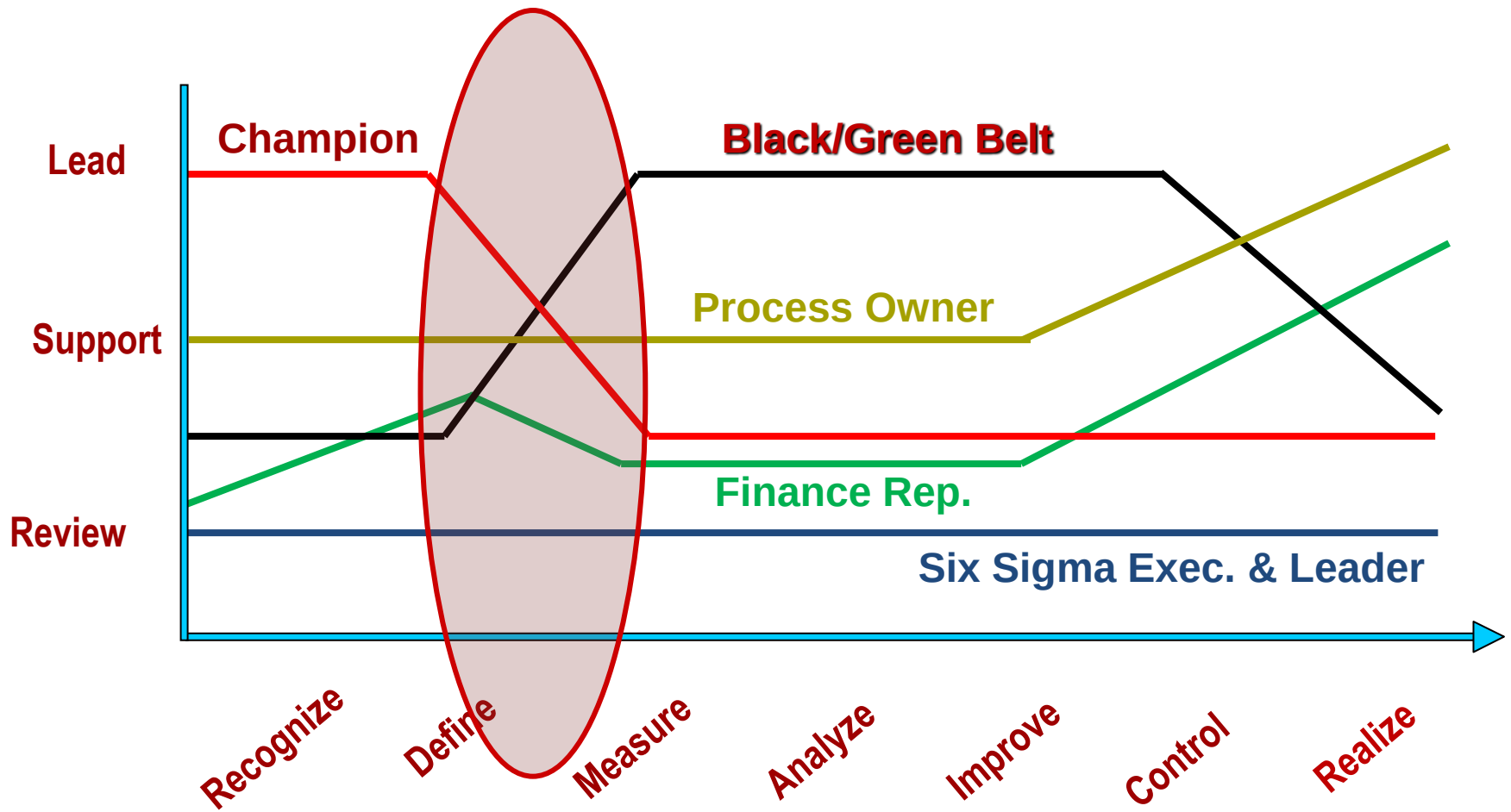
- Problem Definition
- Scope
- Date of Completion
- Project Team Members
- Project Metric
- Objective
- Financial Benefit
- ...

➤ Project Definition Phase Report

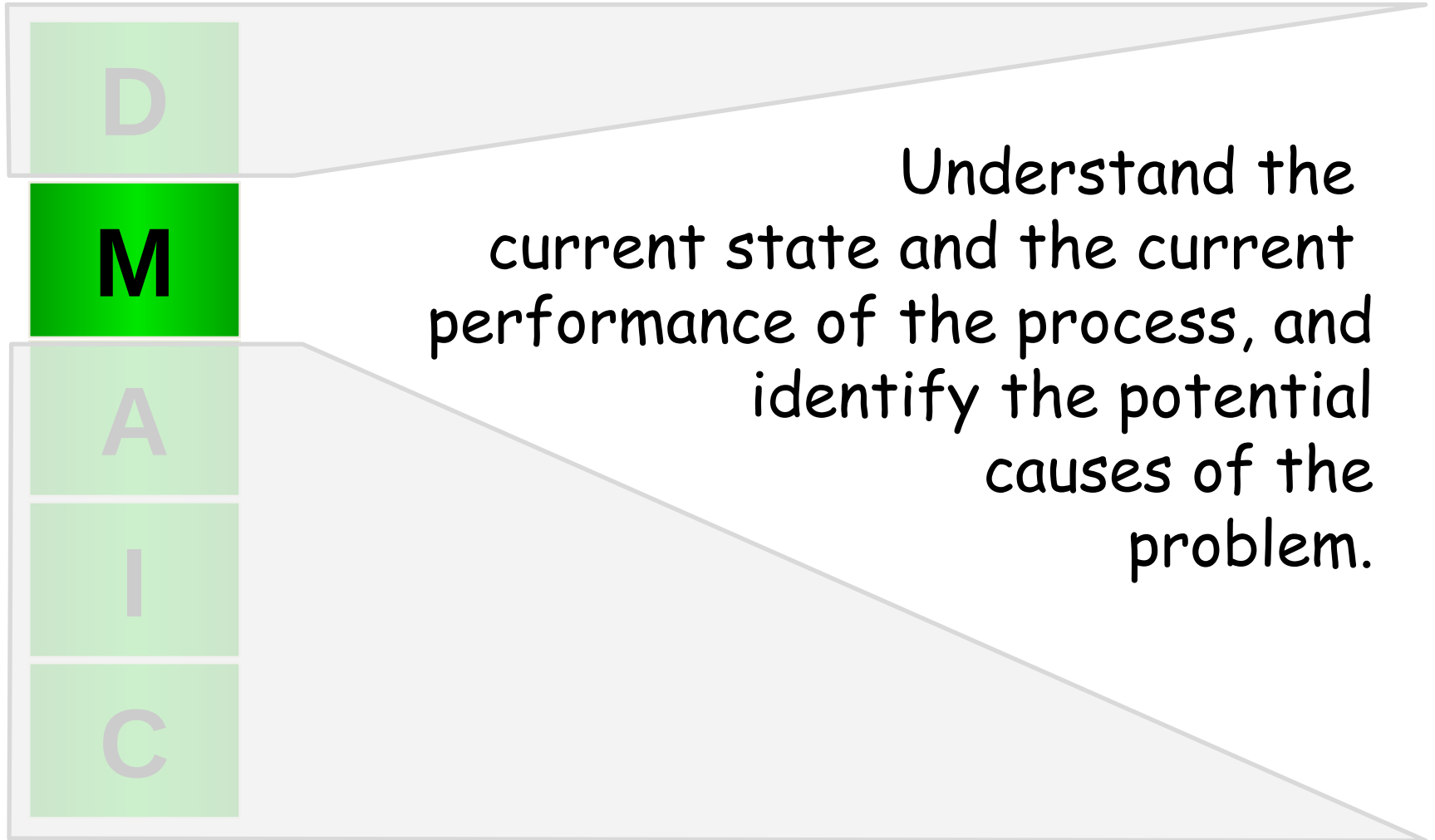
➤ Customer Agreement

➤ Project Kick Off Meeting

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Measure Phace Recipe

1. Current Status Photo: Take a complete and accurate photo of the current status of the problematic process
2. Potential Causes: Identify input variables that could be the cause of the problem that is the subject of the project, using available data and/or tools to leverage knowledge, experience and expertise

1. Current Status Photo (as is)

- I. Prepare a complete and accurate process map that shows the current state of the process (including the "hidden factory")

This Map:

- Reflect exactly what is being done (not what is thought to have been done or what was intended to be done)
- Include all important product characteristics and process parameters

1. Current Status Photo (as is)

II. Measure the capability/performance of the process based on up-to-date data

- If necessary update the error rate and the Project goal on the Project charter
- Never assume that what's in the official record is true anyway

If the up-to-date data gives a different result than the project definition, reconcile with the customer and update the project definition

1. Current Status Photo (as is)

MEASUREMENT SYSTEM ANALYSIS:

- Check whether the measurement system to be used in measuring the capability/performance of the process based on up-to-date data is capable to make these measurements.
 - If the measurement system being used is not capable, start the studies to improve the measurement system.
 - Perform the process capability/performance analysis with the improved measurement system (or another capable measurement system if the improvement of the measurement system will take long).

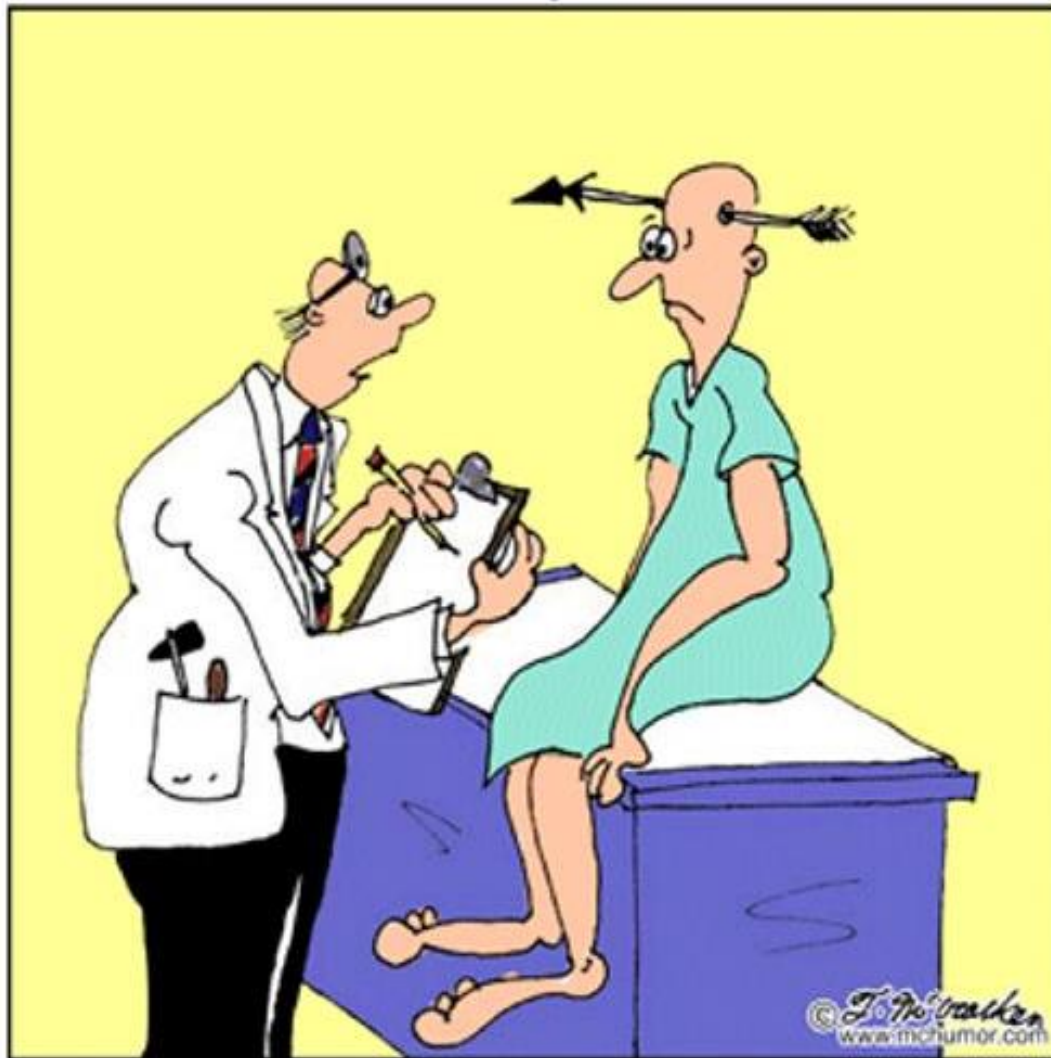
(Immediate Actions)

CAUTION: Do not allow any changes to the process before the baseline (as-is) photo is completed.

After the baseline photo is completed and the photo is agreed upon:

- ▶ Start fixing immediately for those which the solutions are already known

Start implementing “Control Phase” activities for these improvements



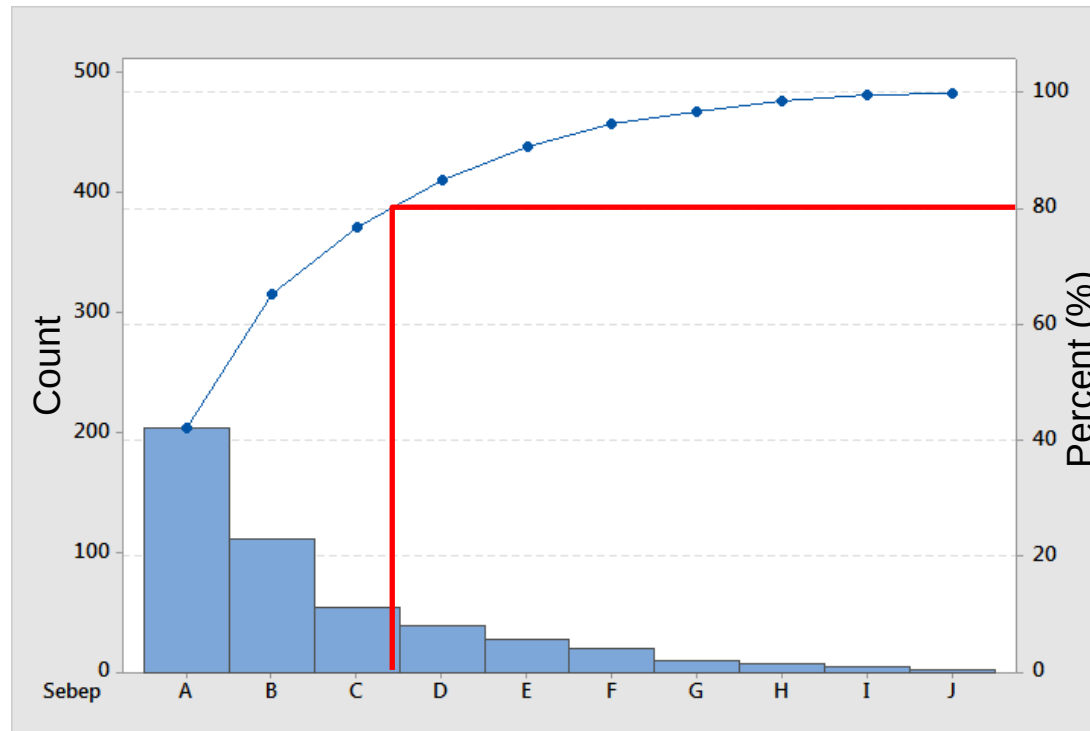
“Off hand, I'd say you're suffering from an arrow through your head, but just to play it safe, I'm ordering a bunch of tests.”

2. Potential Causes

- 2.1 Identify potential causes using data-driven tools if data is available or can be collected quickly
- 2.2 If data is not available, identify input variables that may be the cause of the problem that is the subject of the project, using tools to leverage existing knowledge, experience and expertise.

2.1 Potential Causes – Data Driven

- Use pareto analysis or other tools if data is available.



2.2 Potential Causes – Knowledge Based

- In cases where the available data is not sufficient (which is very common), identify input variables that may be the cause of the problem that is the subject of the project, using tools based on knowledge, experience and expertise.

- Some Popular Knowledge Based Tools:

- Cause-Effect Matrix
- Cause and Effect Diagram (Fishbone)
- Fault Tree Analysis (or 5 WHY?)
- FMEA (Potential **F**ailure **M**odes and **E**ffects **A**nalysis)
- ...

2.2 Potential Causes – Knowledge Based

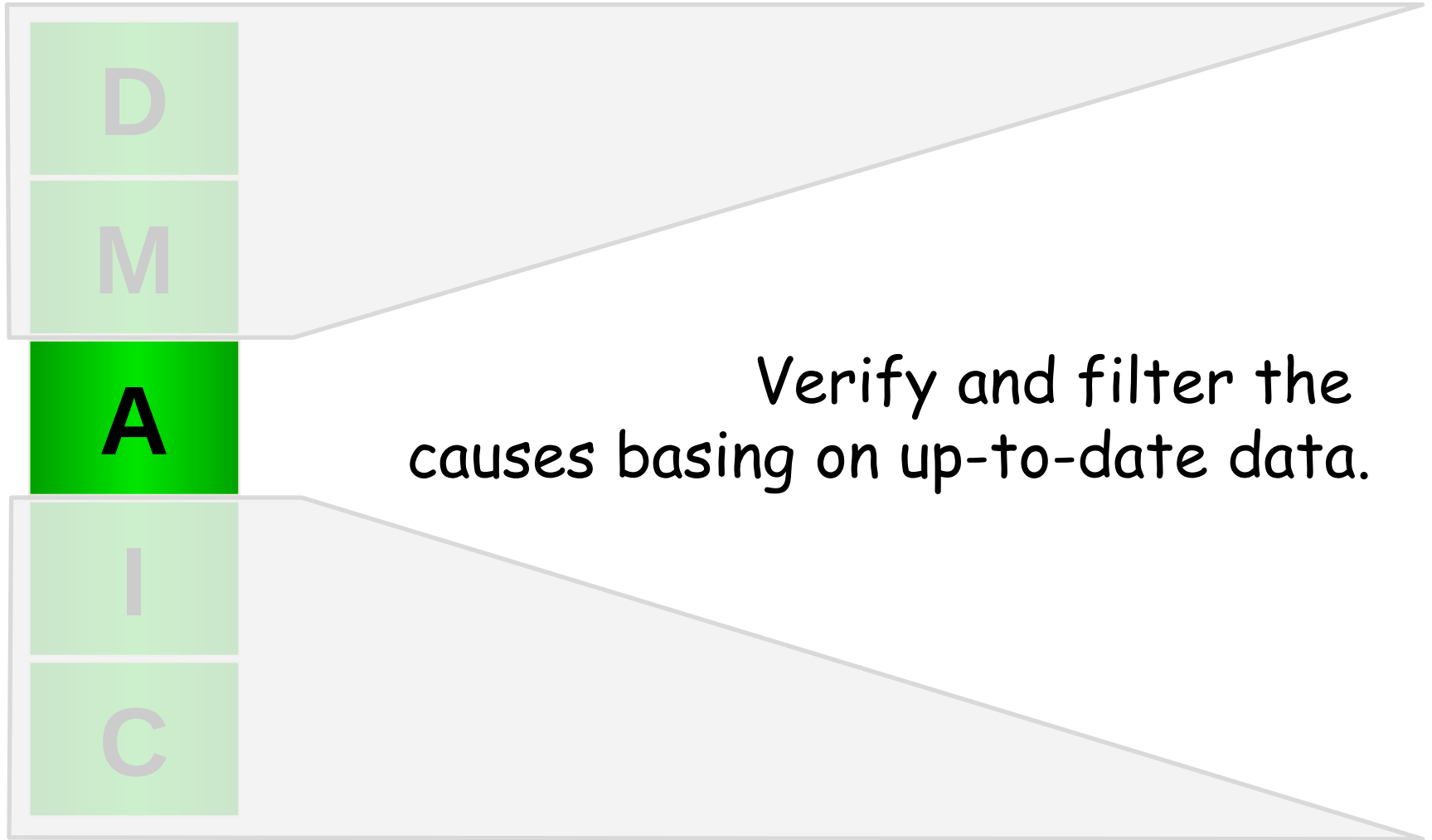
- These tools are effective only if there is product and/or process knowledge, experience and expertise. So the team must include;
 - People with appropriate experience and knowledge,
 - Key process workers.

The Project Manager manages the team

Measure Phase Outputs

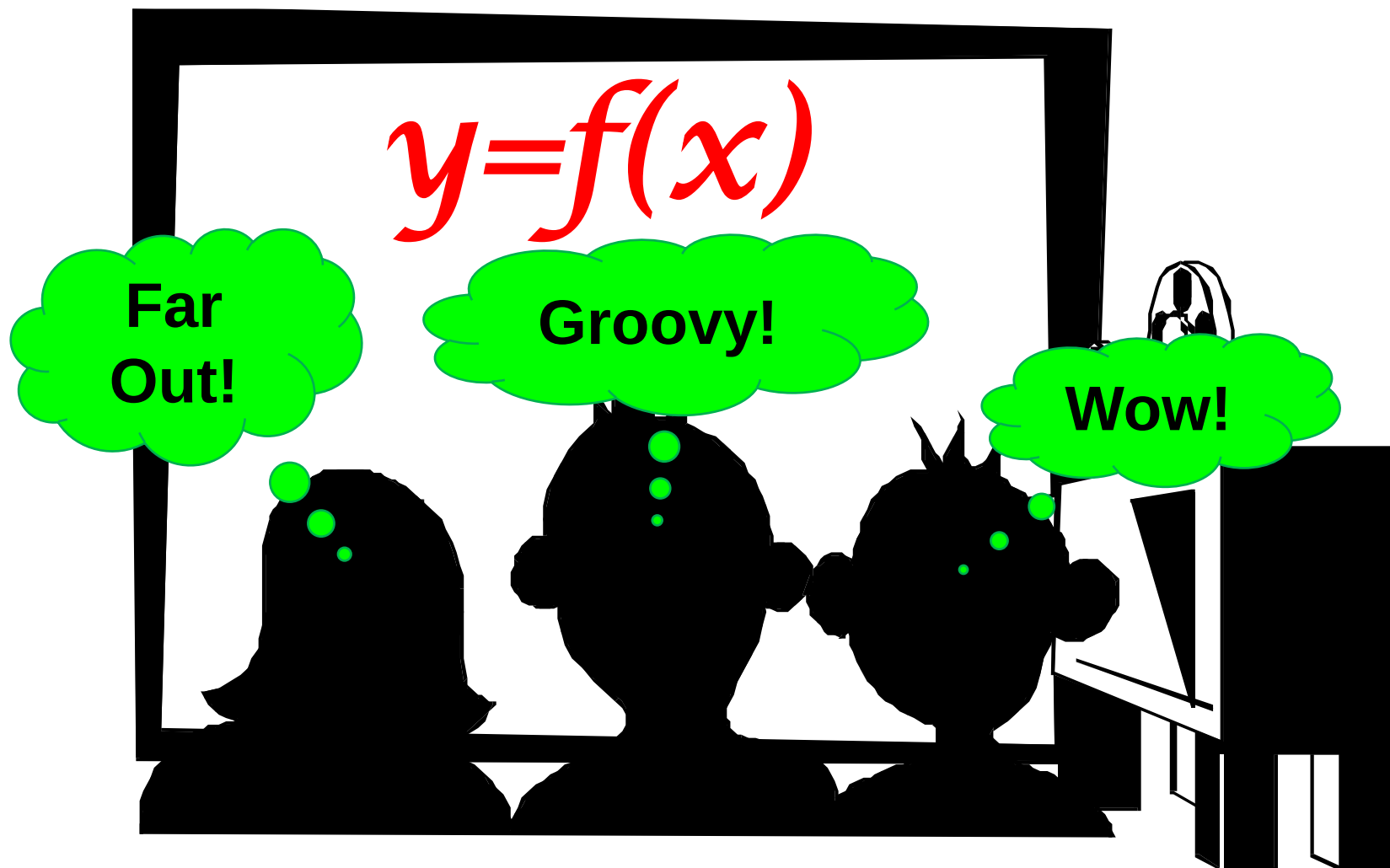
- As-is process map
 - Detailed
 - Correct
 - Exact (containing hidden factory)
- Up-to-date process performance/capability measurement results
- Analysis and compliance results for measurement systems used in process performance/capability analysis
- Revised and agreed Project Charter if required
- List of the potential causes of the problem
 - Obtained by use of data and/or knowledge based tools
- Immediate actions and action plans for already known solutions

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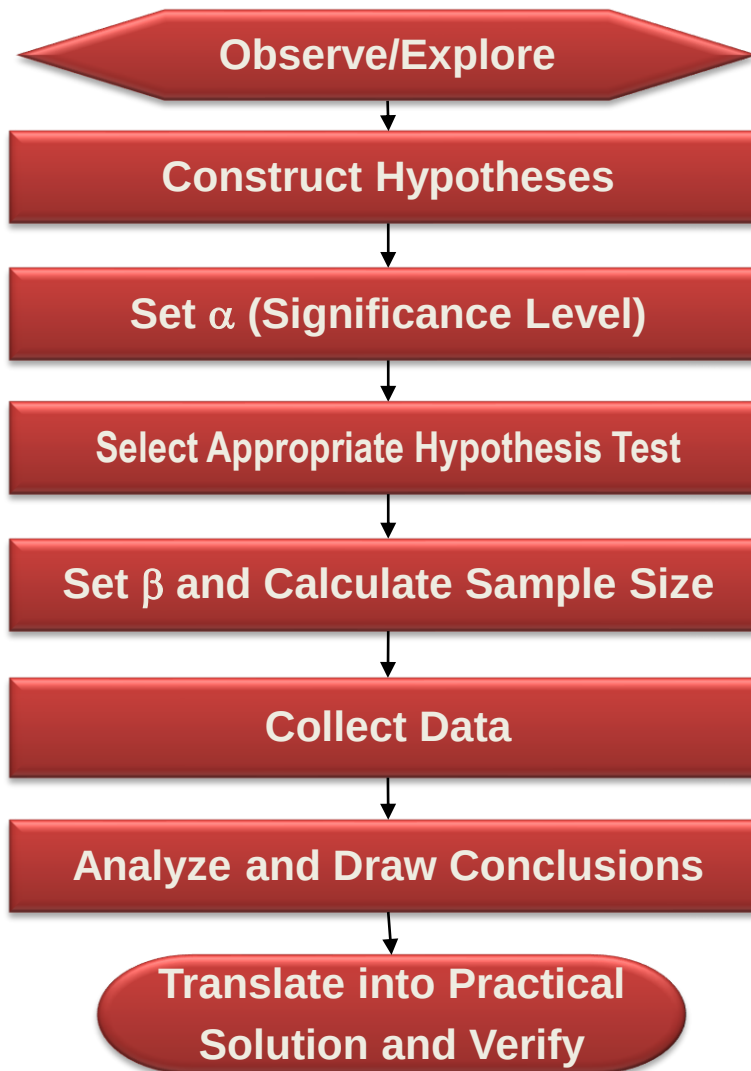


Analysis Phase Recipe

1. Verify: Test, based on up-to-date data, whether the potential causes are actually causes
2. Filter: Eliminate input variables that you are sure are not the cause



Hypothesis Testing Recipe



H_0 : There is no difference (=)

H_a : There is difference (<, $\neq$, >)

Generally 0.05 (%5)

HYPOTHESIS TESTING ROADMAP

β generally is 0.10 (%10)

Random, independent, calculated amount

Calculate "Significance Value" –
Compare it by the "Significance Level".

Hypothesis Testing Road Map

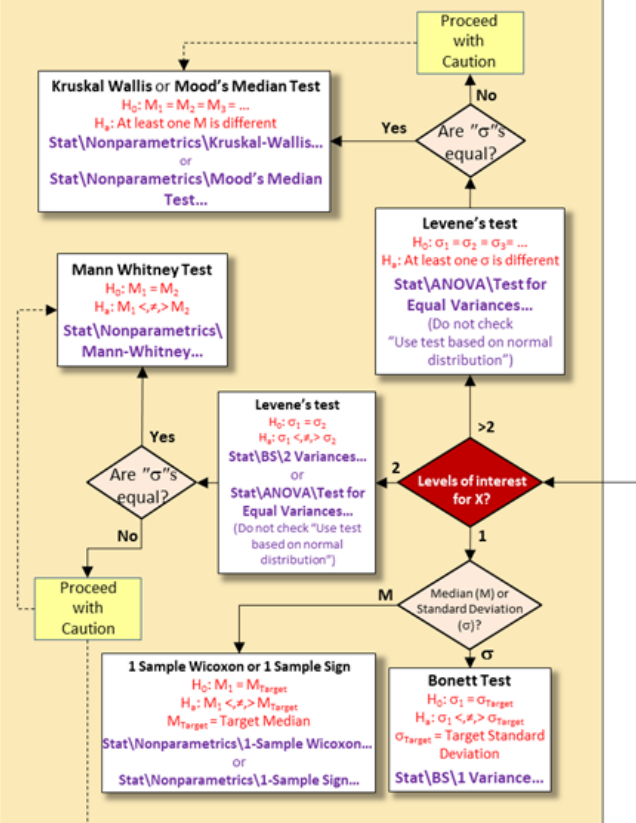
Notes:

1. Box Text Colors Legend:

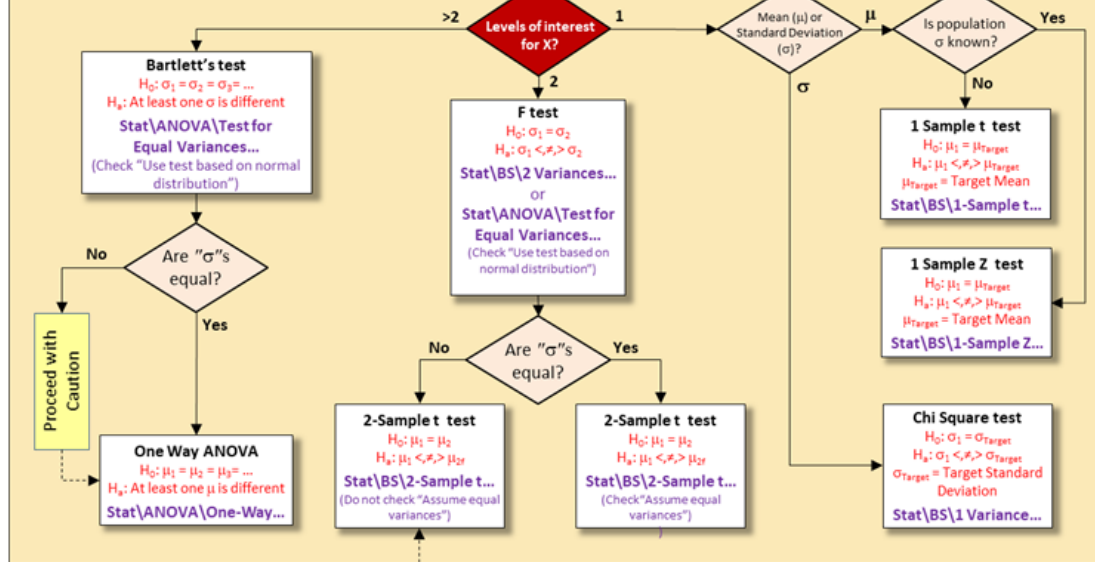
Black Bold Font: Name of the Statistical Test
Red Font: Mathematical Expression of Hypotheses
Purple Bold Font: Minitab routine for the Hypothesis Test

- H_0 can be $<$, $\neq$, or $>$
- If P-value $\geq \alpha$ then fail to reject H_0
If P-value $< \alpha$ then reject H_0
- Proper sample size selection is important for the effectiveness of the tests: **Stat\Power and Sample Size...**

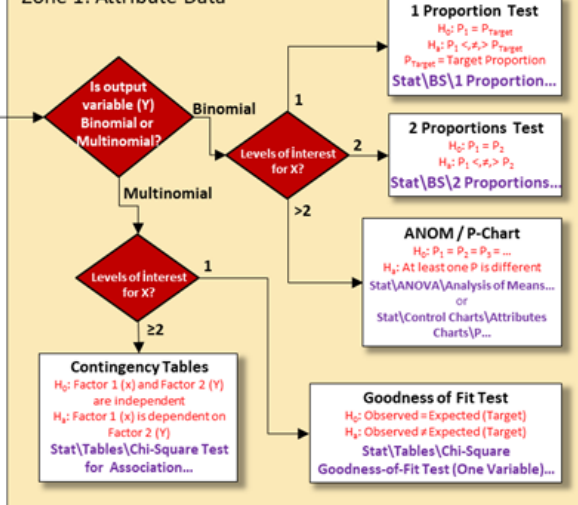
Zone 3: Variable Data – Non-normal Distribution



Zone 2: Variable Data – Normal Distribution

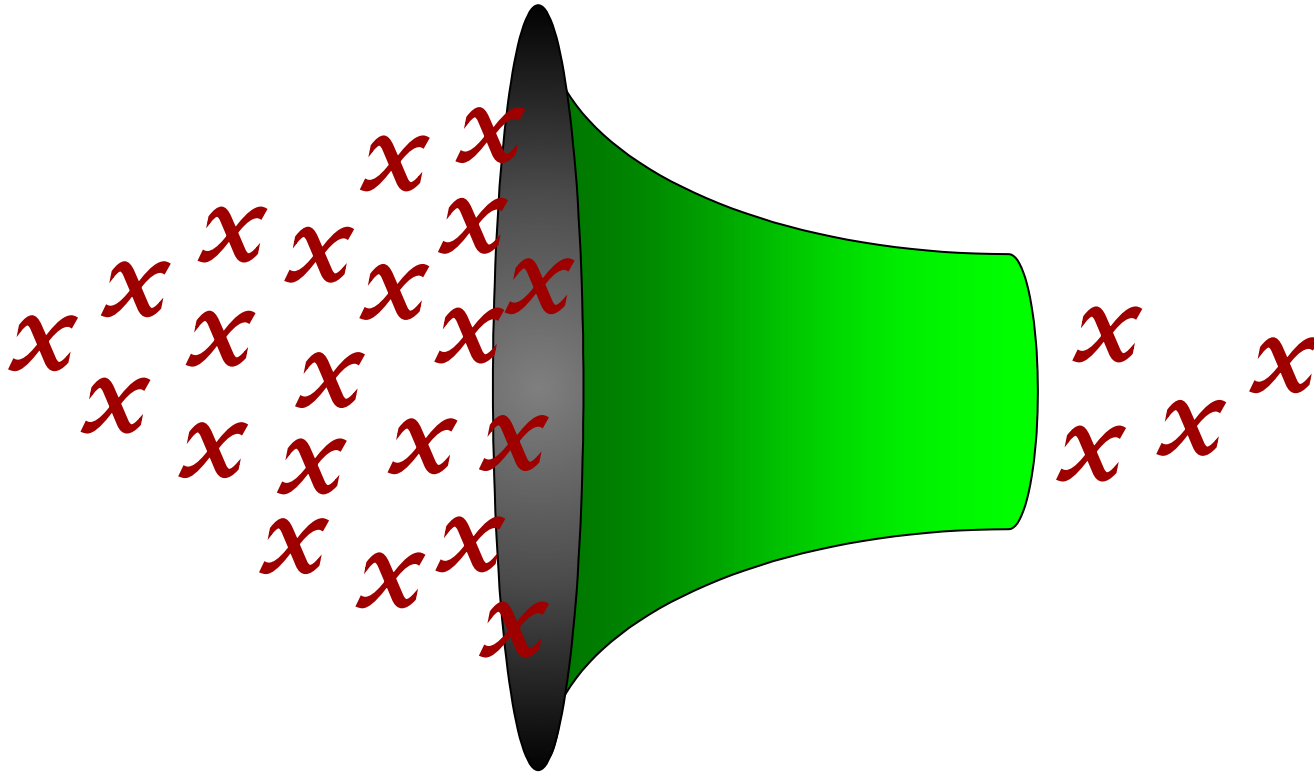


Zone 1: Attribute Data

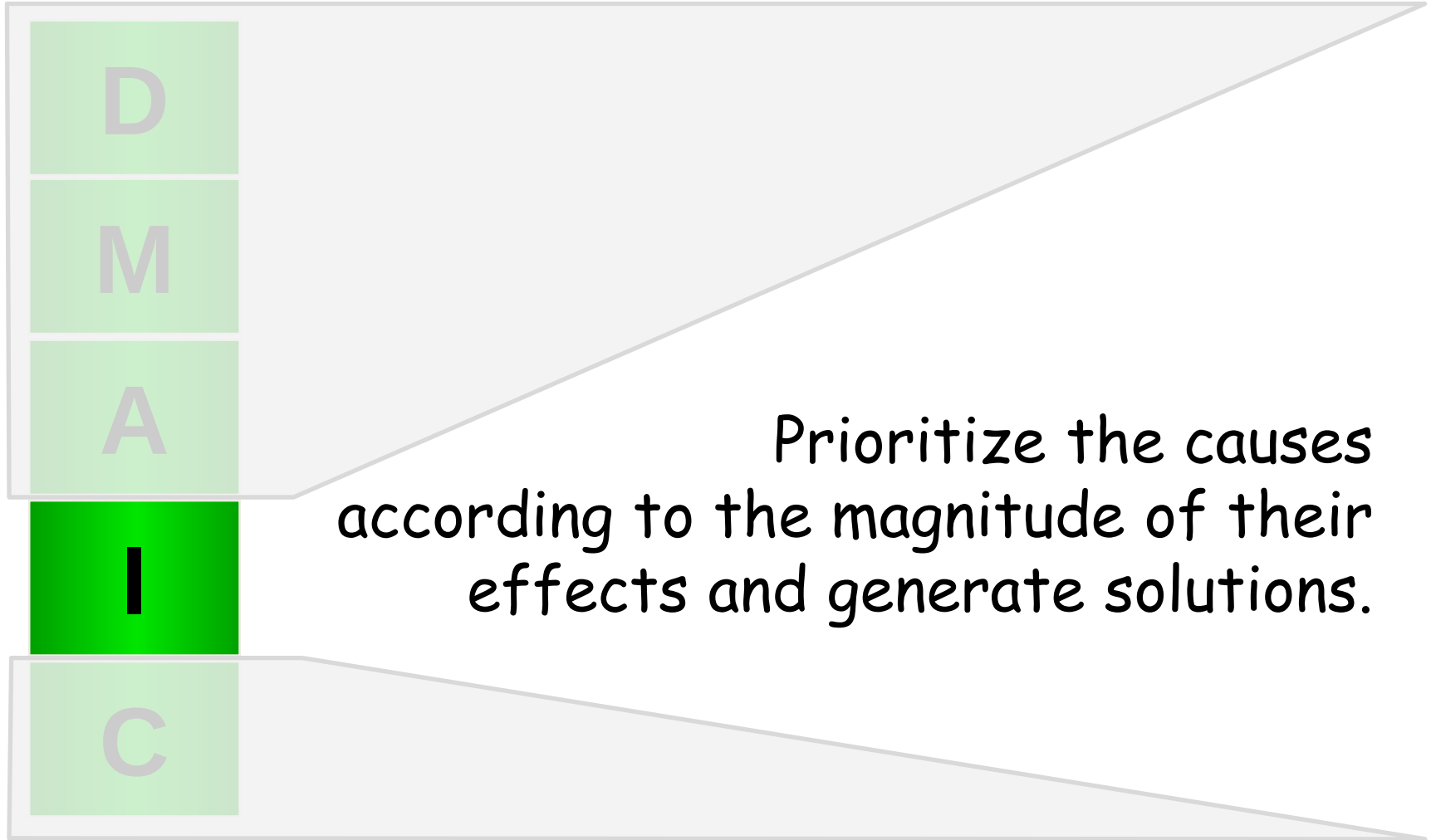


Analysis Phase Outputs

► Verified causes

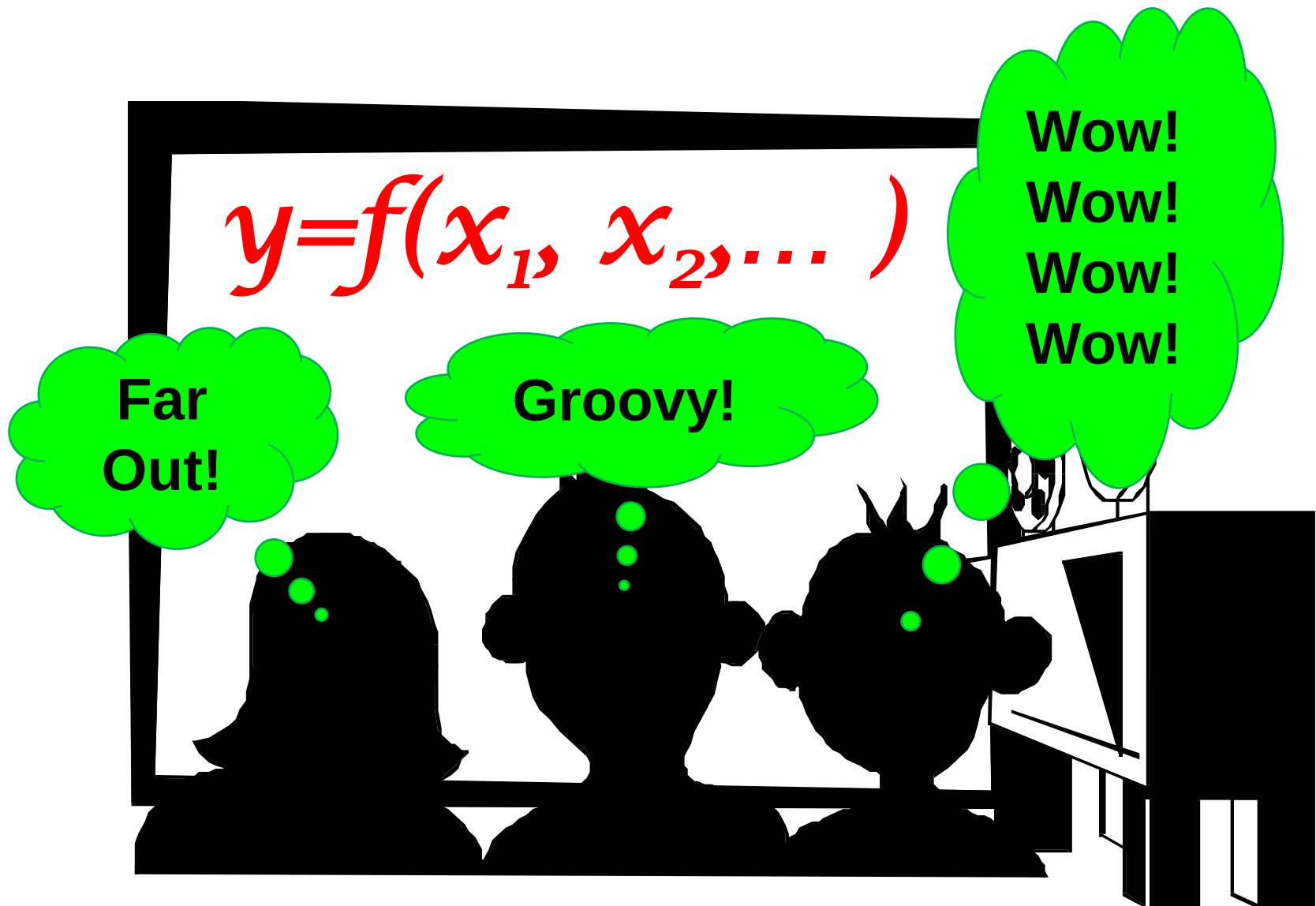


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Improve Phase Recipe

1. Prioritize and rank the causes by the magnitude of their effects
2. Explore/Develop solutions to eliminate the causes
3. Verify Solutions: Test if suggested solutions are actually be solutions
4. Identify Solutions (Improvements)
5. Create Solutions (Improvements) implementation Plan



Improve Phase Outputs

- List of prioritized causes

$$y = f(x_1, x_2, \dots x_n)$$

- Verified solutions
- Solutions implementation plan

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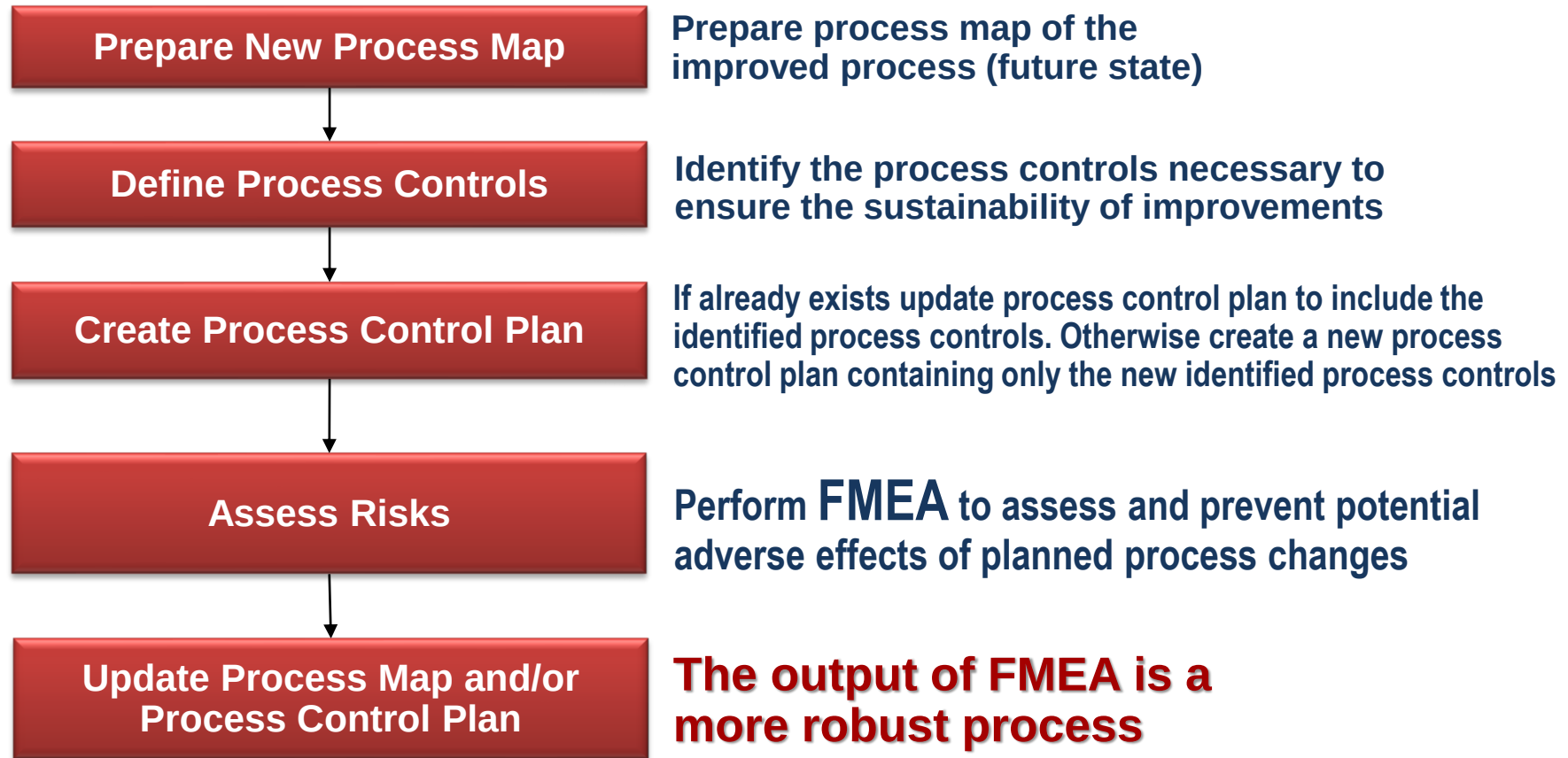
Control Phase Recipe

1. Prepare new process map (future state)
2. Define Process Controls
3. Create Process Control Plan
4. Assess Risks: Evaluate the risks that improvements can bring and develop countermeasures

➡ FMEA

5. Revise implementation plan
6. Implement and verify solutions
7. Update Process Map and Process Control Plan (As Built)
8. Close the project

Steps 1, 2, 3 and 4



Steps 5 and 6

- Revise solutions (changes) implementation plan
 - What?
 - When?
 - Who?
 - How?
 - ...?
- Implement and validate solutions according to plan

Are we having the expected results?

Step 7

- Update Process Map and Process Control Plan: make it reflect the current state of the process (As Built)
- Complete any required procedures, instructions or other documentation
- Plan and execute training of process workers

Step 8 (Close the Project)

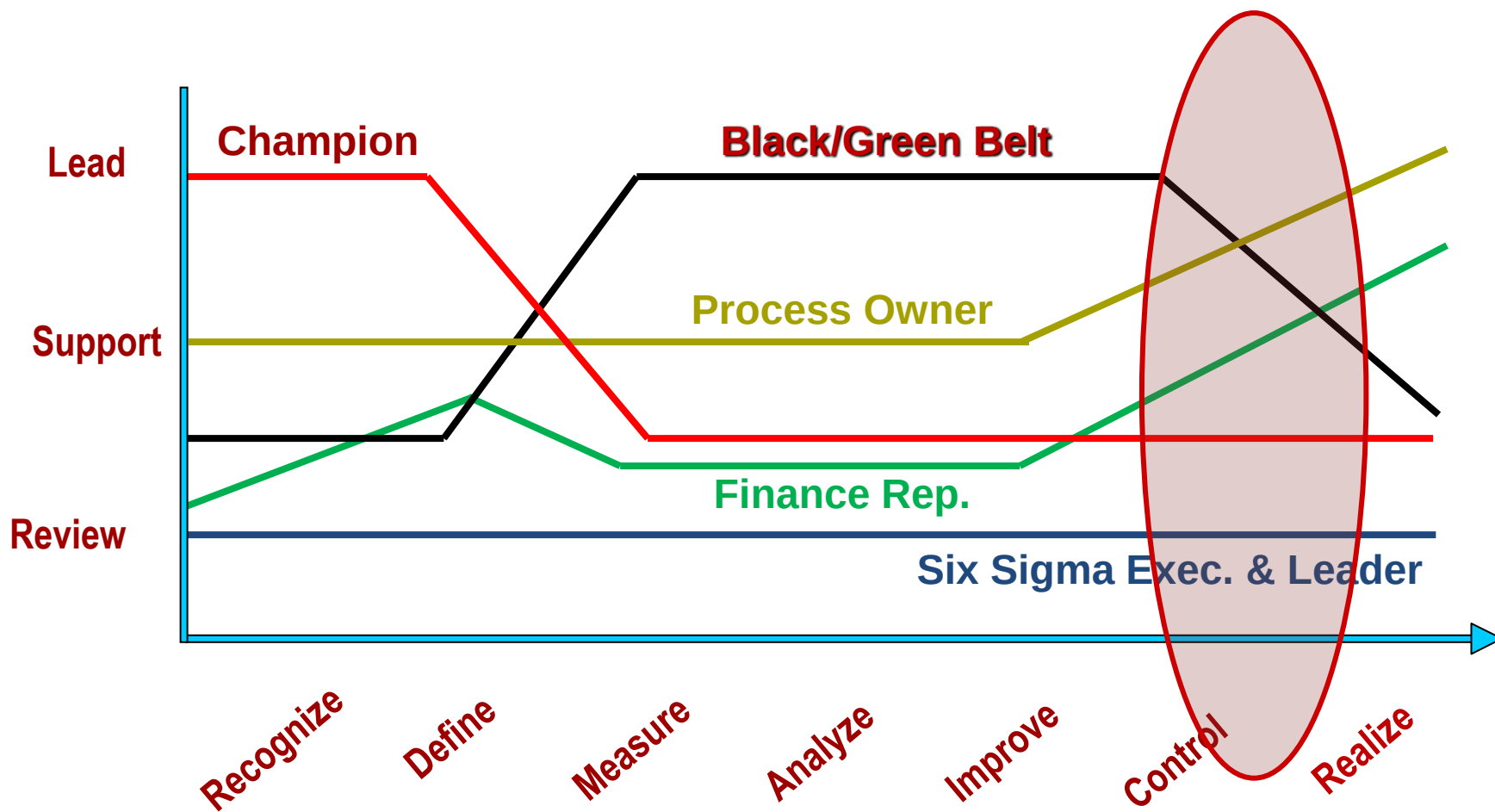
Prepare a Project Closure Report!

- Present the report content to the customer (process owner, champion and other relevant managers) and get their approval
- Congratulate the project team and other supporting staff
- Announce project closure

Control Phase Outputs

- As built Process Map of the improved process
- Process controls defined and implemented for the sustainability of improvements
- As built Process Control plan
- FMEAs showing that the Process Map and Process Control Plan have become robust
- Required documentation (prosedures, instructions, specification sheets, ...)
- Project Report

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