A set of tools for:

Creative Problem Solving

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Engineer's Toolchest

Based, in part, on: Fogler and LeBlanc, "Strategies for Creative Problem Solving," Prentice Hall, 1995

You all have creativity

You all have knowledge
(a trained engineer)

solve
problems
creatively

Effective problems solver develop a mind set of effectiveness

The 7 Habits of Highly Successful People

Stephen R. Covey, Simon & Schuster, Inc., 1989

Habit 1 Be Proactive - take the initiative

Habit 2 Visualize the end from the start - know where you're going

Habit 3 List priorities

Habit 4 Think WIN/WIN

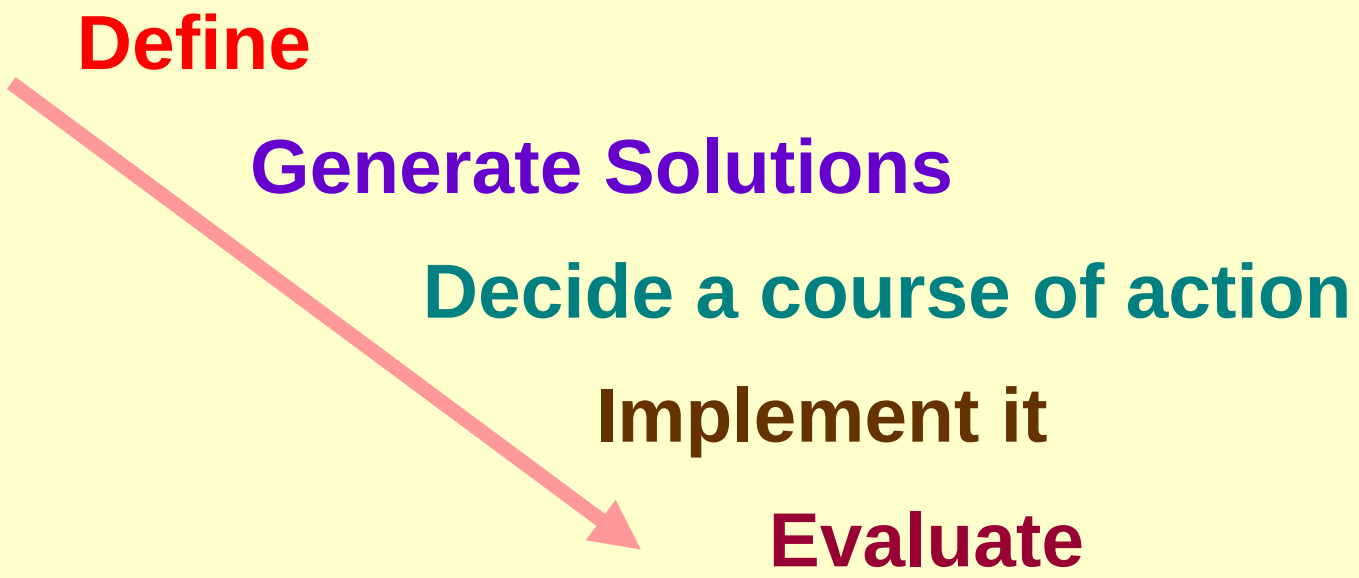
Habit 5 Understand -- listen, listen, listen / learn, learn, learn

Habit 6 Synergize -- make the whole more than the sum of the parts

Habit 7 Personal Renewal

Physical: exercise, nutrition, stress management
Mental: reading. Thinking
Spiritual: value clarification, meditation
Social/Emotional: empathy, self-esteem

A Recommended Approach to Problem Solving

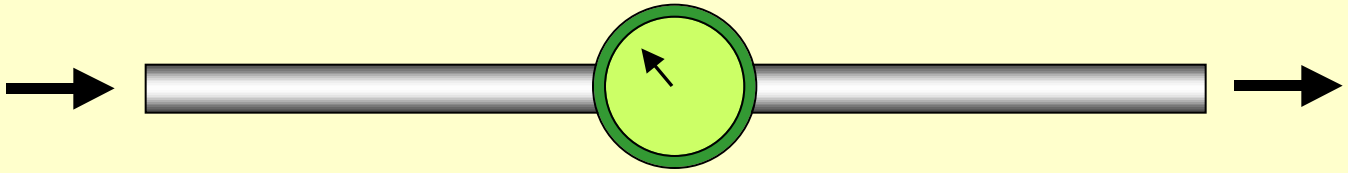


Define

Two wilderness hikers chanced upon a fierce grizzly bear.
One of them pulled his running shoes from his pack and
rapidly laced them up. His companion yelled in astonishment,
“Are you crazy? You can’t outrun a bear.”
His reply as he took off down the trail,
“I don’t have to outrun the bear.
All I have to do is outrun you.”

Defining the real problem. A difficult task!

Define



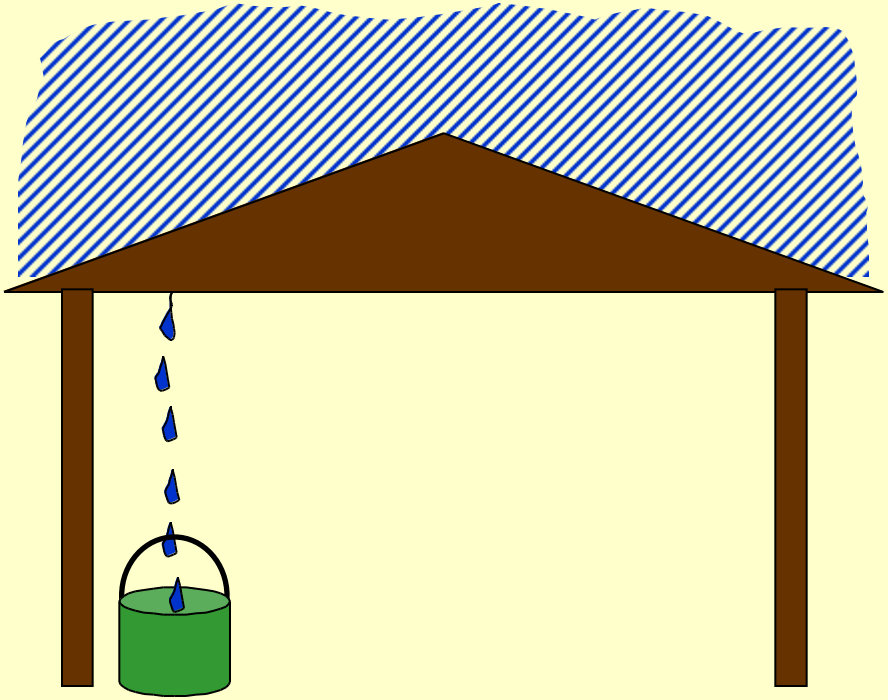
A flowmeter was installed in a chemical plant to deliver a highly corrosive solution. After six months, the solution corroded the flowmeter and the corrosive liquid leaked on the floor. The plant manager instructed his engineers to find a flowmeter that resists corrosion. An extensive search was carried out, both time-consuming and expensive, with no success in finding the perfect flowmeter.

The real problem is preventing the flowmeter from leaking, The plant crew finally decided that the flow meter leaks at six months. Replace it every four months.

Define

Treating the symptom

Less effective



Define the Problem (a “how to”):

The first four steps

Know about your subject (read, collect data, think)

Talk with others, especially experts

Expose yourself to the problem -- firsthand

Verify your findings -- are you sure you’ve got the problem?

The second four steps

Should the problem really be solved?

Gather more information

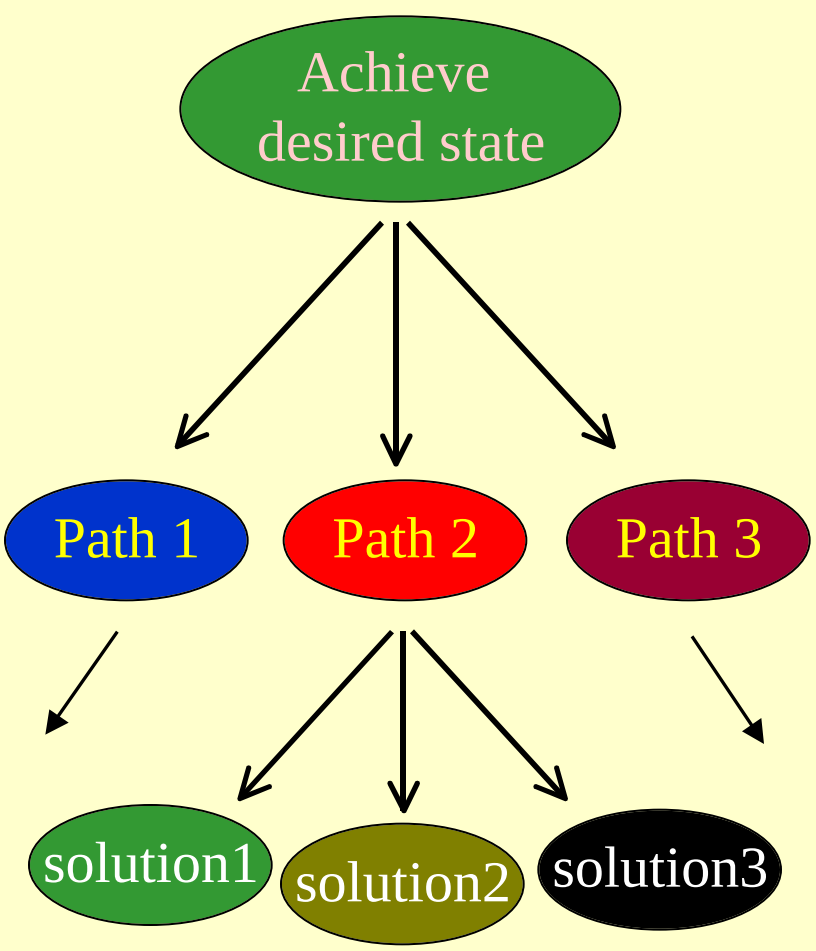
Hypothesize -- test the hypothesis

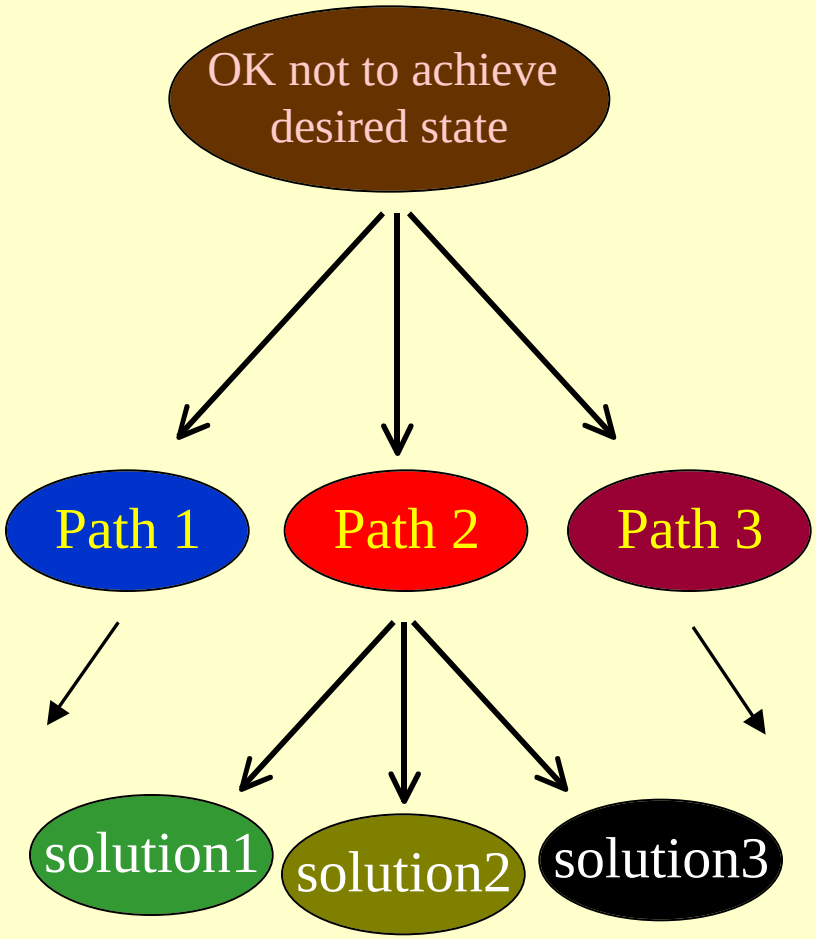
Brainstorm -- come up with solution alternatives

Define

The Duncker Diagram

Can we make it “acceptable” not to reach the solution?



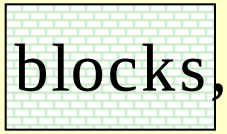


Generate Solutions

The blocks to generating solutions

- Mental blocks
  - Stereotyping
  - Limiting the problem unnecessarily
  - Information overload (...the forest but for the trees)
- Emotional Blocks
  - Fear of failure -- no risk taking
  - Judging rather than generating ideas
- Cultural blocks
  - Fear of offending or angering
- Expressive blocks -- you can't communicate your ideas.

Generate Solutions

Look at the  and find creative ways through them

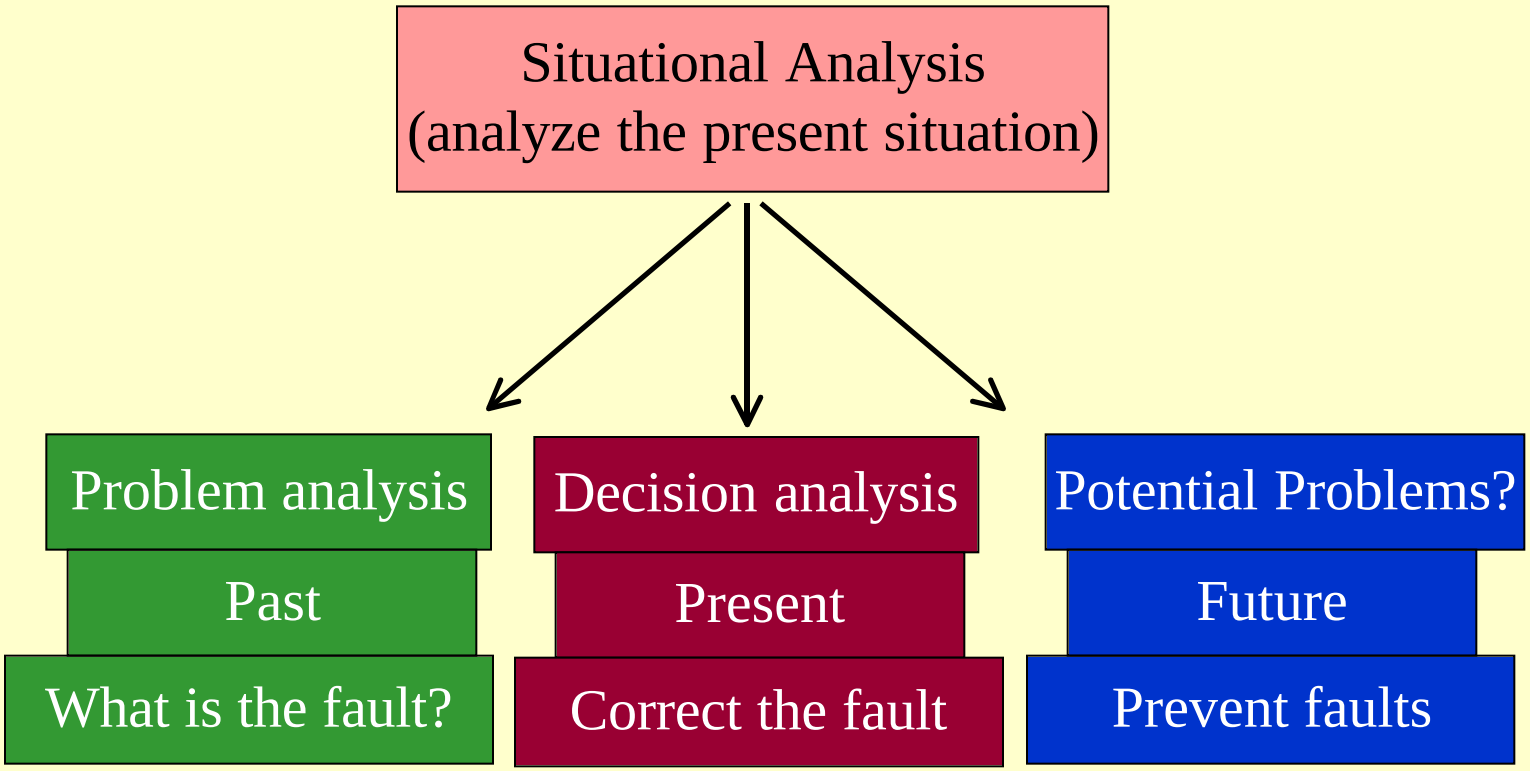
Brainstorming (be open and positive)

1. Checklist: (a) adapt, (b) modify, (c) magnify, (d) minify
   (e) substitute, (f) rearrange, (g) combine
2. Random simulation: look at randomly chosen words
3. What would someone else do?
4. Futuring -- imaging a solution that's not feasible today.
5. Analogy / cross-fertilization (talk with a musician)
6. A breath of fresh air -- stop thinking and just let things percolate

Decide a course of action

The Kepner-Tregoe (K.T.) method

A well-developed method for making decisions on which action, defining the problem, and prioritizing problems:



Kepner, C.H. and Tregoe, The New Rational Manager, Princeton Research Press, Princeton, NJ, 1981

Decide a course of action

The Kepner-Tregoe (K.T.) method

Problems are rated according to:

- Timing (urgency)
- Trend (potential for growth or disaster)
- Impact (how serious; how will it affect others?)

High (H); Medium (M); Low (L)

Also, what type of K.T. to carry out?

Problem analysis (PA); Decision analysis (DA); Potential Problem analysis (PPA)

Core K.T. ideas:

Things were OK; they're not now. What's changed?

Something distinguishes what is a problem and what is not.

Who was involved?
Who was not?
Why was it important?
Why is it unimportant?
How was the conclusion reached?

Musts
Wants
Adverse consequences

Implement it

Evaluate

Checklist ✔

Challenge assumptions and information you receive
Is the real problem being addressed?
Patchwork solution or a real solution?
Is there real impact?
Examine consequences
Argue both sides -- positive and negative
Might you accomplish more?
Economically justifiable solution?
Does the solution meet everyone’s needs?
Other problems generated from you solution?
Logical? Reasonable? Smart?
Responsible, ethical, safe?

The difference between effective problem solvers and ineffective ones:

- Attitudes with which they approach the problem
  - I (we) can solve this problem!
- Aggressiveness in problem solving
  - Read the problem several times
  - Re-formulate the problem
  - Mental picture -- visualize
  - Draw a picture / write an equation
- The concern for accuracy
  - Test the model / check & recheck
- The solution procedure used
  - Break the problem into sub-problems
  - Start someplace that is understood
  - Identify key concepts
  - Problem solving tools (heuristics)
  - Persistence / tenacity
  - Quantitative description
  - Track your progress

Take risks

Open up new horizons and new ways to view things.

Eat an oyster for the first time
Start a conversation with a stranger
Do paintings intrigue you? Start painting
Try a new new dish for dinner, maybe with anchovies
Switch to OS X
Vacation in a radically new place
Read Seneca
Write a letter to the editor of the Seattle Times
Start a small business
Try a weird experiment
Start a Toolbox course at the University of Washington

Boldly go where no one has gone before...

Key Tricks in Creative Problem Solving

(mostly from "Creative Problem Solvers Toolbox")

- Identify the problem (the real problem)
- Welcome new ideas
- Explore alternatives
  - mind map
  - matrix
- Think dimensionally - quantify ideas on a line (vector)
- Understand clearly -- be knowledgeable; avoid mistaken assumptions
- Group brainstorming (creativity is not necessarily a solo act)
- Understand people (E.Q.) (so many problems are with people)
- Review your goals
- Try "blanking" your mind for a few minutes (relax!)
- Use these tools in any order
- Take action... Does it solve the problem?
  Handling criticism