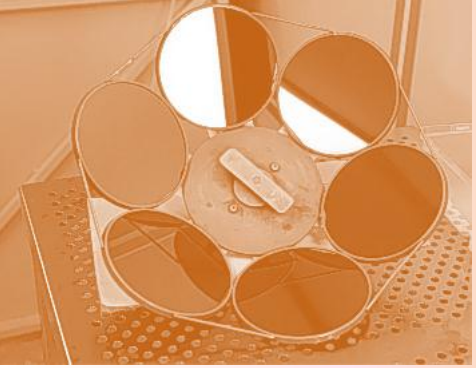
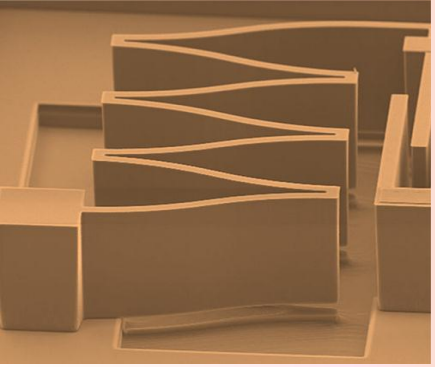


Problem Solving for Technicians

Presented by

Southwest Center for
Microsystems Education
-SCME-
November 2012



Our Presenters

Southwest Center for Microsystems Education

Barb Lopez

Research Engineer, University of New Mexico and Instructional Designer, SCME

Mary Jane (MJ) Willis

Instructional Designer, SCME and retired Chair for the Manufacturing Technology Program – Central New Mexico Community College

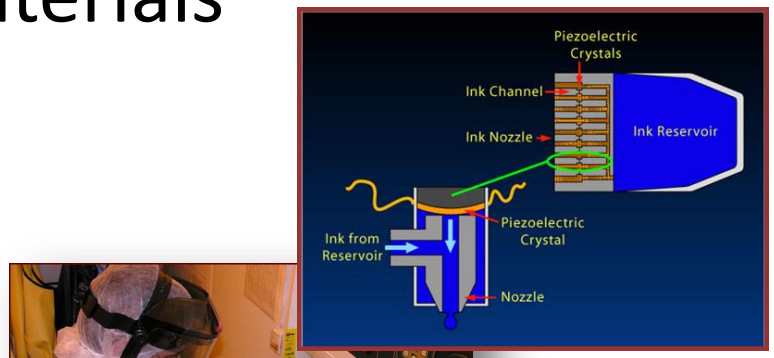
Questions that we'll answer

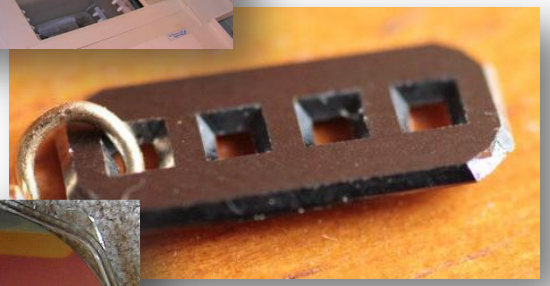
- What can SCME do for you?
- What's a systematic approach to problem solving?
- How do you ask a good question? Who do you ask?
- What type of problems do technicians solve?
- What's the difference between problem solving and troubleshooting?

Educational Materials

To date SCME offers

- 150 Shareable Content Objects (SCOs)
  - Informational Units / lessons
  - Supporting activities
  - Supporting assessments
- 37 Learning Modules in the areas of
  - Safety
  - Microsystems Introduction
  - Microsystems Applications
  - Bio MEMS
  - Microsystems Fabrication
- 11 Instructional Kits
- All are available @ scme-nm.org





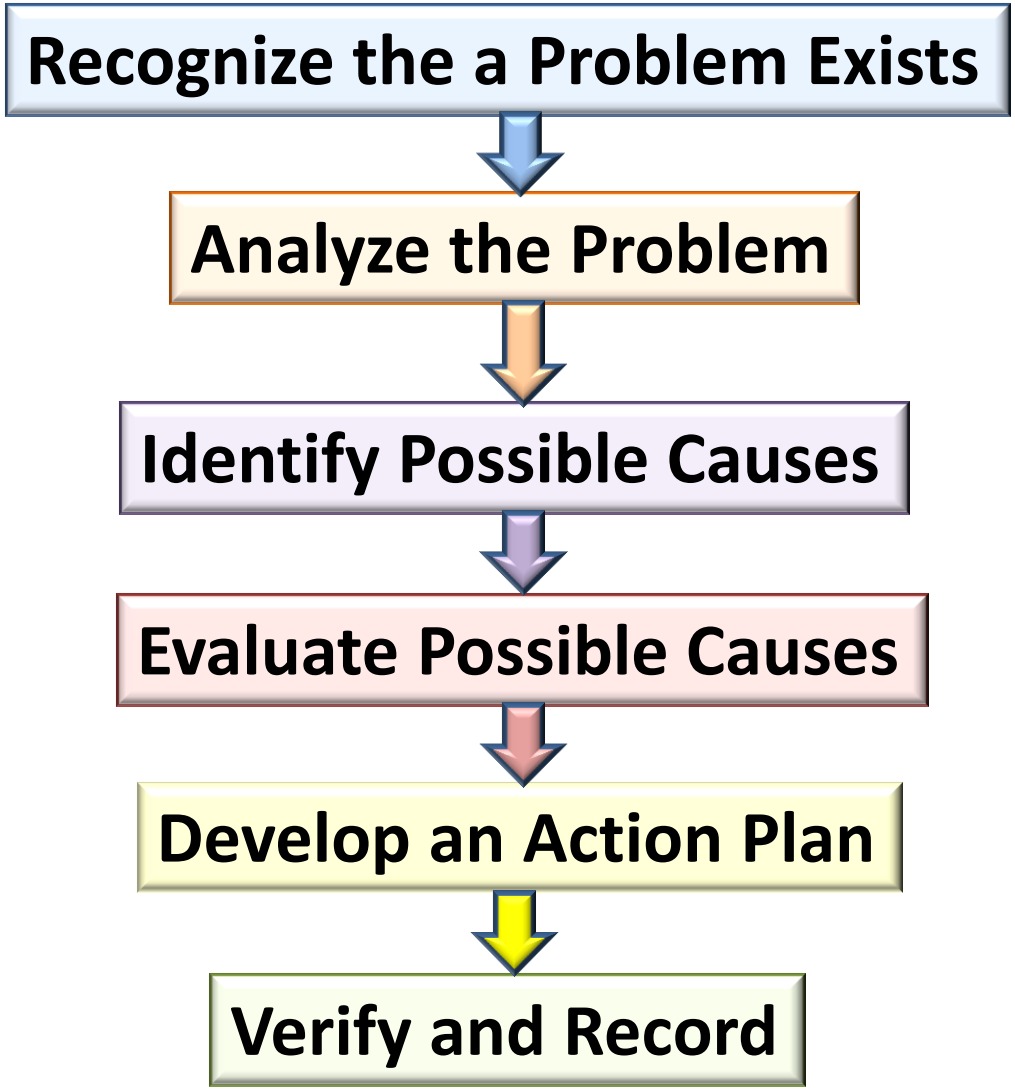
Professional Development

- 4 to 5-day workshops
- 2-day workshops
- 1-day workshop
- Conferences and conference workshops
- Create hubs at other colleges to teach our workshops
- Webinars

What is Problem Solving?

- What is problem solving and why are we doing it?
- To get everyone involved on the same page and used to the same methods.
- Problem Solving should become part of your daily tools.

Six Steps to Problem Solving



My Grass is Dying!

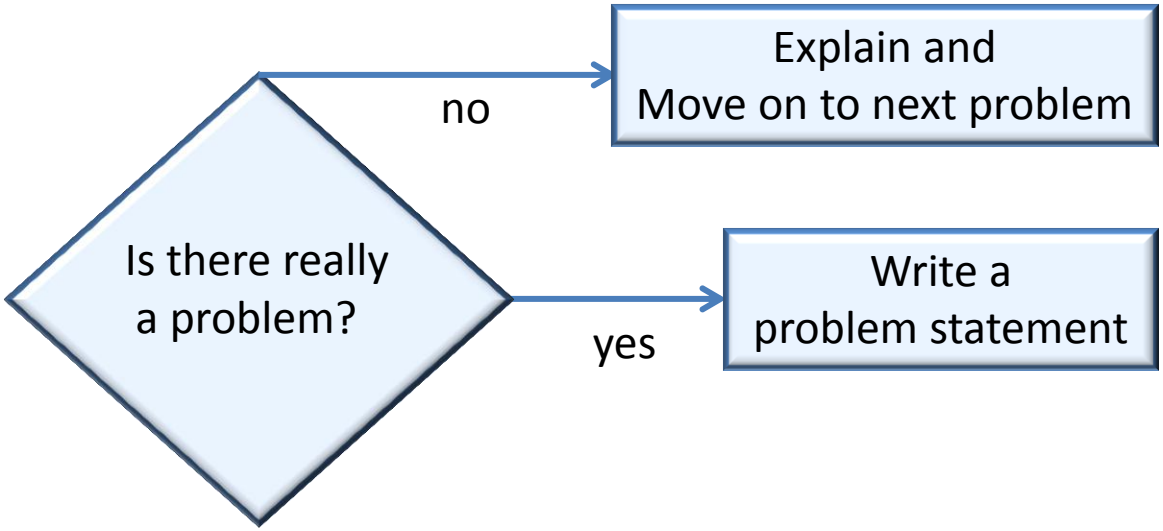
Scenario

- You work for a lawn care company.
- A customer walks in and tell you that her grass has dead spots in it and they weren't there before.

This is what my yard looked like a few months ago.

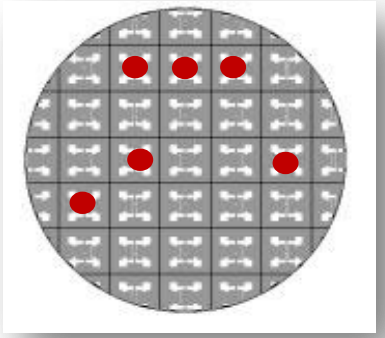
Step 1: Recognize that a Problem Exists

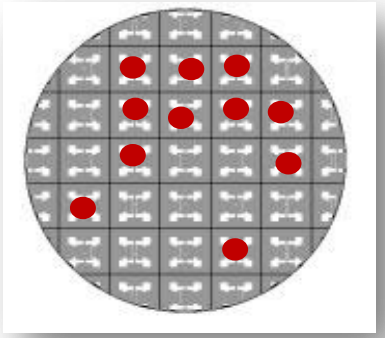
- A problem may not really be a problem.
- Make sure that you truly do have a problem and that everyone agrees.
- Define the problem.
- Write problem statement.



Problem Statements

- There are spots of dead grass in my yard that weren't there before.
- Product yield has dropped from 78% to 58% over the past month.
- Rework in photolithography has increased in the past month.





Photolithography Process Steps

Step 2: Analyze the Problem

Ask questions -

- **Why** do you see this as a problem?
- **What** does it look like?
- **When** did it start?
- **Who** maintains it?
- **Where** do you see the problem occurring?
- **How** many times has it happened?
- Did anything **change** recently and if so, what?
- What is **NOT** happening?

5 W's and an H

Change?

What is NOT?

Gather Data -

- **Collect** data
- **Look at records**, maintenance schedules
- **Talk to the people** closely related to the problem

My Grass is Dying?

There are spots of dead grass in my yard that weren't there before.

What's a Good Question

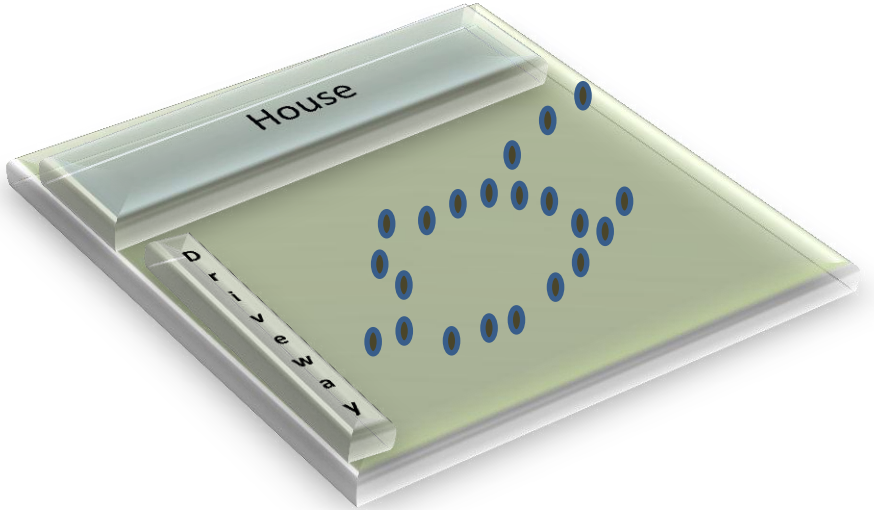
WHY do you see these dead spots as a problem?

WHAT do the spots look like?

WHEN do you start noticing these spots?

WHERE in your yard do you have spots? WHERE do you NOT have spots?

WHO else in your neighborhood has spots of dead grass?
HOW do you water your grass?
HOW do you fertilize your grass?



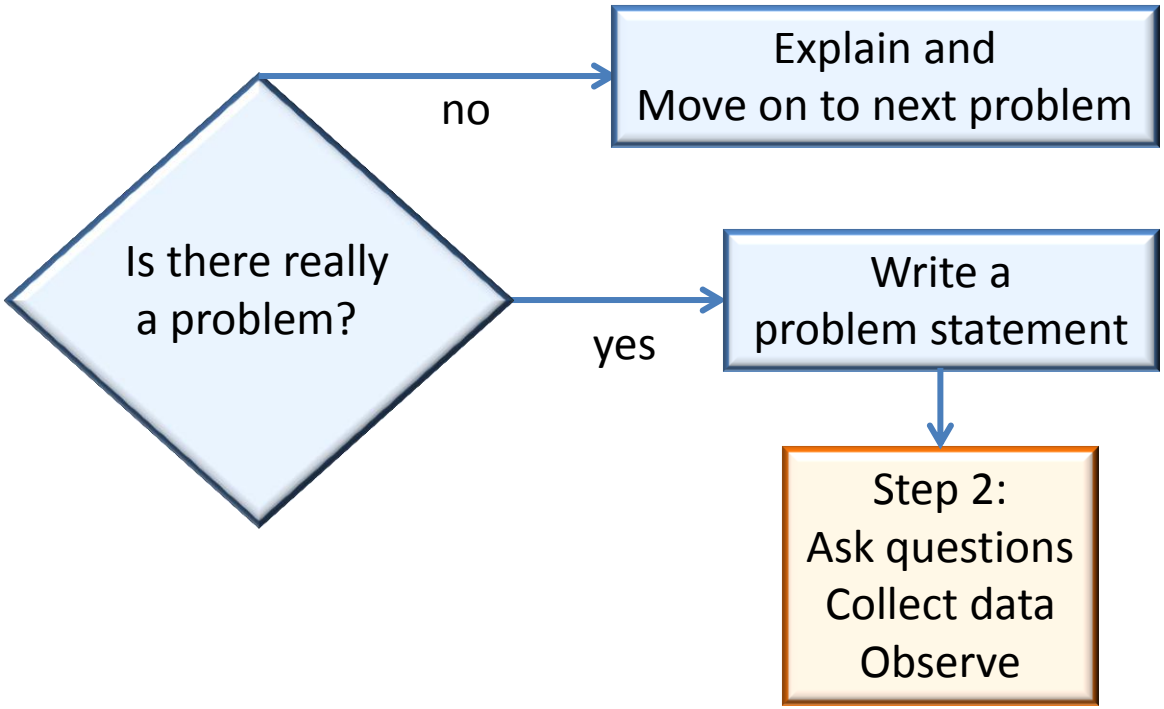
What's a NOT Good Question

Do you fertilize and water your lawn?

What do your neighbors think about your lawn?

What type of lawnmower do you have?

Problem Solving Flowchart



Step 3: Identify the Possible Causes

Brainstorm

- A fast method for generating ideas
- Everyone participates

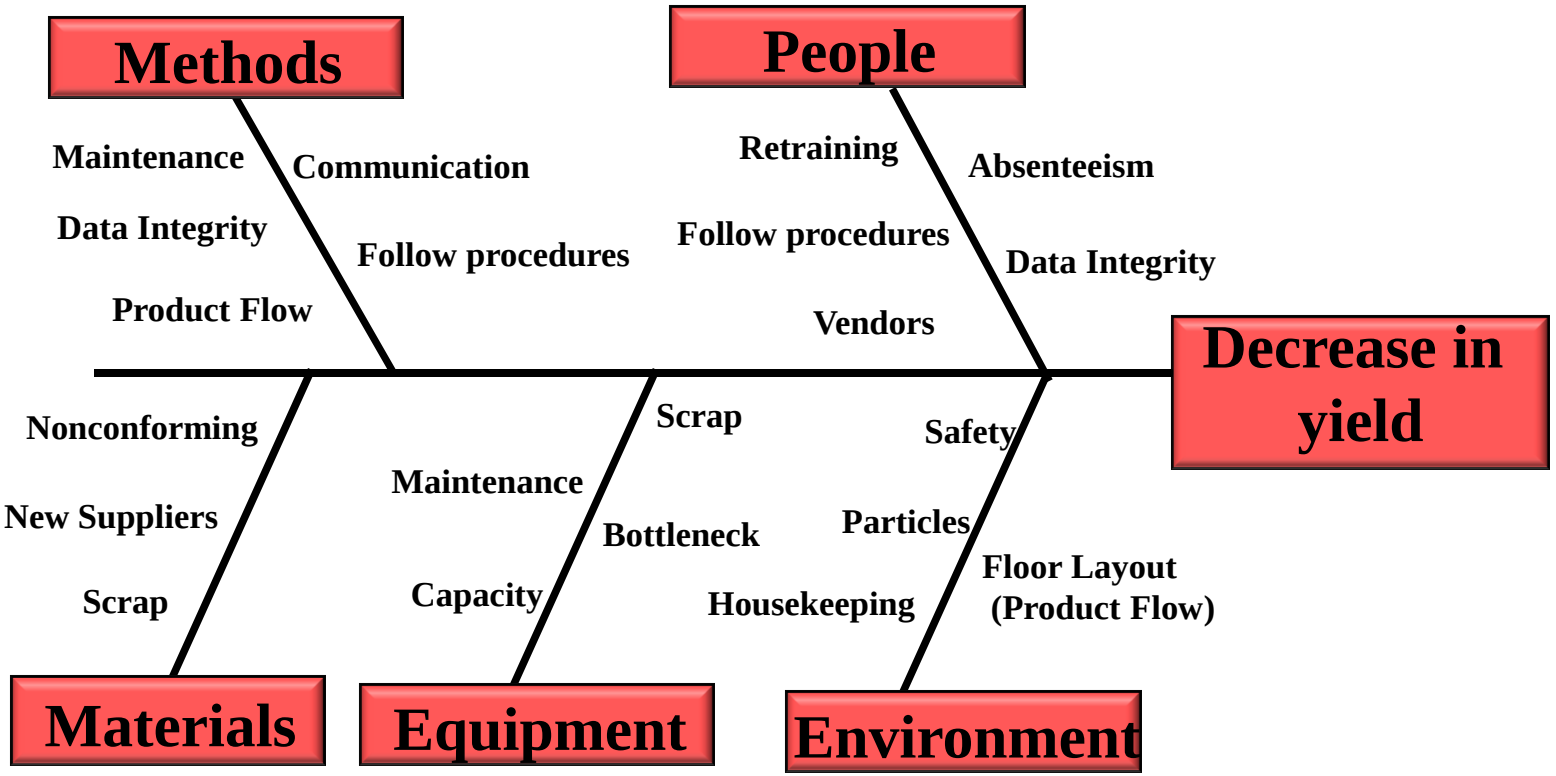
Rules for Brainstorming

- No analysis or evaluation (that comes later)
- Any and all ideas are welcome (there is no wrong idea)
- The more ideas, the better
- “piggybacking” is encouraged

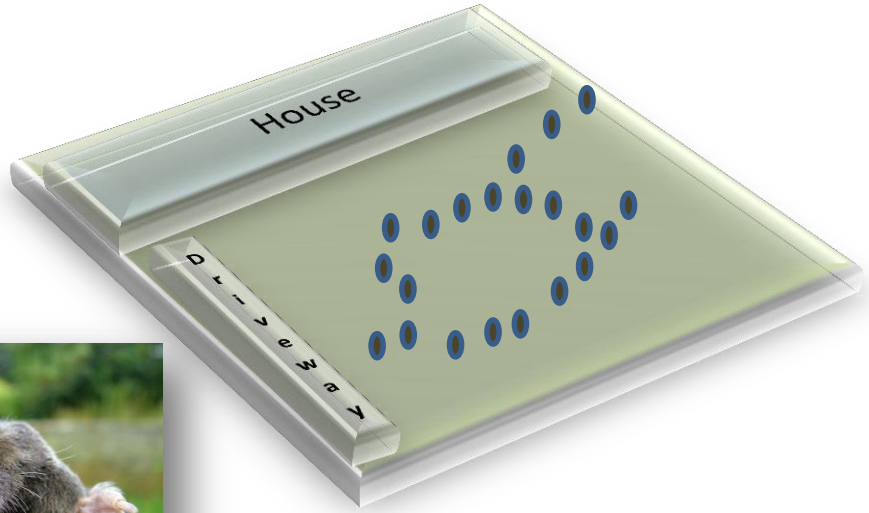
Step 3: Identify Possible Causes

Record results of Brainstorming session.

- Make a list
- Create a Cause and Effect Diagram (also called Fishbone or Ishikawa)

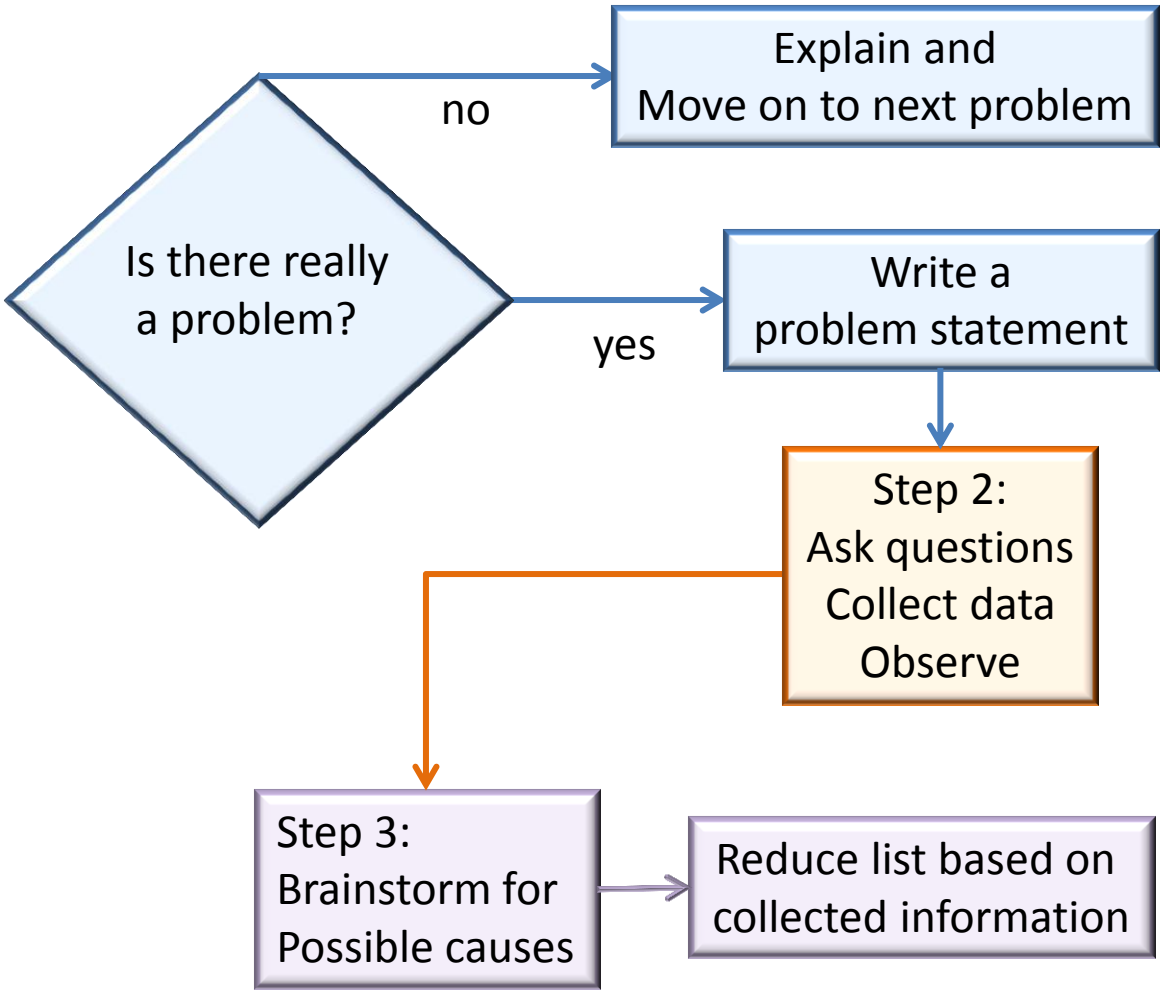


Brainstorming for Causes of Spots



What are some causes of the dead spots in your customer's yard?

Flowchart

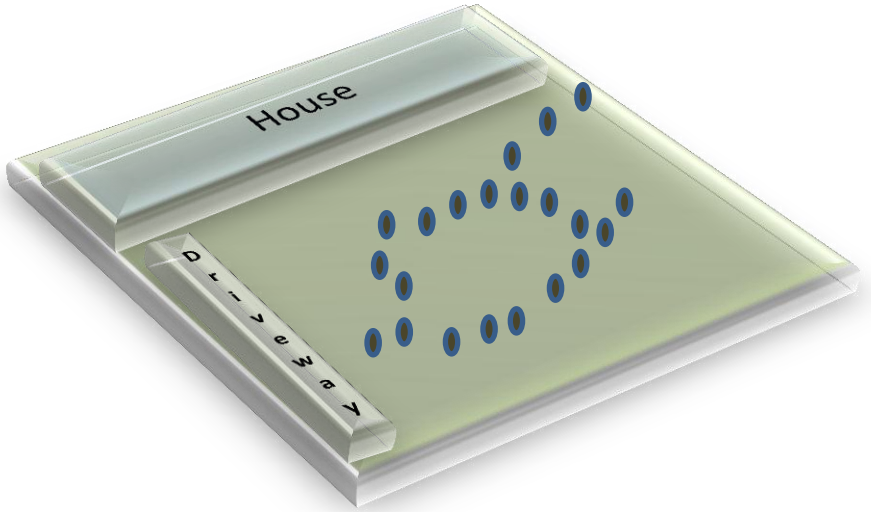

Is there really a problem?
no
Explain and Move on to next problem
yes
Write a problem statement
Step 2: Ask questions Collect data Observe
Step 3: Brainstorm for Possible causes
Reduce list based on collected information

Step 4: Evaluate the Possible Causes

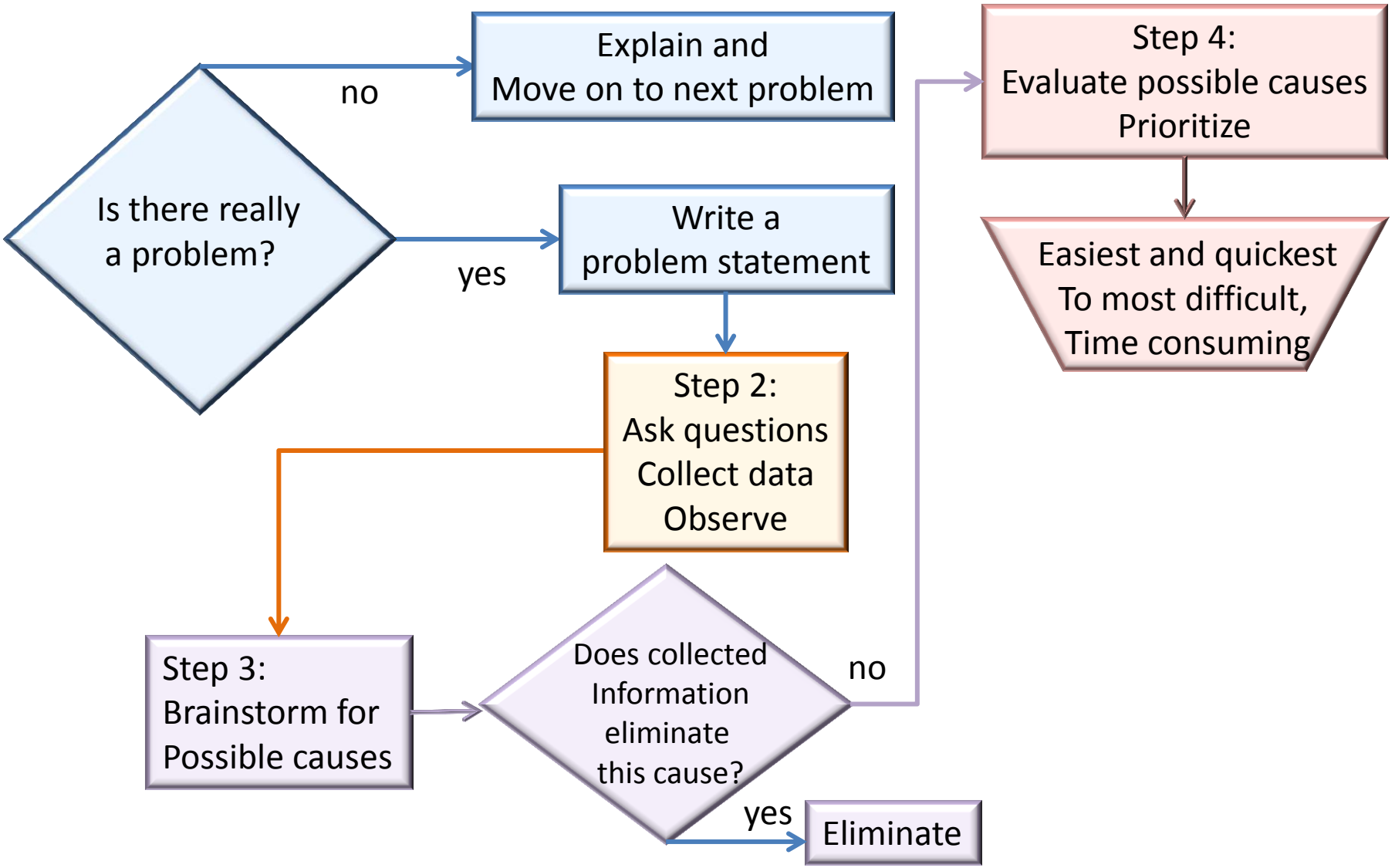
- Prioritize the possible causes
  - From the easiest and quickest to eliminate
  - High priority to low priority
  - To the most difficult
- Ask more questions.
  - How could this have caused the problem?
  - Would it account for everything that IS and IS NOT happening?
  - Would this have caused the full extent of the problem?
  - Does this correlate to the discovery of the problem?
  - Would this explain everything that is happening?
- Ask the customer more questions.

Step 4: Evaluate the Possible Causes

- Let's evaluate the possible causes for the dead grass in my yard.



Flowchart


Is there really a problem?
no
Explain and Move on to next problem
yes
Write a problem statement
Step 2: Ask questions Collect data Observe
Step 3: Brainstorm for Possible causes
Does collected Information eliminate this cause?
no
yes
Eliminate
Step 4: Evaluate possible causes Prioritize
Easiest and quickest To most difficult, Time consuming

Step 5: Develop an Action Plan

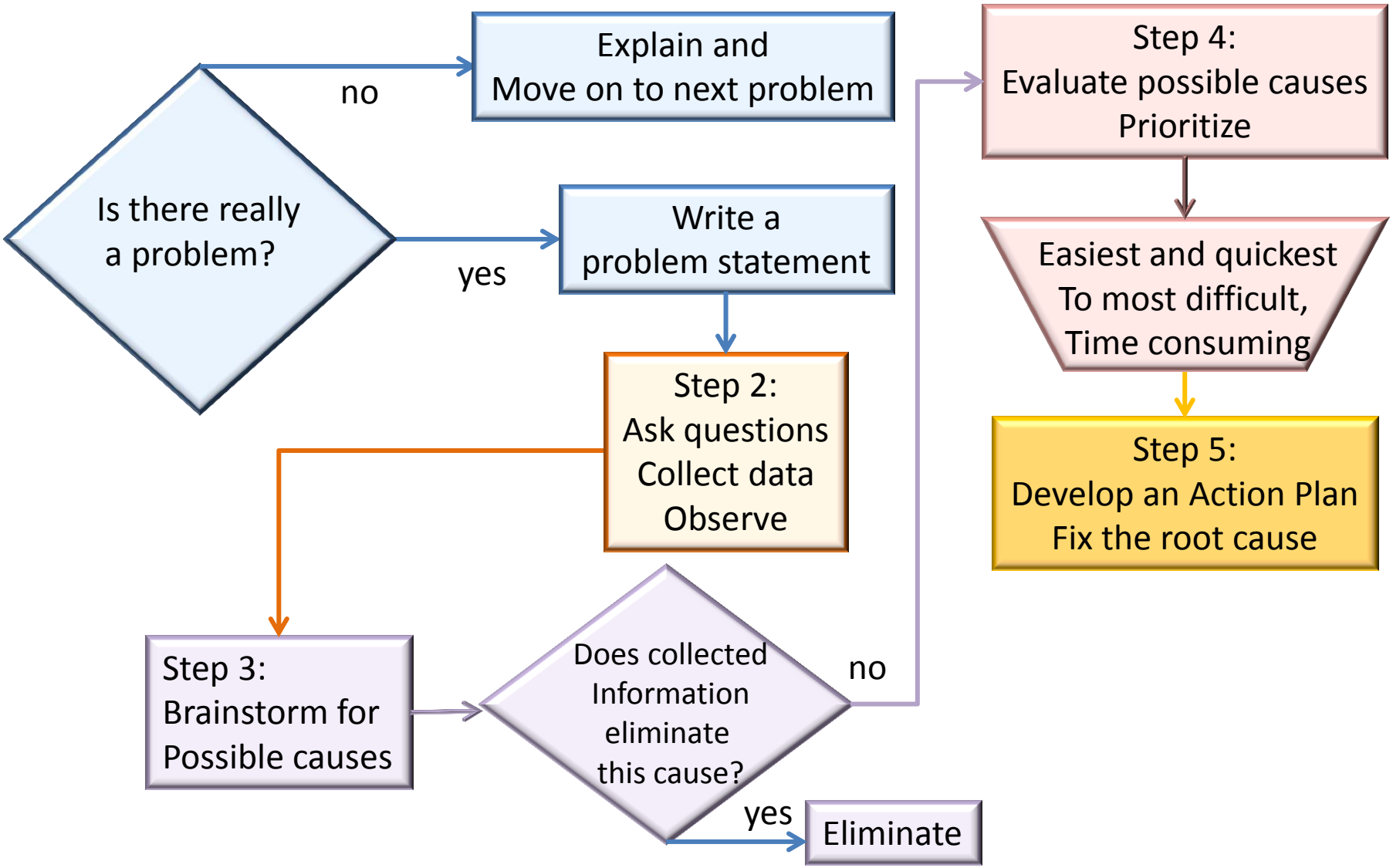
A good action plan includes a series of steps

- **Steps** or actions required
- **Sequence** in which these should be carried out
- **Responsibilities** of the various people involved
- **Provisions** for follow-up and control
- **Methods** for communicating the plan and the results

Step 5: Action Plan for Dying Grass

What would our action plan be for the dying grass based on the information and possible causes that we have gathered and developed?

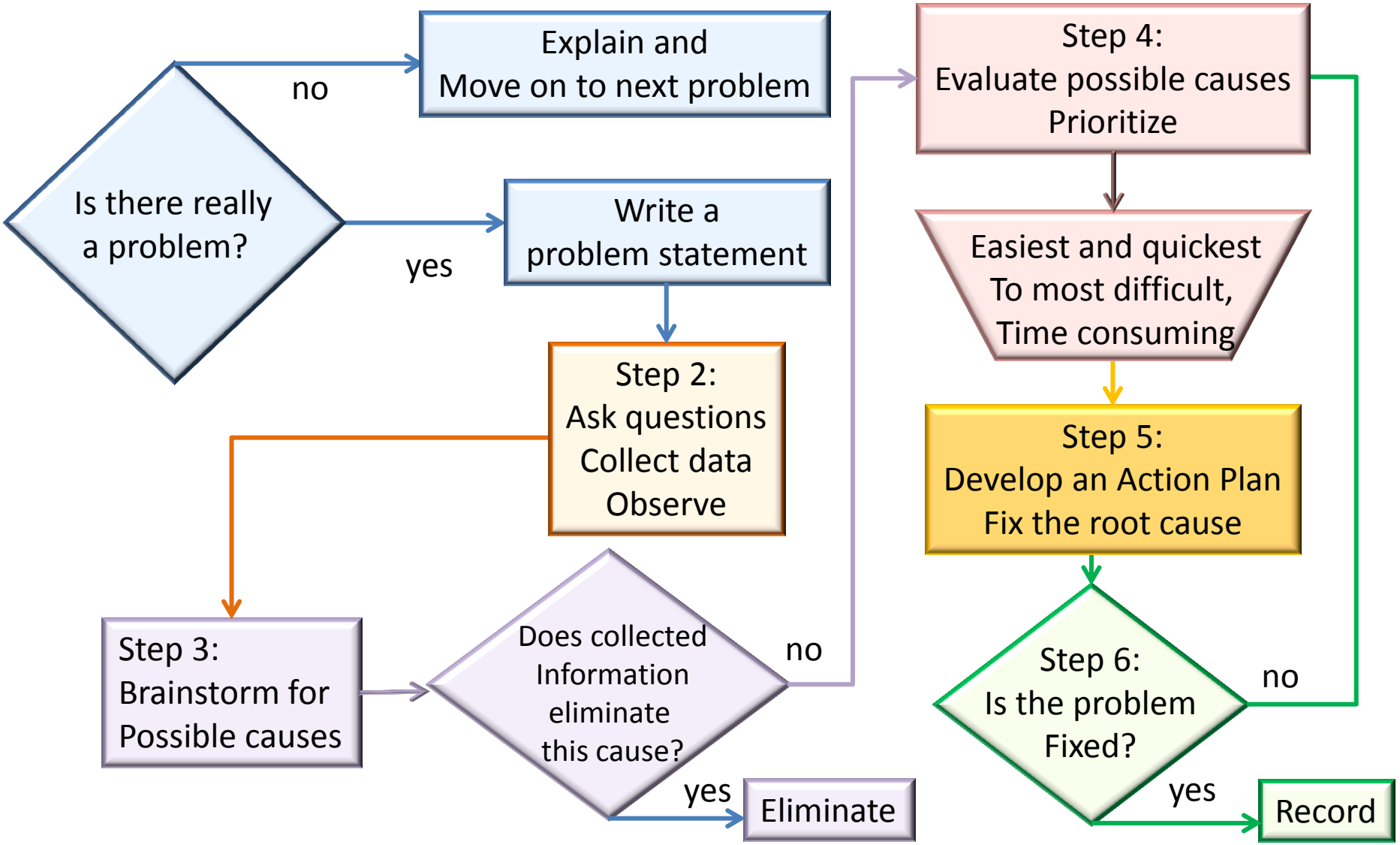
Example of an Action Plan

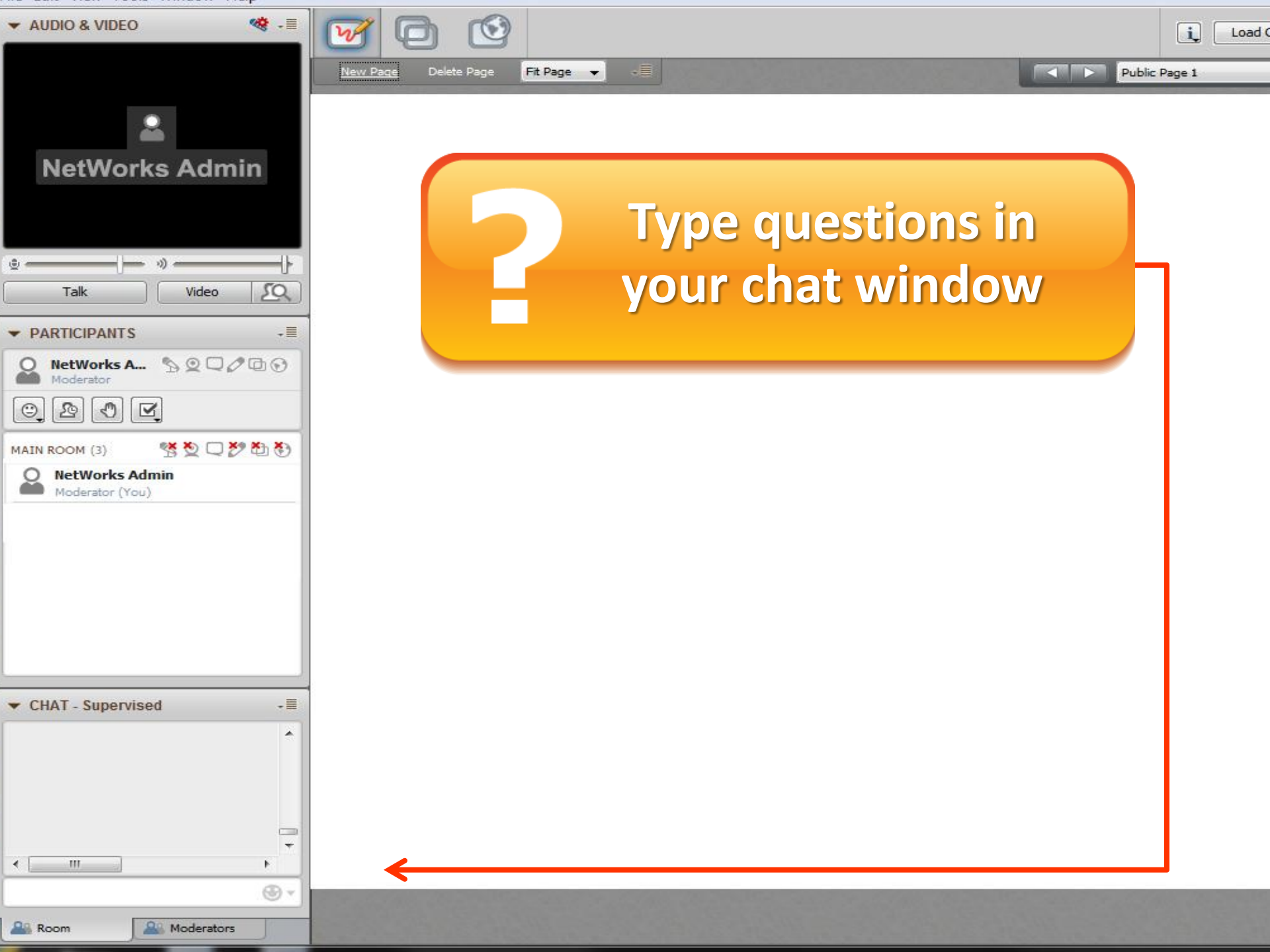


Step 6: Verification

- Once the cause of the problem has been found and action has been taken to correct, you must verify that the problem has been solved.
- Record, record, record.

PS Flowchart




AUDIO & VIDEO
NetWorks Admin
Talk
Video
PARTICIPANTS
NetWorks A...
Moderator
MAIN ROOM (3)
NetWorks Admin
Moderator (You)
CHAT - Supervised
Room
Moderators
New Page
Delete Page
Fit Page
Public Page 1
Load
Type questions in your chat window

Types of Problems

Well-defined or well-structured problem

- Simple and well-defined
- Solution can normally be quickly identified and fixed

Ill-defined or ill-structured problem

- Can’t be solved quickly and easily
- Does not have an obvious cause
- Numerous possible causes or one cause that is difficult to identify

Well-Structured Problems

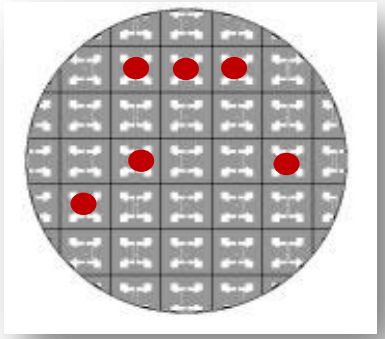
We've lost vacuum to the chuck in the photolithography spin module.

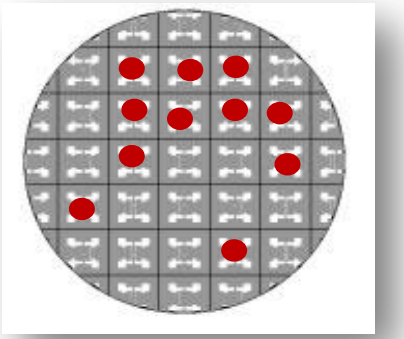
The last batch of wafers from the evaporator showed a huge increase in particle counts whereas particle counts have been low for weeks.

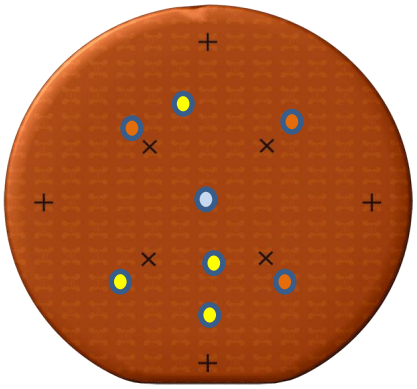
Even though the program parameters on the oxidation furnace haven't changed, the last two batches of wafers came out with an unacceptable low oxide thickness.

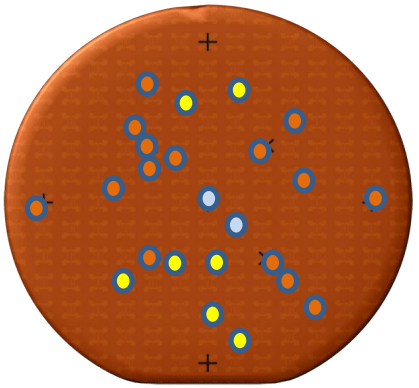
Ill-Structured Problems

- The yield on the number of good die per wafer has been steadily decreasing over the past two weeks.
- The gas mileage on your car has been steadily decreasing over the past year.
- Particle counts on the wafers from coat/develop have slowly been increasing over the past 4 weeks.









Problem Solving vs. Troubleshooting

Troubleshooting

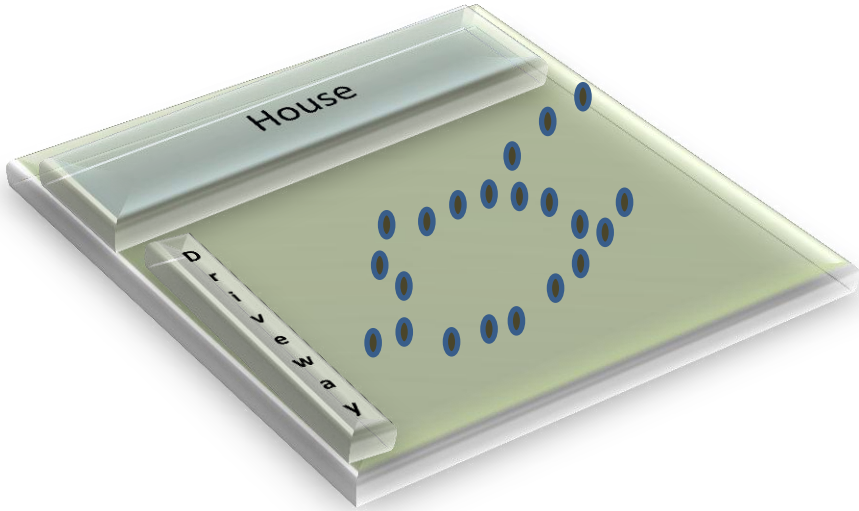
- Normally applied to well-structured problems
- If the cause is obvious, then fix it
- Troubleshooting requires critical thinking
- Troubleshooting skills come with knowledge and experience
- Developed over time

Problem Solving

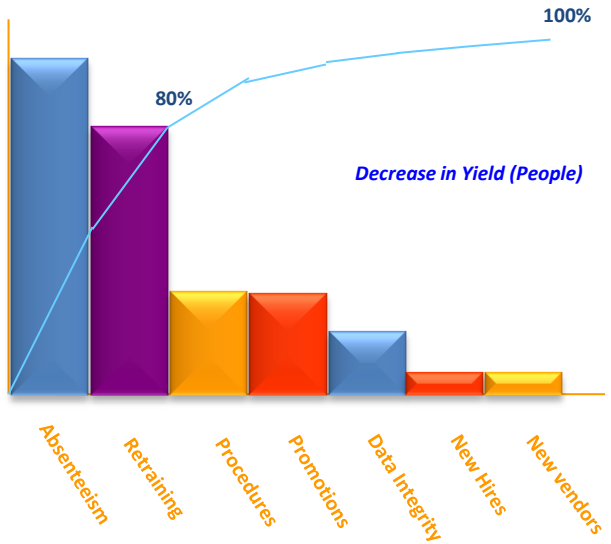
- Applied to ill-structured problems
- Engaged when the quick fix didn’t work
- Problem solving requires critical thinking
- Problem solving requires organization and teamwork

Tools for Problem Solving

- **Scatter diagrams**
- **Cause & Effect Diagrams**
- **Checklists**
- **Pareto charts**
- **Histograms**
- **Control charts – Statistical Process Control (SPC)**
- **Design of Experiments (DOE)**

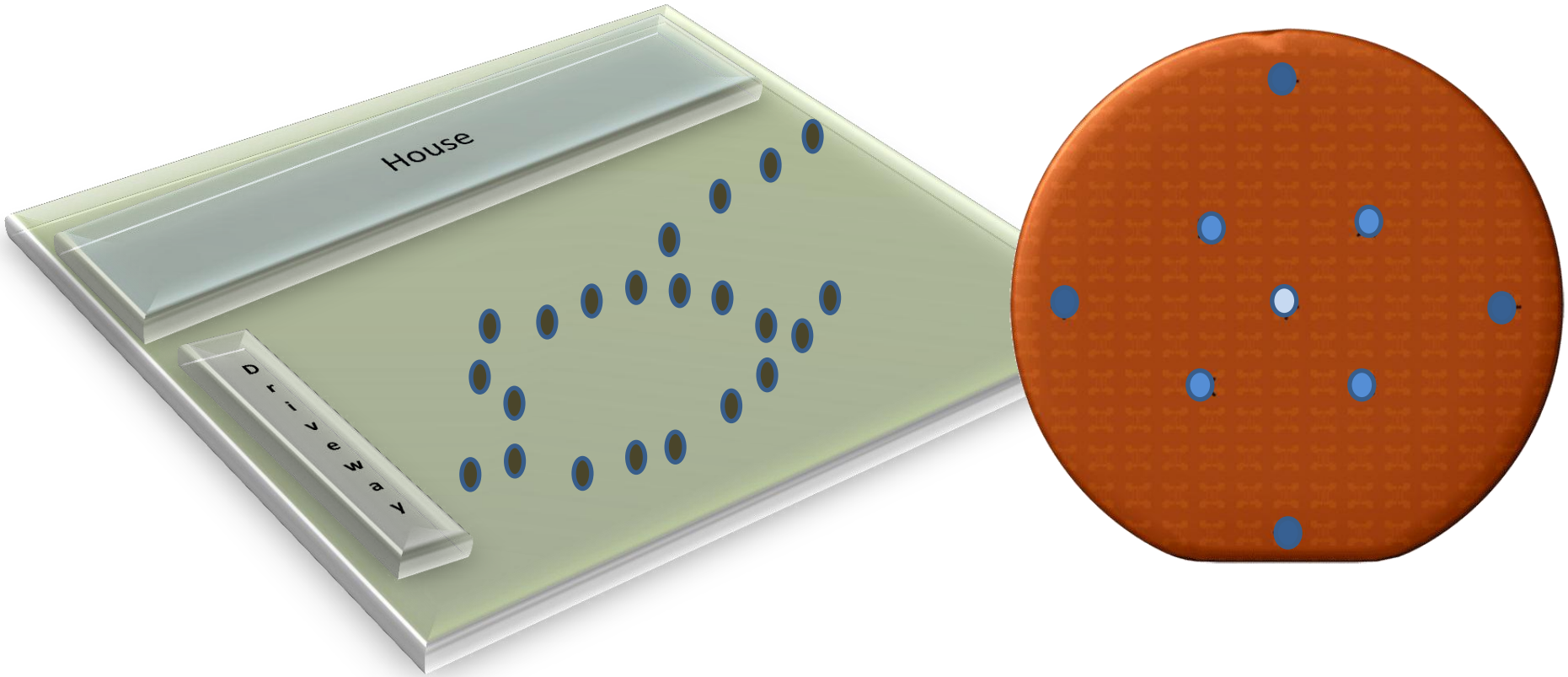


People	# of occurrences
Retraining	14 people
Follow procedures	4 (failure to follow)
Absenteeism	18 hours
New vendors	1
Data Integrity	3 (entry errors)
Promotions	4
New Hires	1



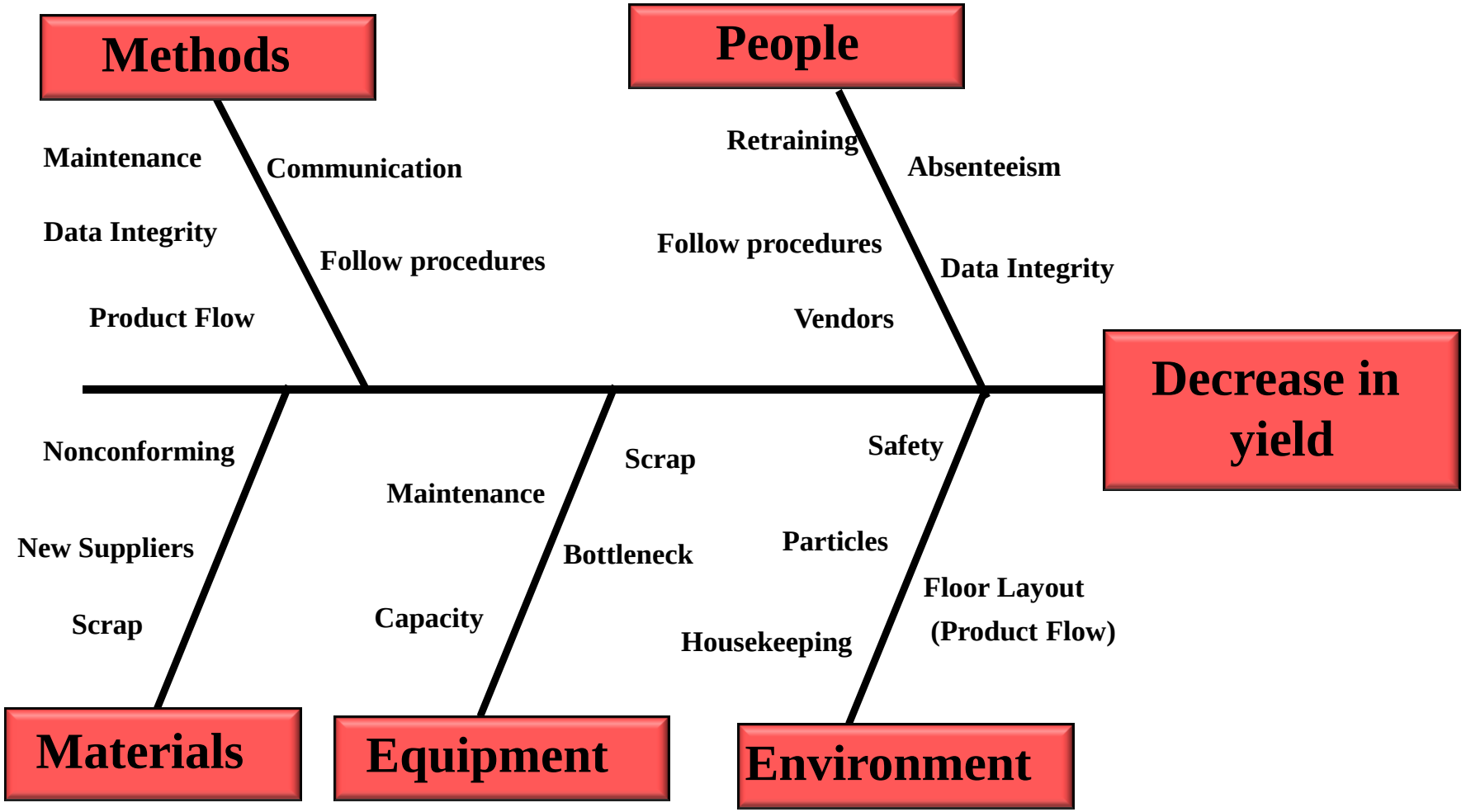
Scatter Plots

SCATTER DIAGRAMS – A pictorial representation of the problem.



Tools for Problem Solving

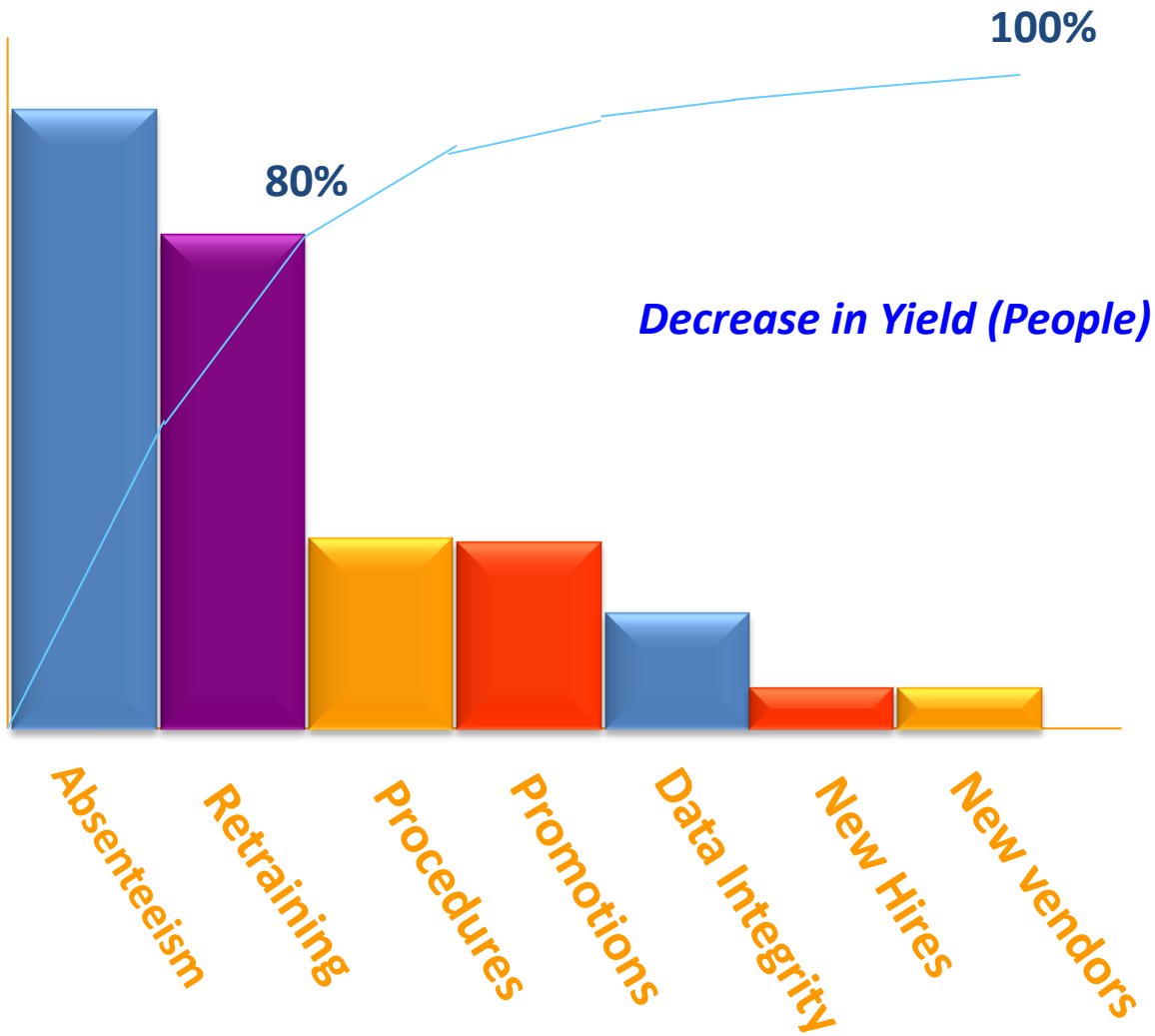
- Cause & Effect Diagram



Item Checklists

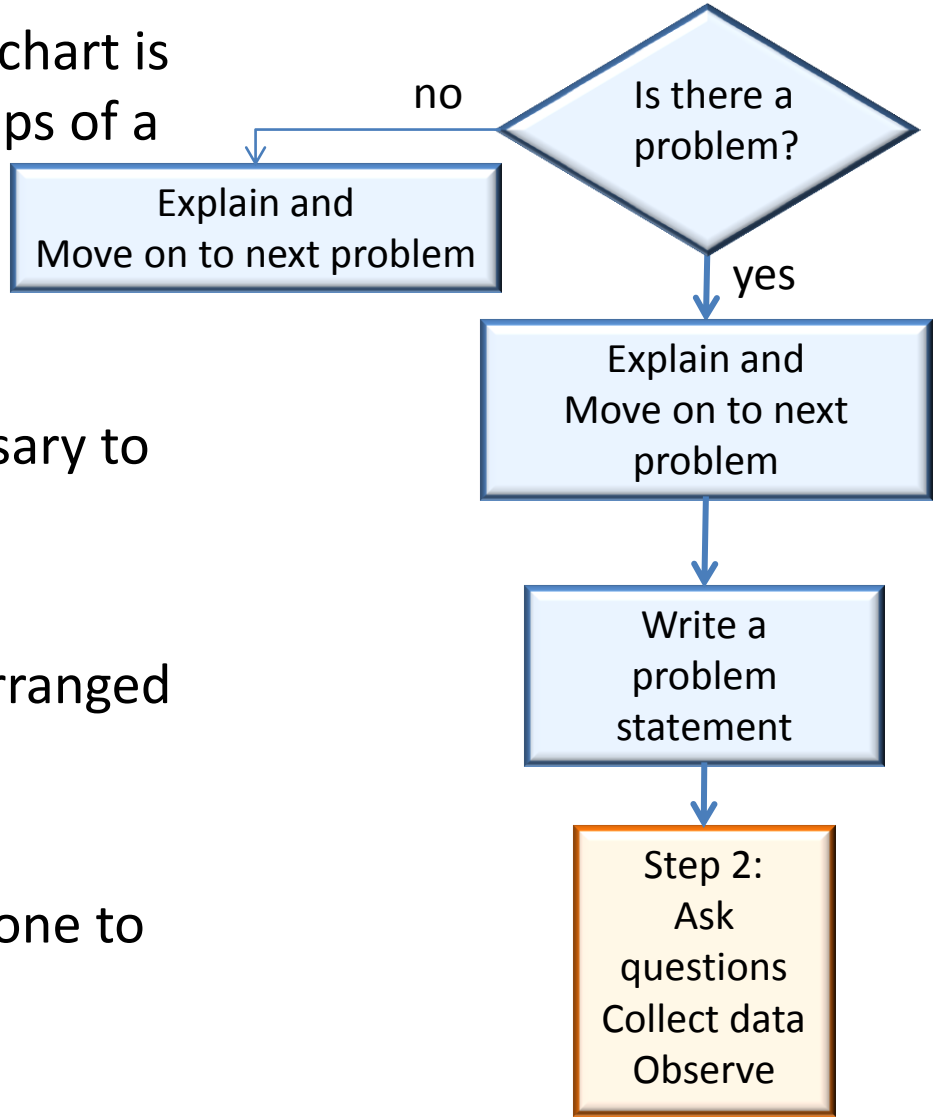
People	# of occurrences
Retraining	14 people
Follow procedures	4 (failure to follow)
Absenteeism	18 hours
New vendors	1
Data Integrity	3 (entry errors)
Promotions	4
New Hires	1

Pareto Charts



Process Flowcharts

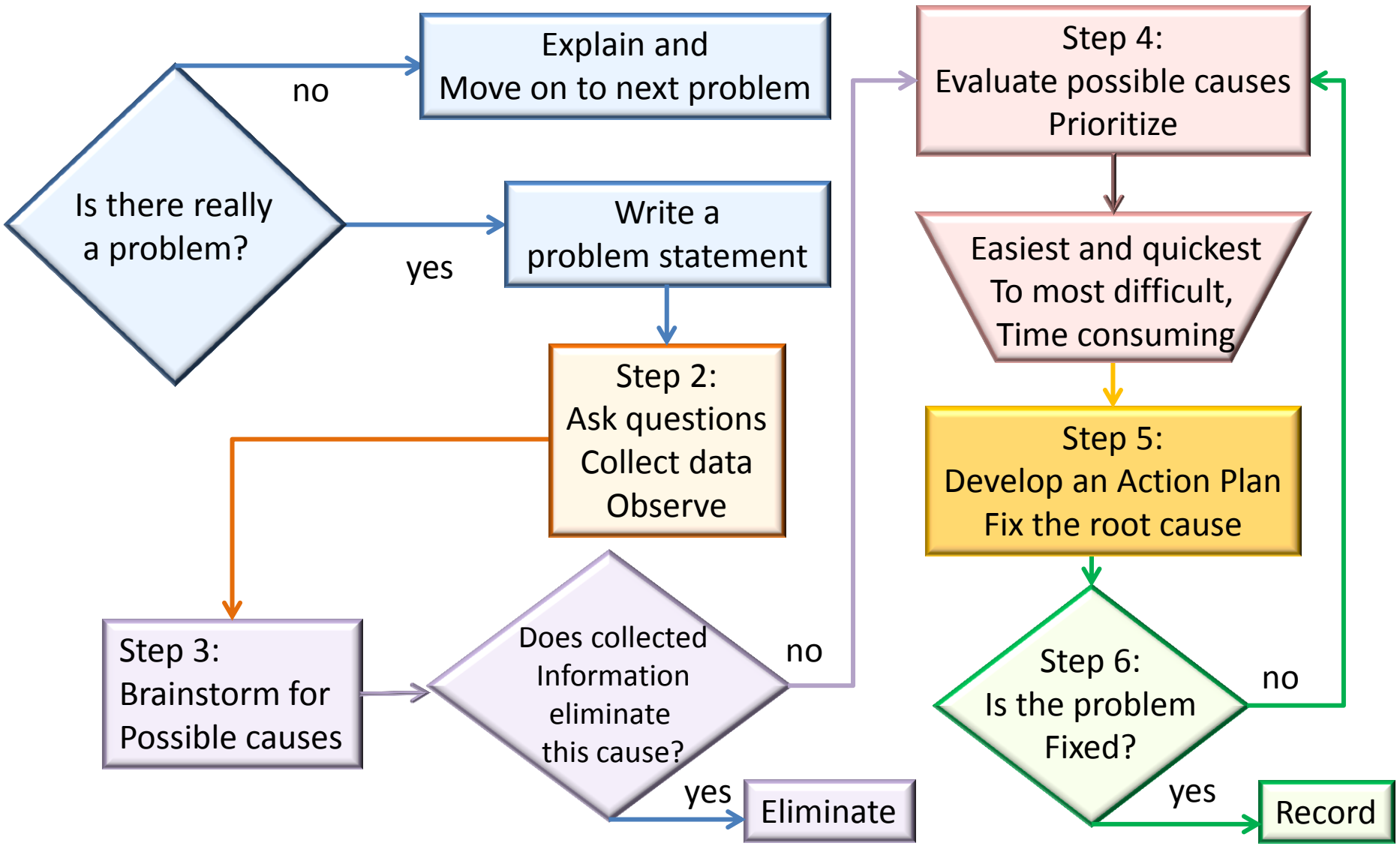
The objective of creating a process flowchart is to identify and layout the sequential steps of a procedure or process.



Flowcharts can identify

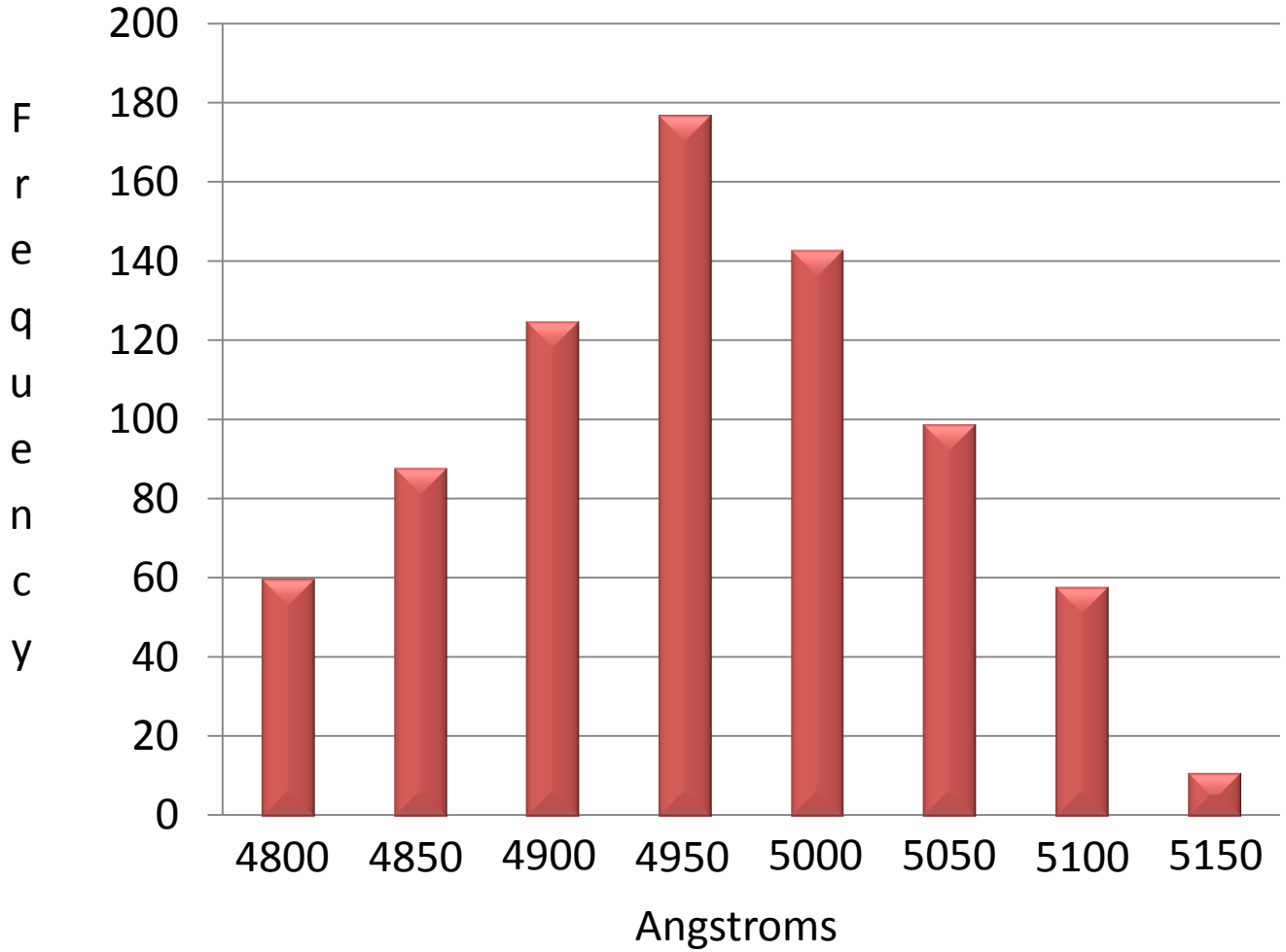
- Specific skills and knowledge necessary to perform each task
- Steps that can be eliminated or rearranged for more efficient operation
- A standardized procedure for everyone to follow.

Problem Solving Flowcharts



Tools for Problem Solving

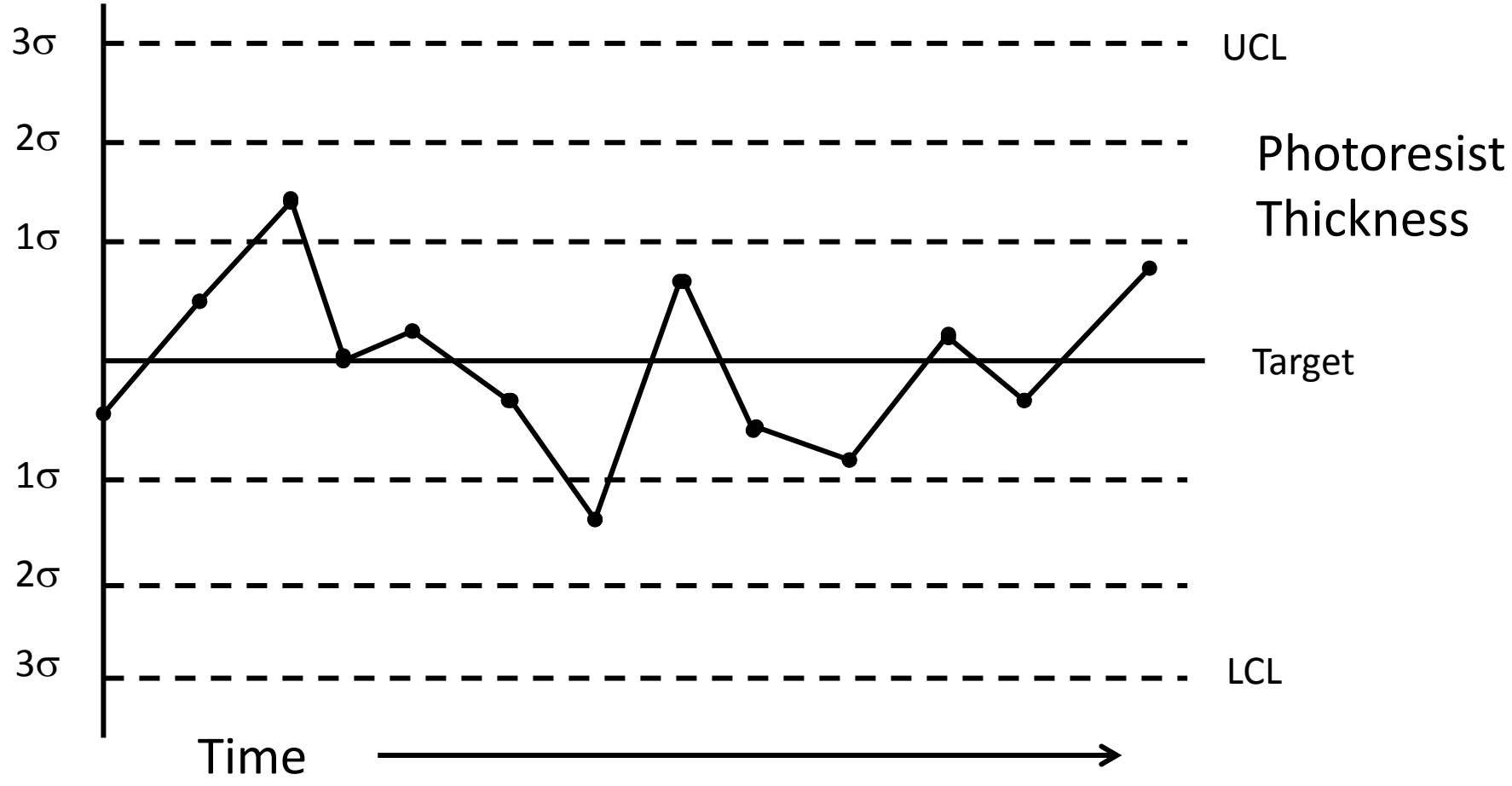
Histograms – Graphical representation of a frequency distribution



Photoresist Thickness

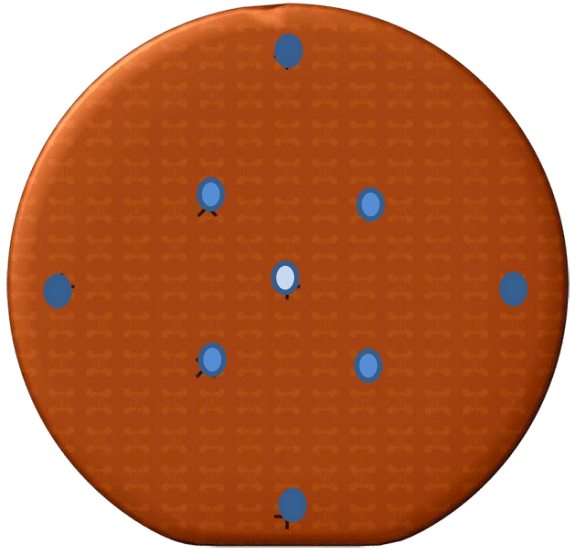
Tools for Problem Solving

Control Charts – Show what process parameters are doing on a daily basis.



Problem #2

You are a technician in the photolithography aisle of a local MEMS fabrication facility. After randomly testing several wafers from the last processing batch and plotting the data on a control chart, you identify an out-of-control situation with resist thickness.



Write a Problem Statement

There was a sudden increase in photo resist thickness on wafers from the photolithography aisle. The increase exceeds the upper control limit of photoresist thickness.

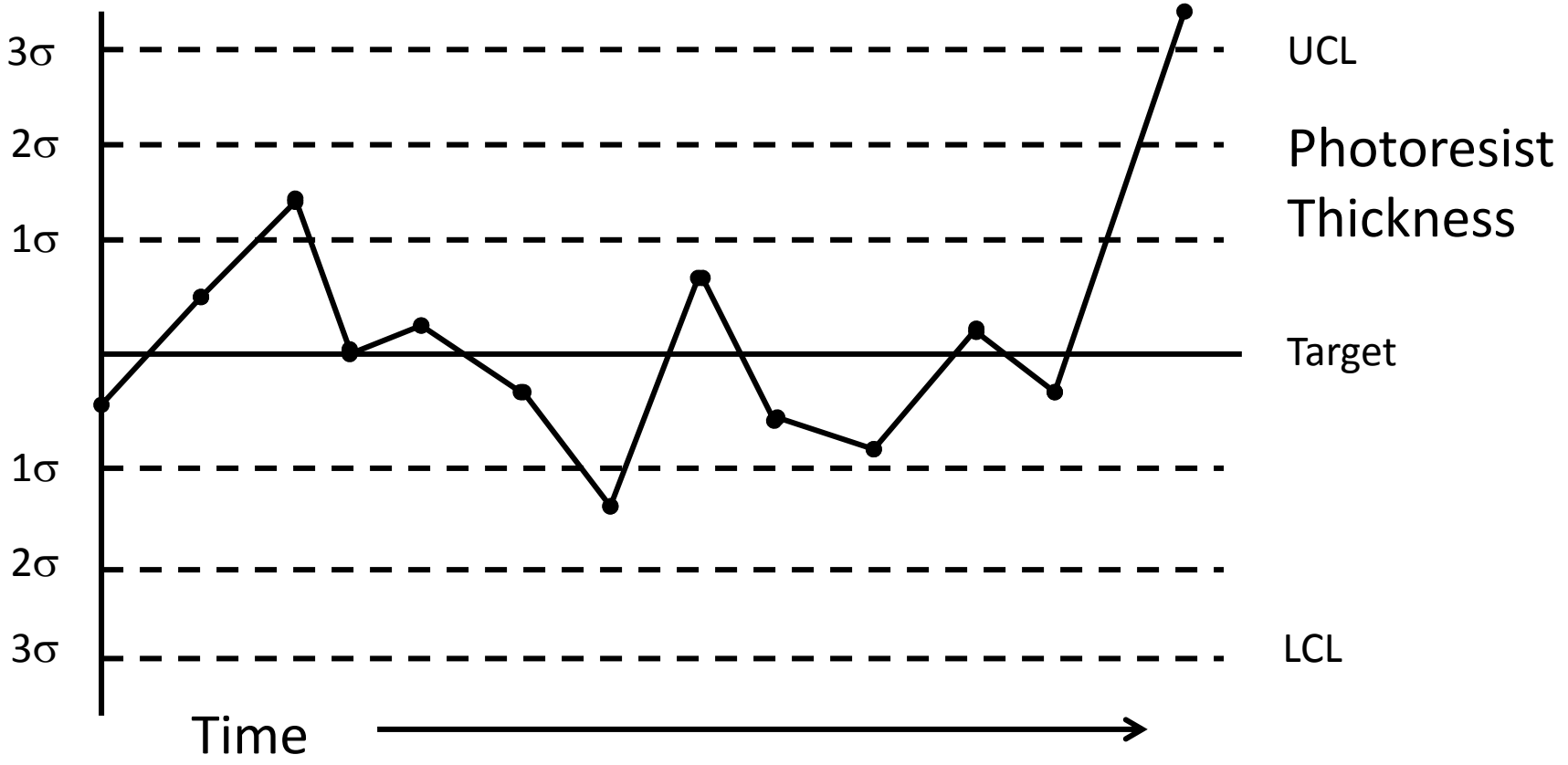
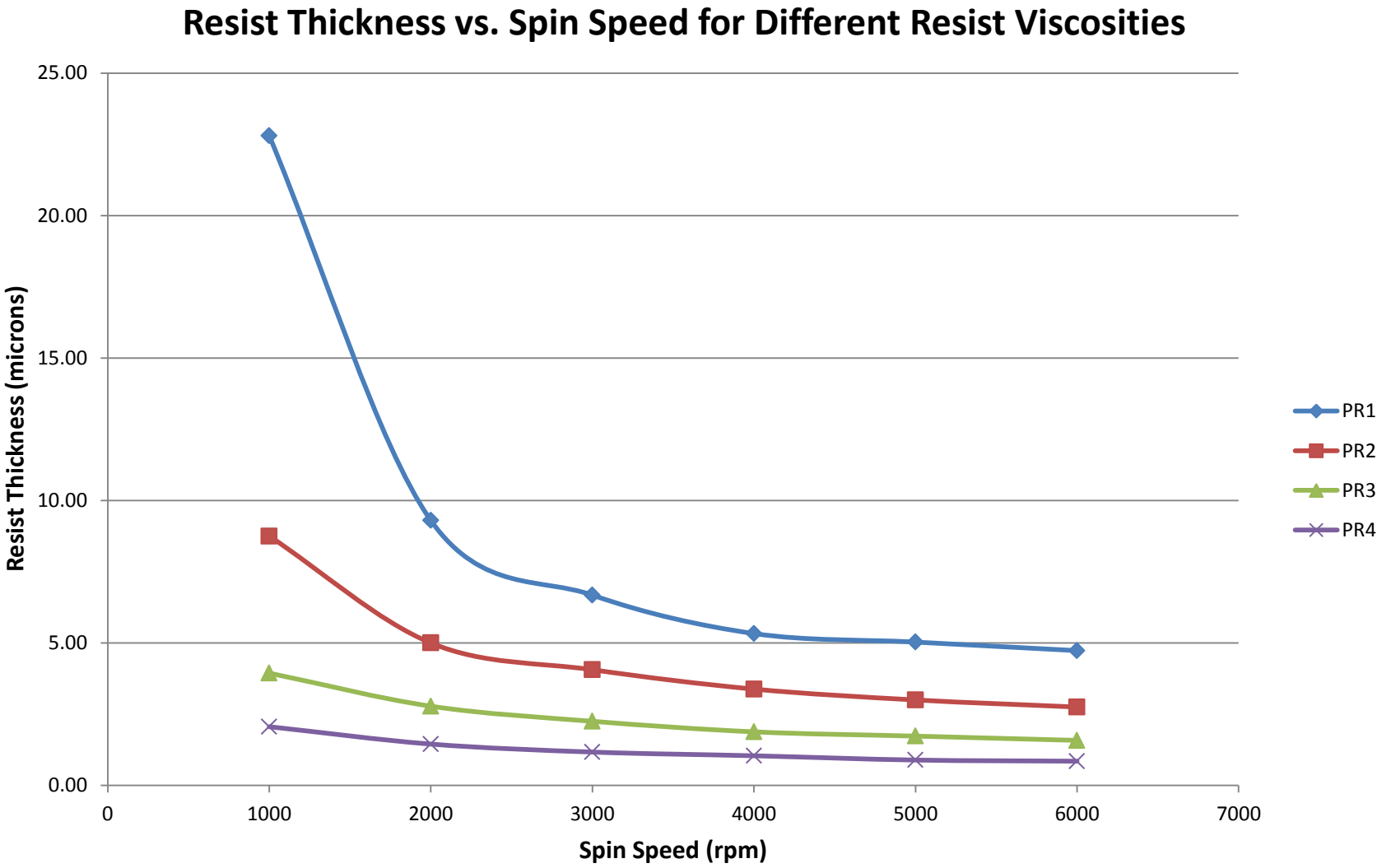
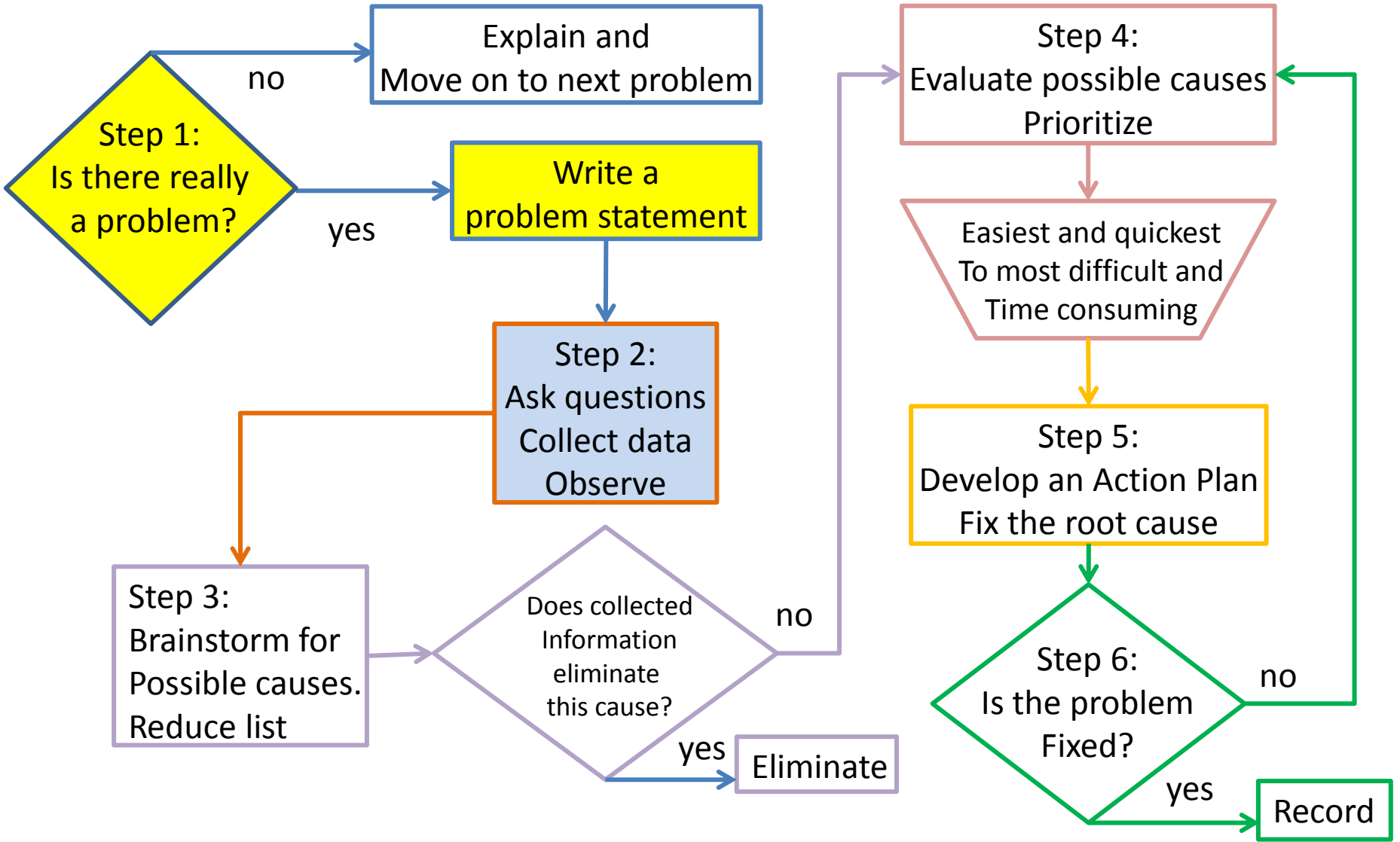


Photo Review

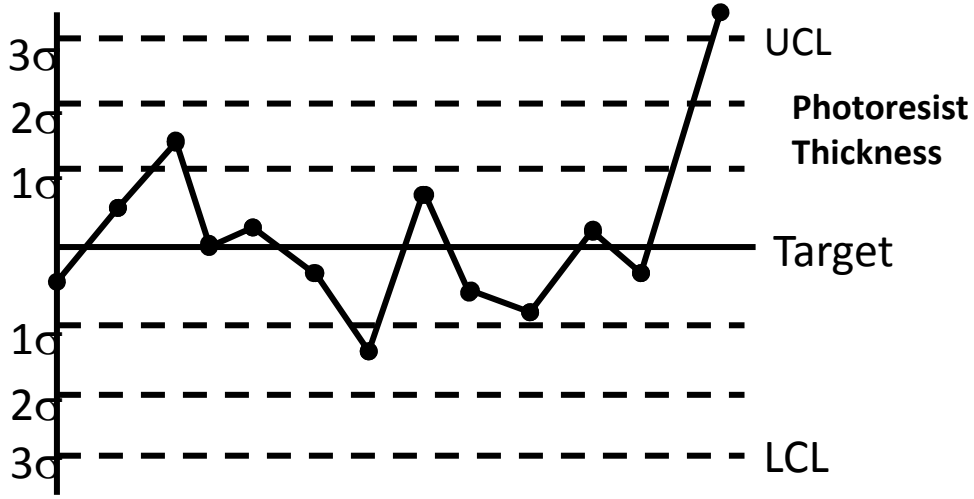


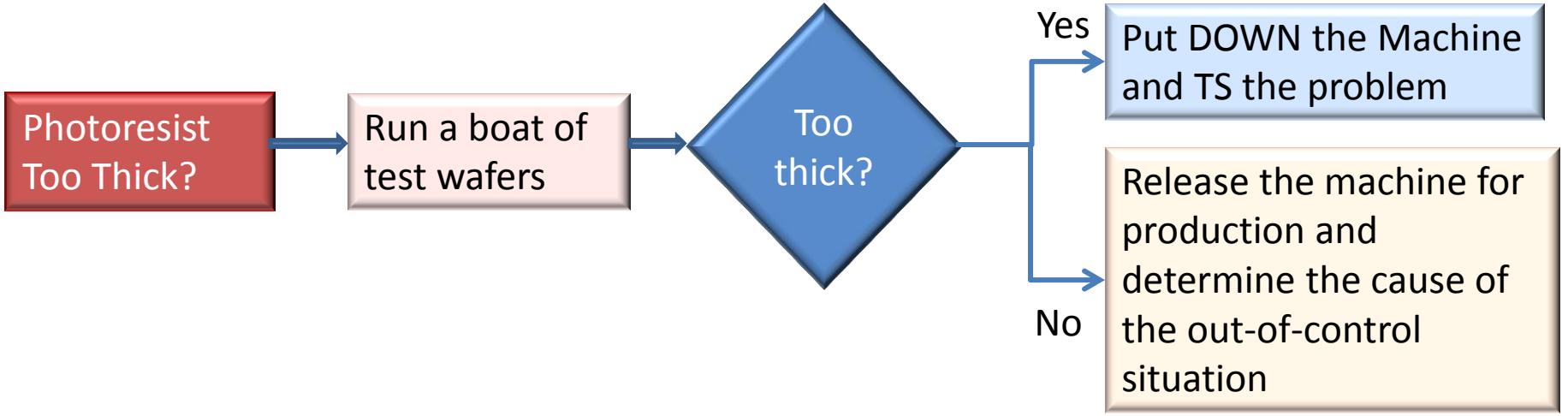
Step 2


Step 1:
Is there really
a problem?
no
Explain and
Move on to next problem
yes
Write a
problem statement
Step 2:
Ask questions
Collect data
Observe
Step 3:
Brainstorm for
Possible causes.
Reduce list
Does collected
Information
eliminate
this cause?
no
yes
Eliminate
Step 4:
Evaluate possible causes
Prioritize
Easiest and quickest
To most difficult and
Time consuming
Step 5:
Develop an Action Plan
Fix the root cause
Step 6:
Is the problem
Fixed?
no
yes
Record

Step 2: Analyze the Problem

You are a technician in the photolithography aisle of a local MEMS fabrication facility. After randomly testing several wafers from the last processing batch and plotting the data on a control chart, you identify an out-of-control situation with resist thickness.





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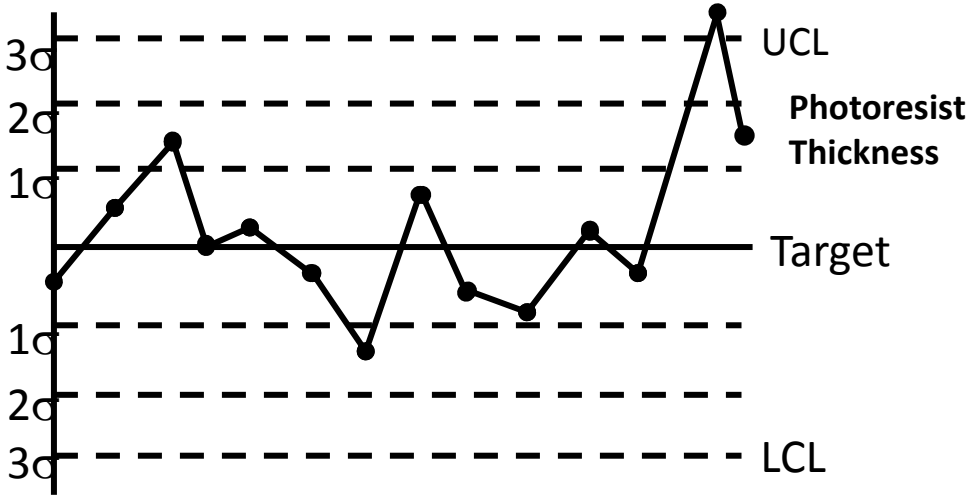
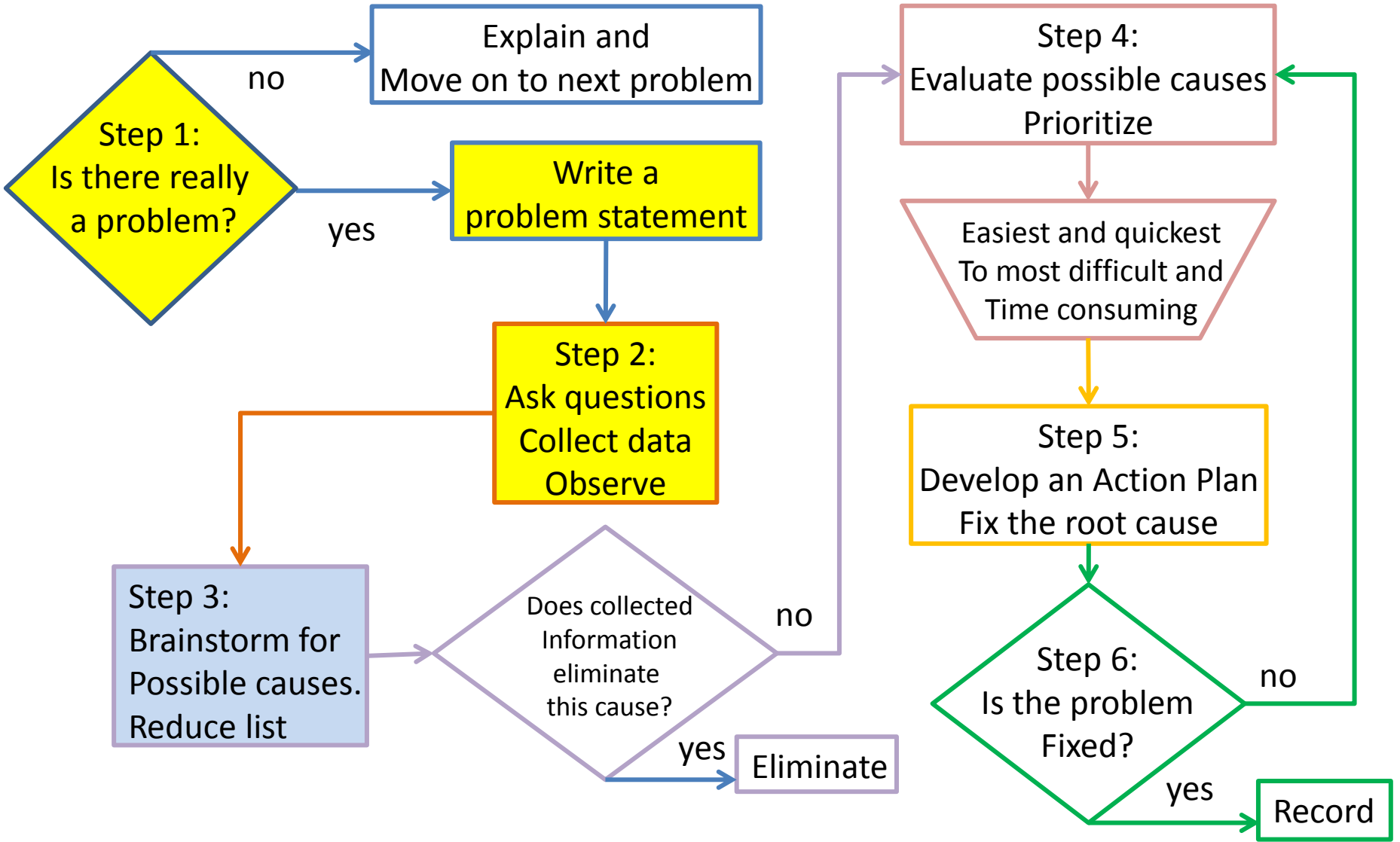
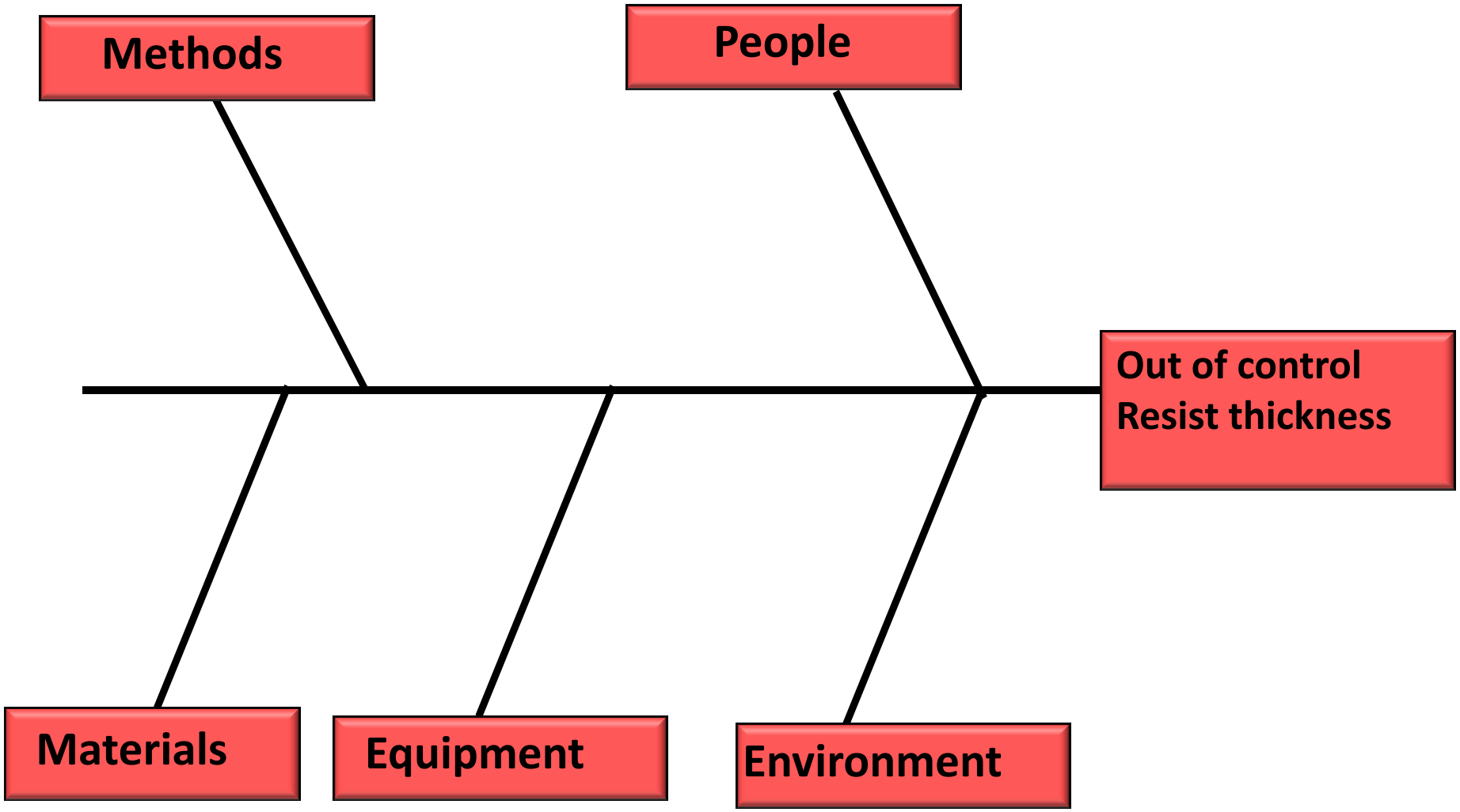


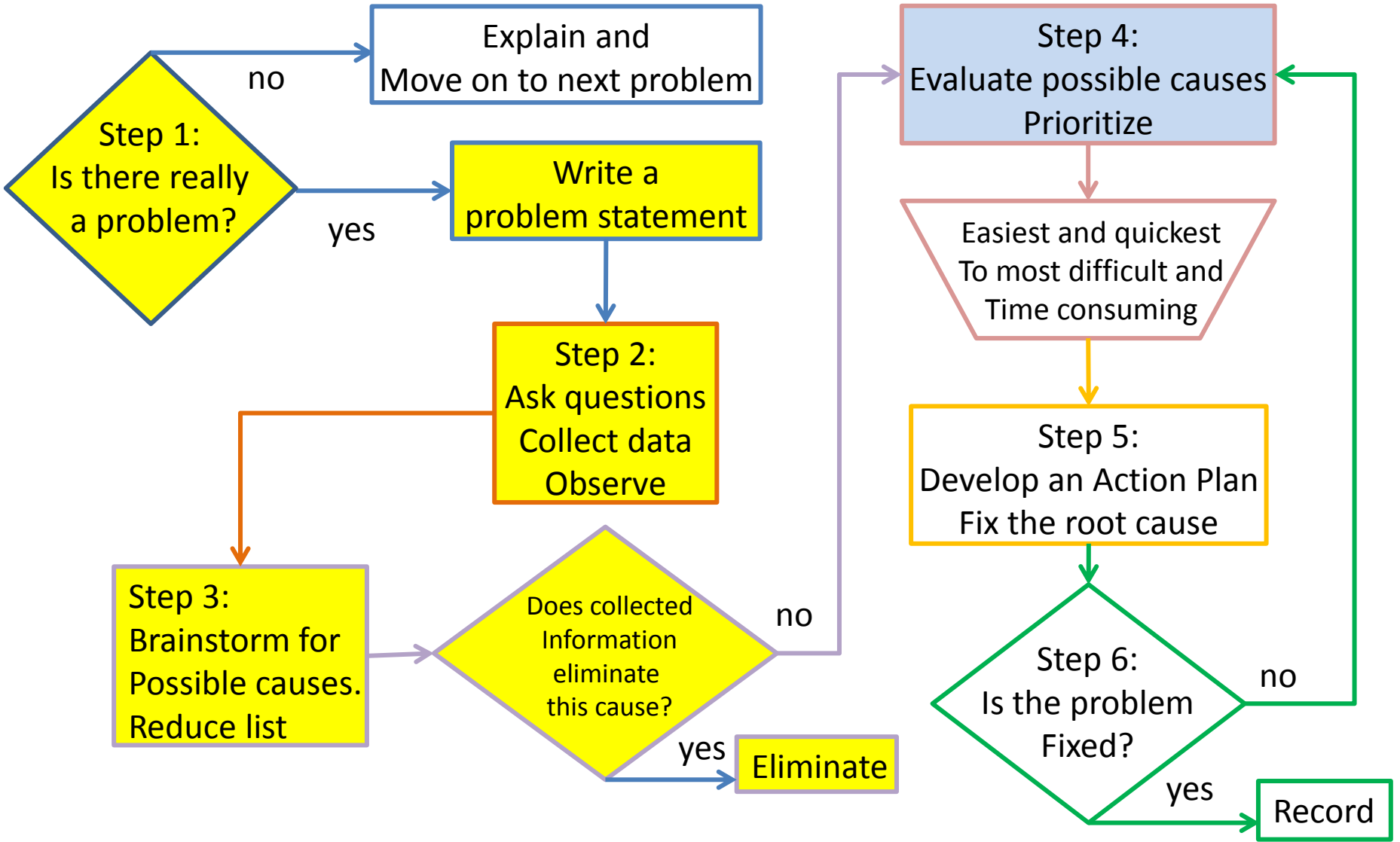
Step 3: Possible Causes



Brainstorm for possible causes

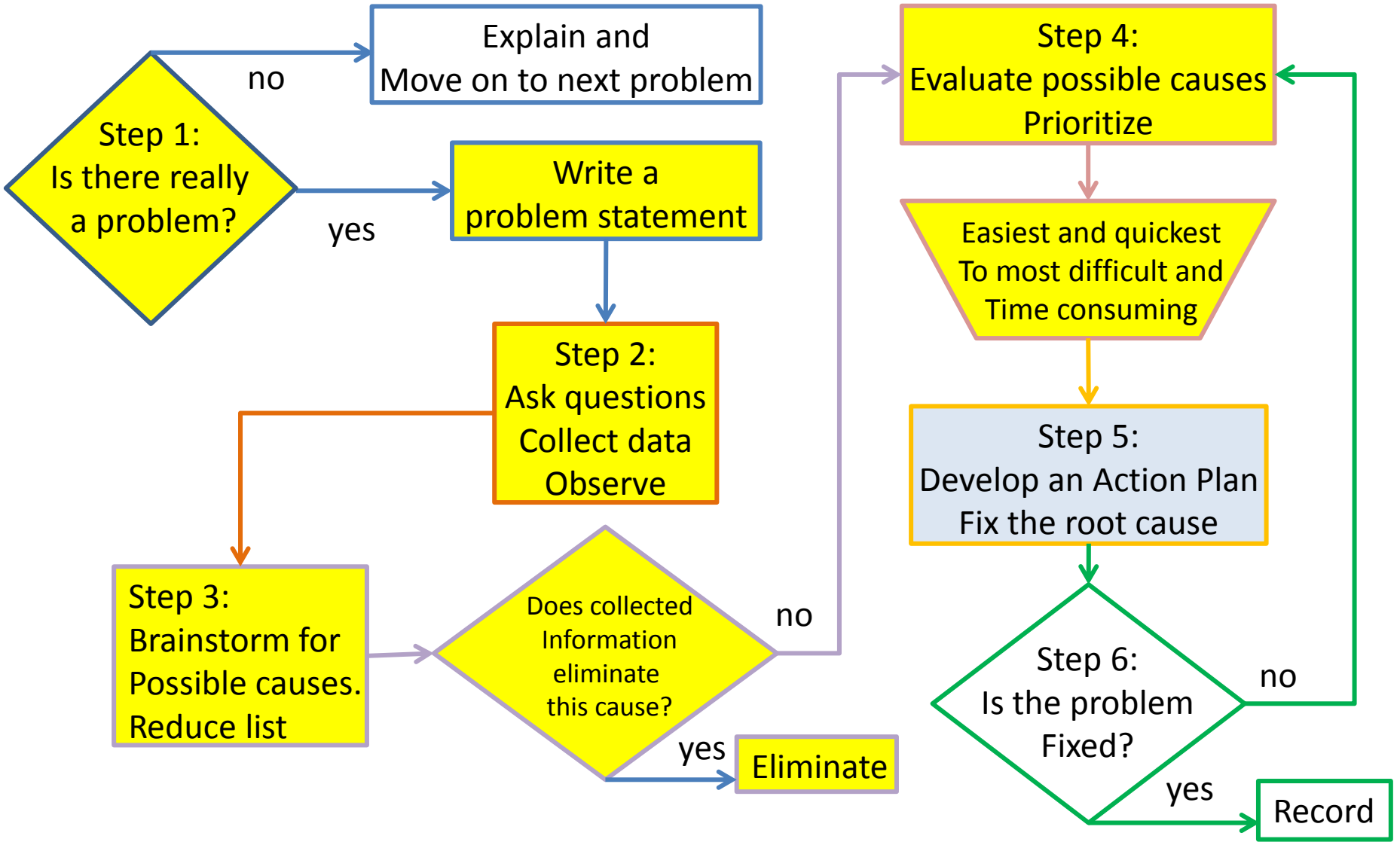


Step 4: Evaluate possible causes



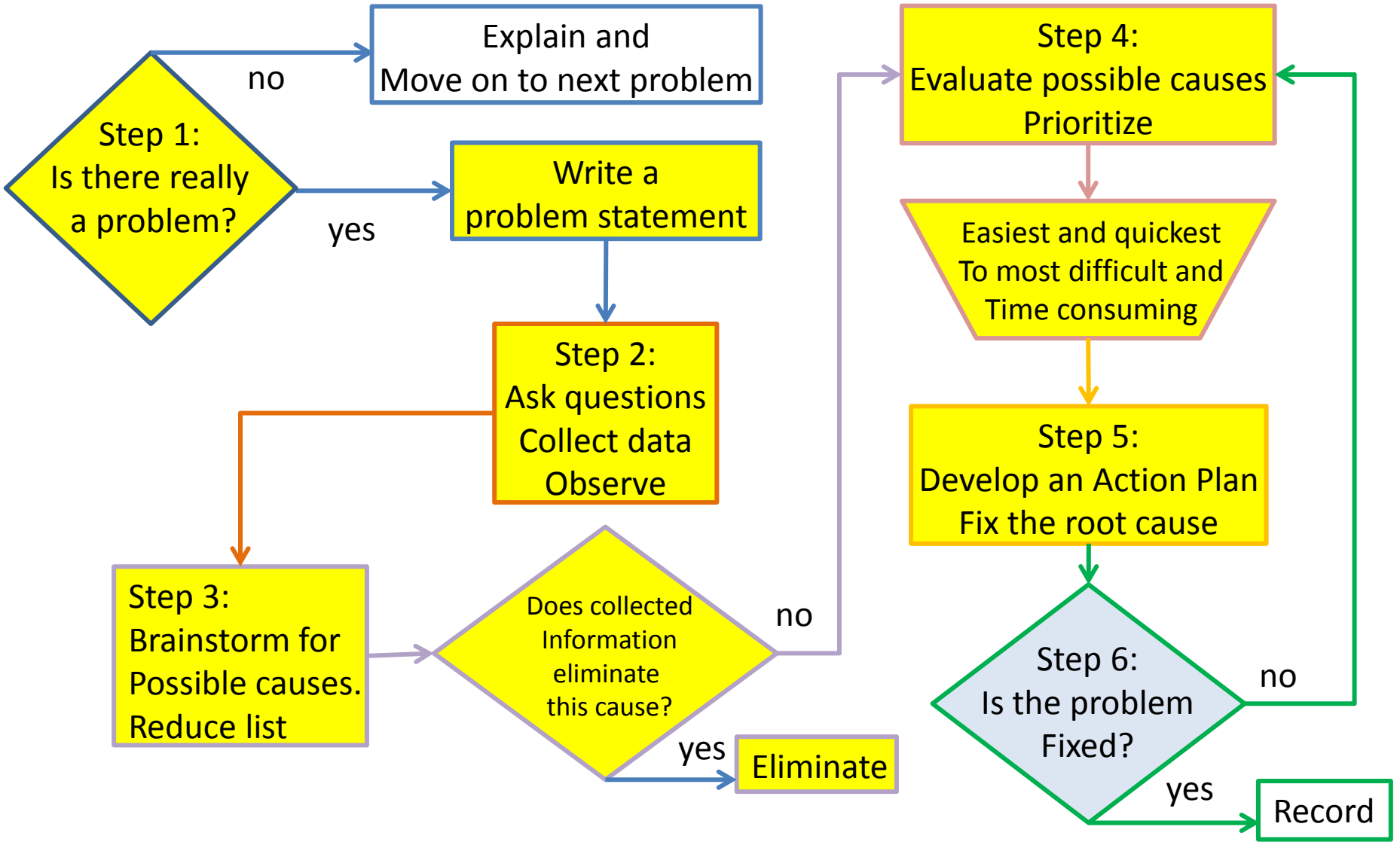
Step 4: Evaluate

Step 5: Action Plan



Step 5: Develop an Action Plan

Step 6: Verification

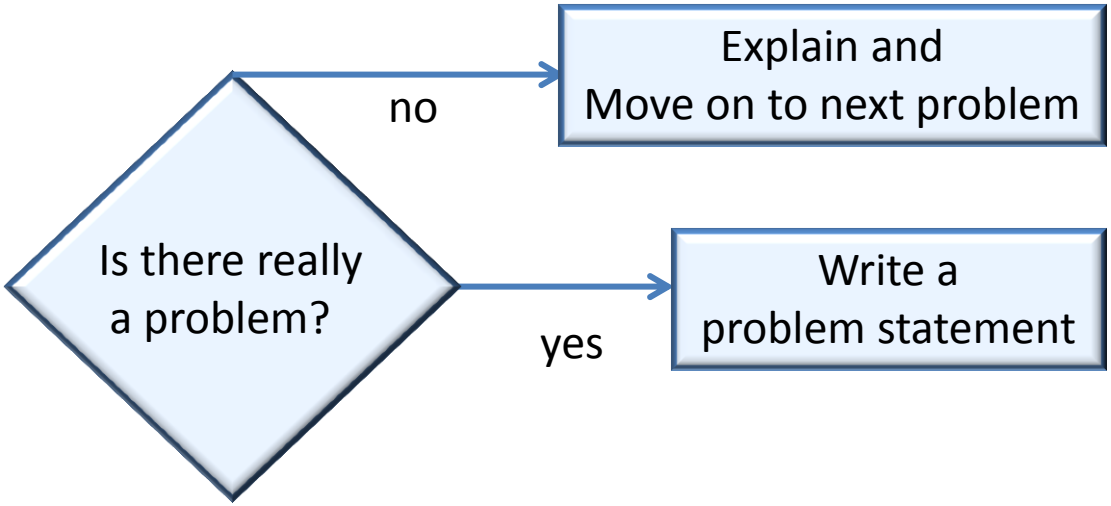


Step 6: Verification

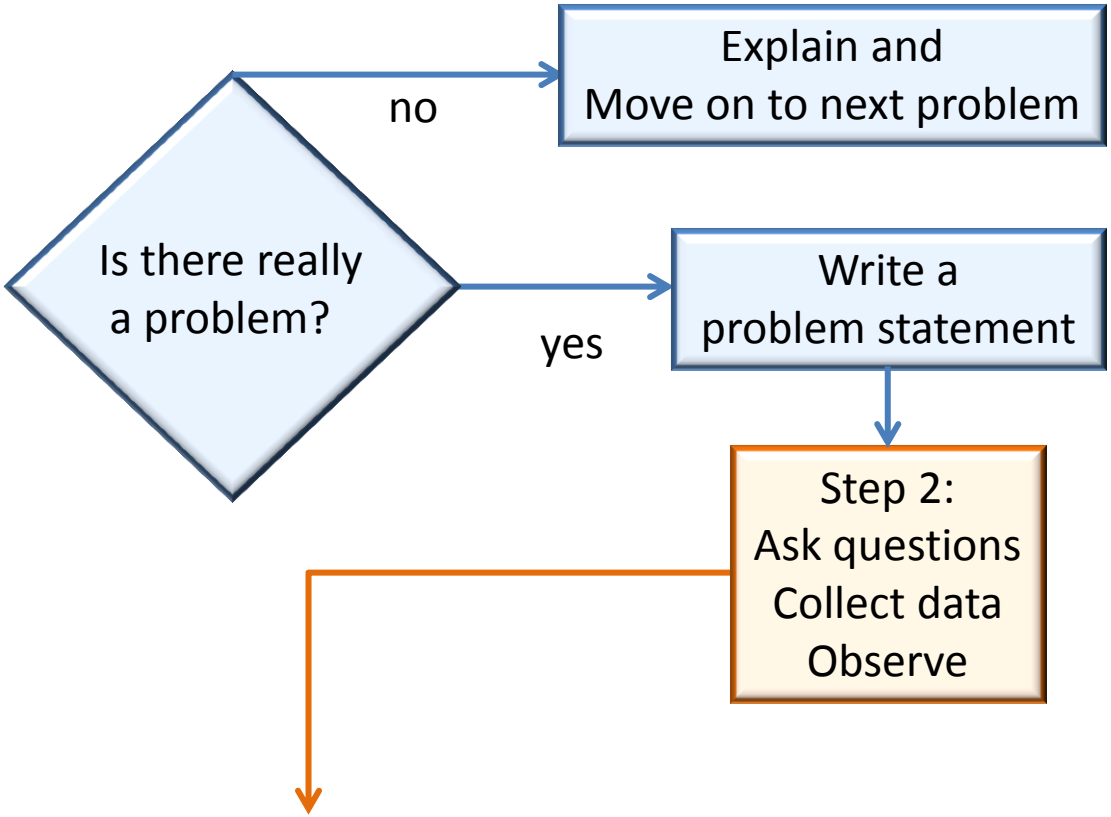
- Is the problem fixed?
- How will you prevent the problem from occurring again?
- Record the data, the process, and the solution (Documentation)

- Was this a well-structured problem or an ill-structured problem?

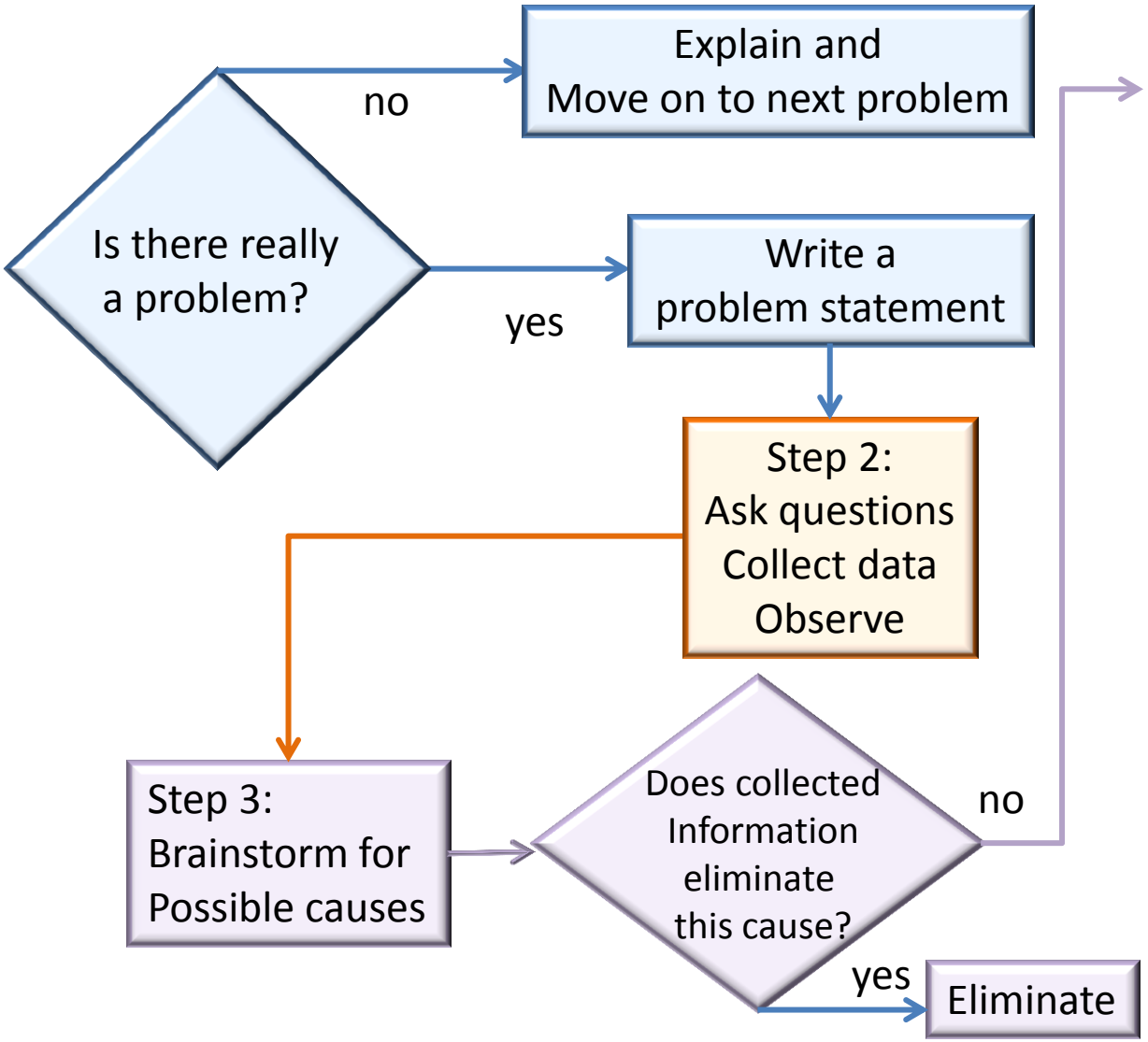
Step 1: Does a problem exists?



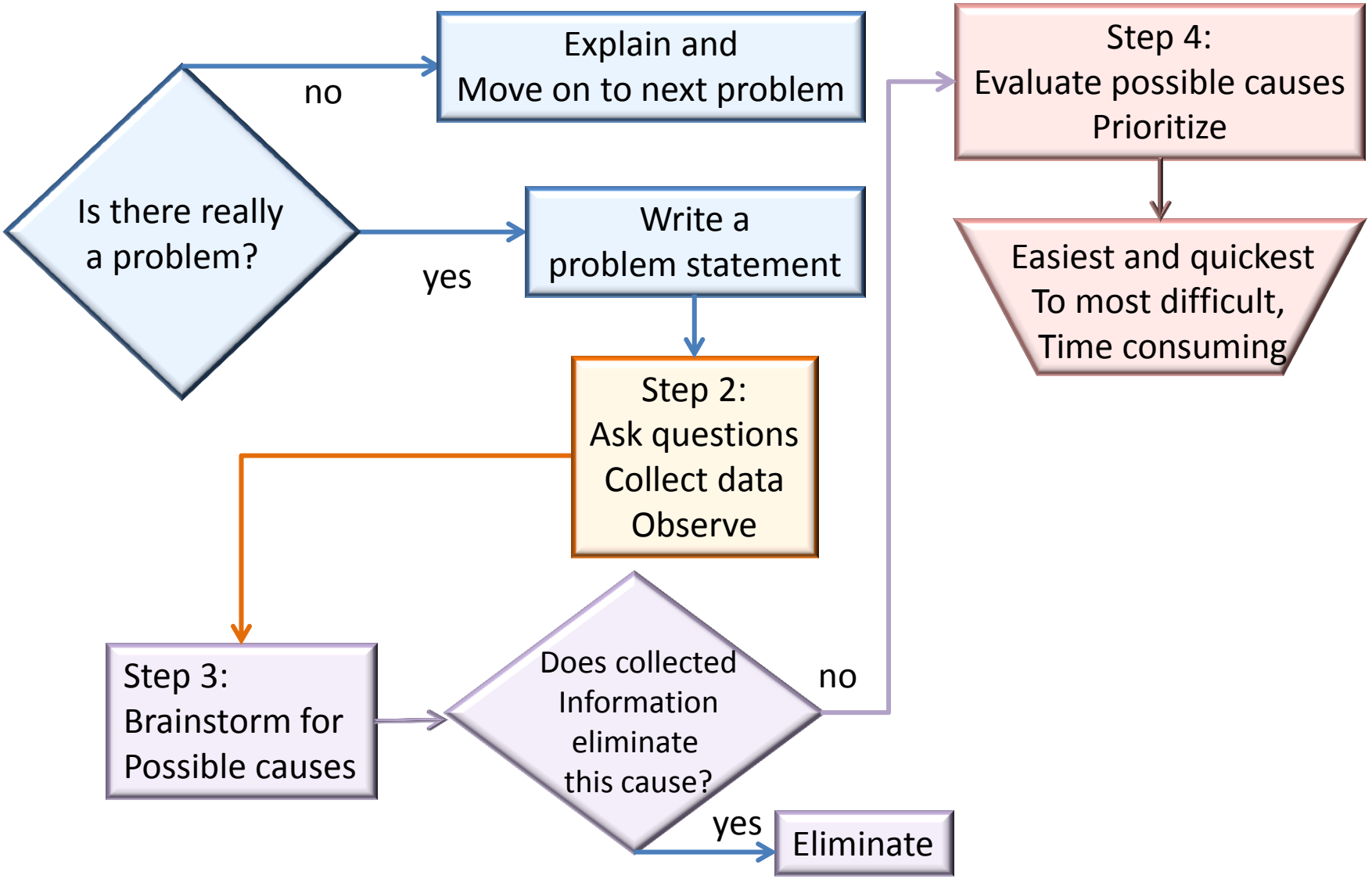
Step 2: Analyze the Problem



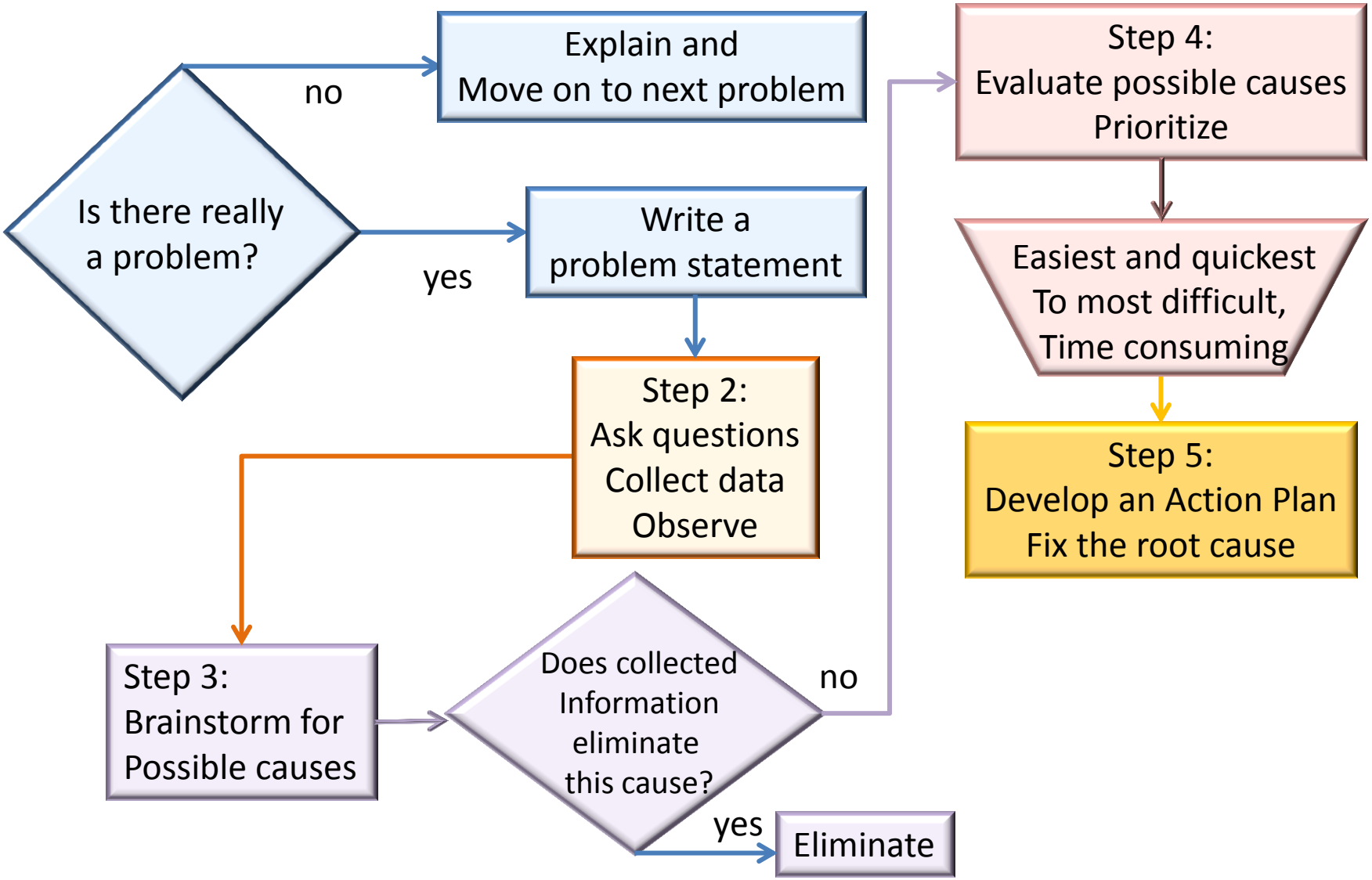
Step 3: Possible Causes



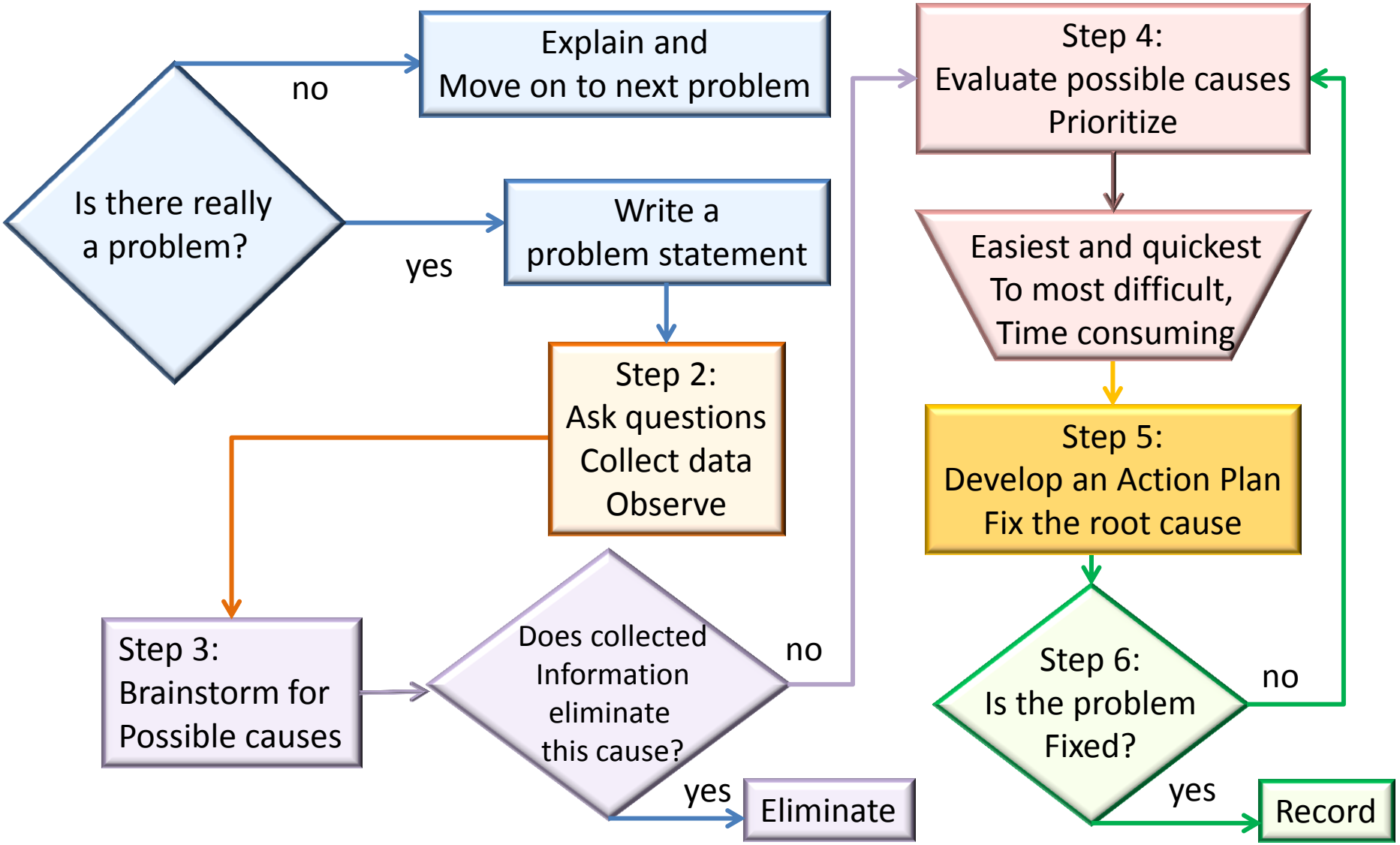
Step 4: Evaluate Possible Causes

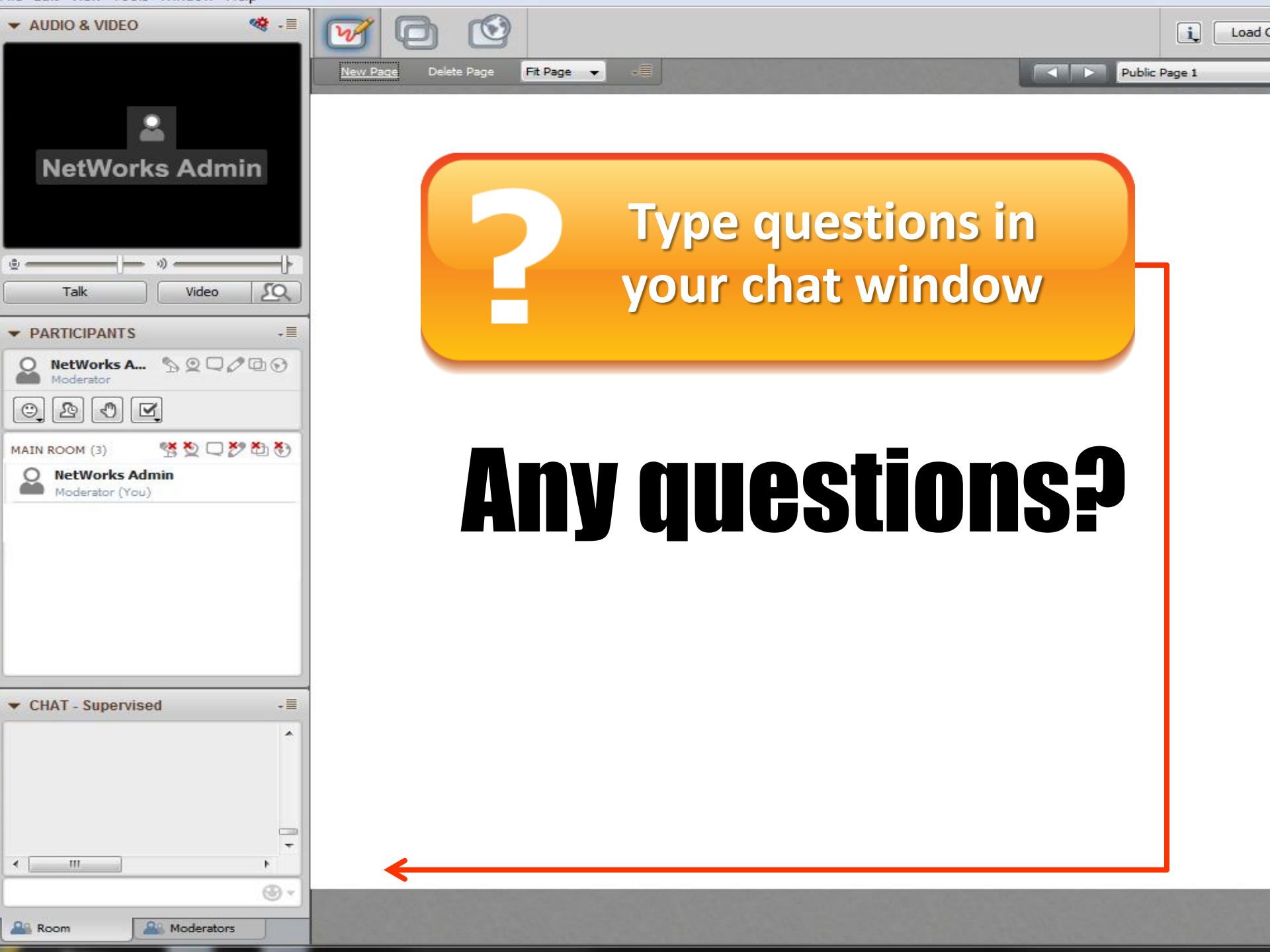


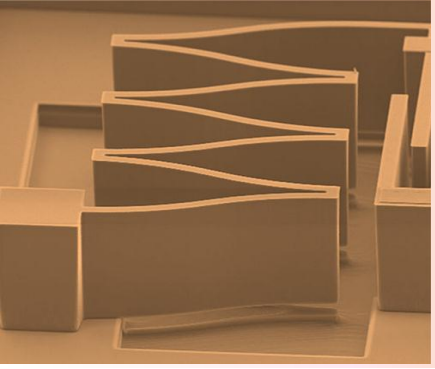
Step 5: Action Plan



Step 6: Verification




AUDIO & VIDEO
NetWorks Admin
Talk
Video
PARTICIPANTS
NetWorks A...
Moderator
MAIN ROOM (3)
NetWorks Admin
Moderator (You)
CHAT - Supervised
Room
Moderators
New Page
Delete Page
Fit Page
Public Page 1
Type questions in your chat window
Any questions?



Thank You For Joining Us

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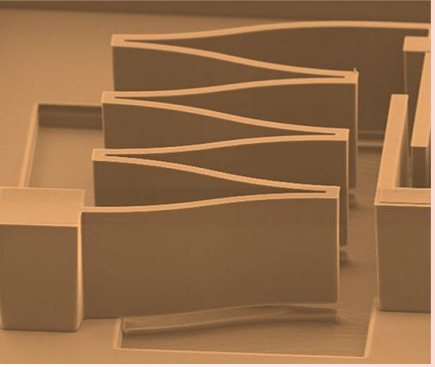
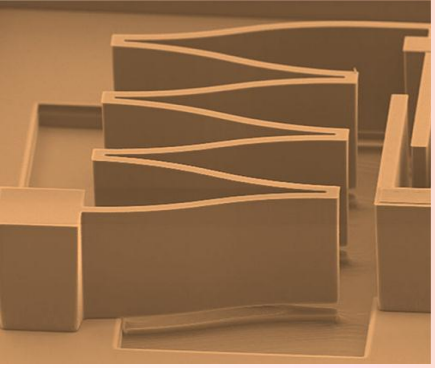


How Can We Serve You Better?

Southwest Center for Microsystems Education

Please take 1 minute to provide your feedback and suggestions

https://www.research.net/s/F6J3FWJ

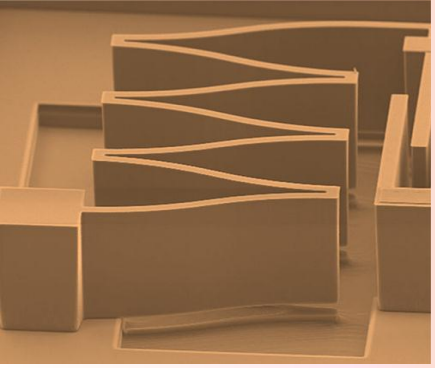


Webinar Resources

SCME
Southwest Center for Microsystems Education

To access this webinar recording, slides, and handout, please visit

www.scme-nm.org



SCME Upcoming Webinars

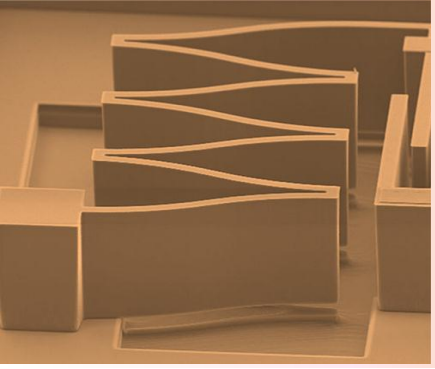
Southwest Center for Microsystems Education

January 24, 2013: Statistical Process Control for Technicians

February 28, 2013: Design of Experiments for Technicians

TBA: Problem-solving Tools Applied to Microfabrication

All Webinars on Thursday @ 1 PM ET



It was Fun!

Southwest Center for Microsystems Education

Thank you for attending this SCME Webinar

Problem Solving for Technicians