Engineering Skills (Problem Solving)

Chapter 5

Introduction

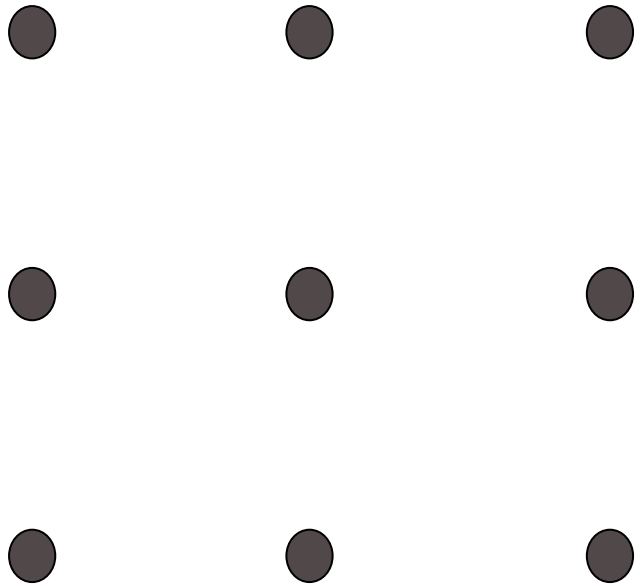
- Life is full of crises, problems, and decisions, but many people do not have the appropriate skills to manage them.
- WHAT IS A PROBLEM? It is a situation you want to change.
- In the problem solving approach “small” is not so much “beautiful” as “manageable”.
- Problem solving requires many “tools” and skills. Make sure that you have them, or at least know where to find them and how to use them
- Two basic types of problem solving involved in design process: creative and analytic
- More students familiar with analytic, where there is one right answer
- Creative problem solving has no *right* answers

Analytic Problem Solving

Six steps to analytic problem solving:

- Define the problem and create a problem statement
- Diagram and describe the problem
- Apply theory and any known equations
- Simplify assumptions
- Solve necessary problems
- Verify accuracy of answer to desired level

EXERCISE



Connect all nine dots with four (4) straight continuous lines without your pen (or pencil) leaving the paper.

MENTAL BLOCKS

Mental blocks are reasons (attitudes) why we don't "think something different."

To break these blocks

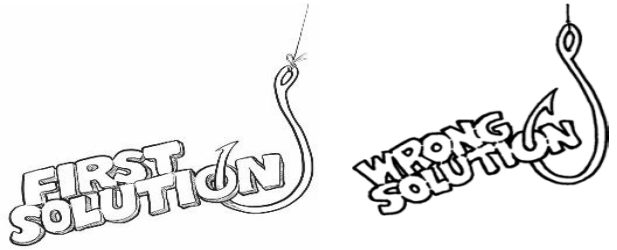
- Obtain additional training, background or resources.
- Ask for help!

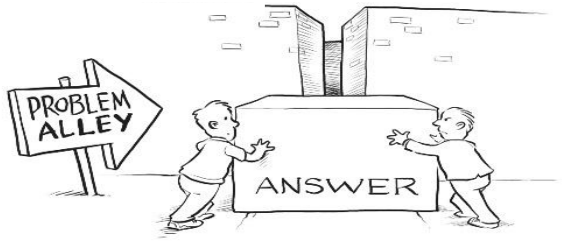
Example:

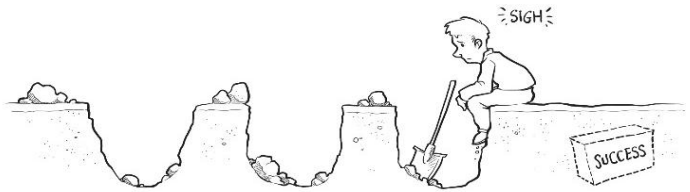
- Many people are not comfortable with errors. Our educational system has taught us to look for the "right answers". From an early age, we are taught that right answers are good and incorrect answers are bad. From this, we learn to be right as often as possible, to make as few mistakes as possible. In other words, we learn that "to err is wrong."

Common Causes of Mental Blocks

- Getting “hooked” on the first solution that comes to mind.
- Getting “hooked” on a solution that almost works (but really doesn’t).
- Defining the problem too narrowly or ambiguously.
- Assuming there is only one right answer.
- Being distracted by irrelevant information, called “mental dazzle”.
- Getting disappointed because lack of success.
- Being worried to finish.

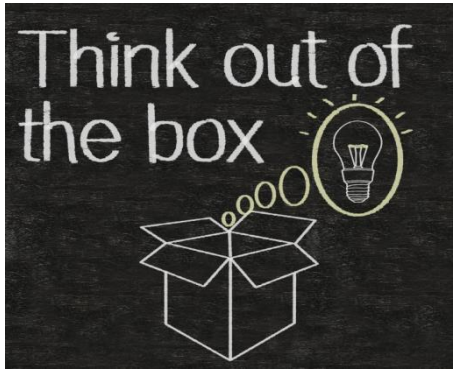




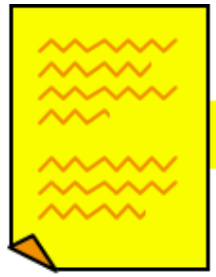


Why Creative Problem Solving (CPS)?

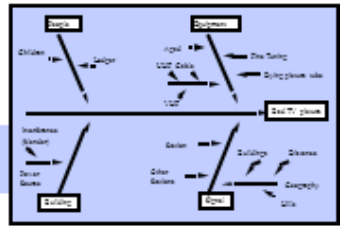
- Creative Thinking is the process we use to develop ideas that are unique, useful and worthy of further elaboration
- Interpersonal problem solving skills are learned from experiences beginning in the family and wherever the child interacts with others in situations that give rise to interpersonal difficulties.
- How can you become more creative?
  - Develop practical interpersonal and communication skills
  - Improve the capacity to think creatively
  - Experience intellectual challenge and growth
  - Learn to overcome barriers & habits
  - Strengthen the ability to manage diverse groups
  - Utilization of tools to help define complex problems, generate solutions and transform solutions into action
  - Use divergence and convergence to gather and analyse ideas. Divergence is brainstorming. Convergence is analysing and evaluating the ideas, seeking out the best possible solutions



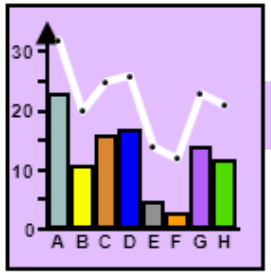
TOOLS FOR PROBLEM SOLVING



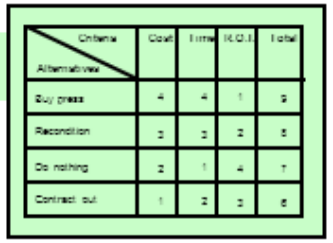
BRAINSTORMING



CAUSE & EFFECT



GRAPHS/CHARTS

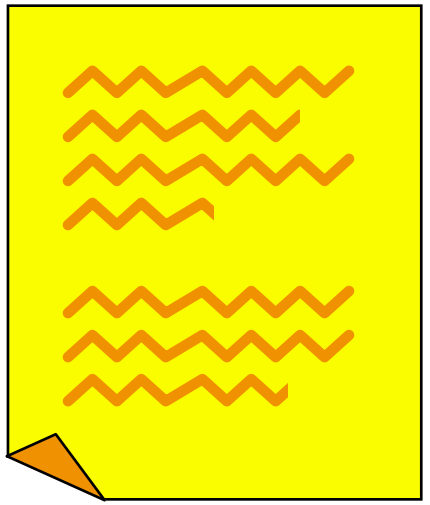


SOLUTION MATRIX

Mind Map

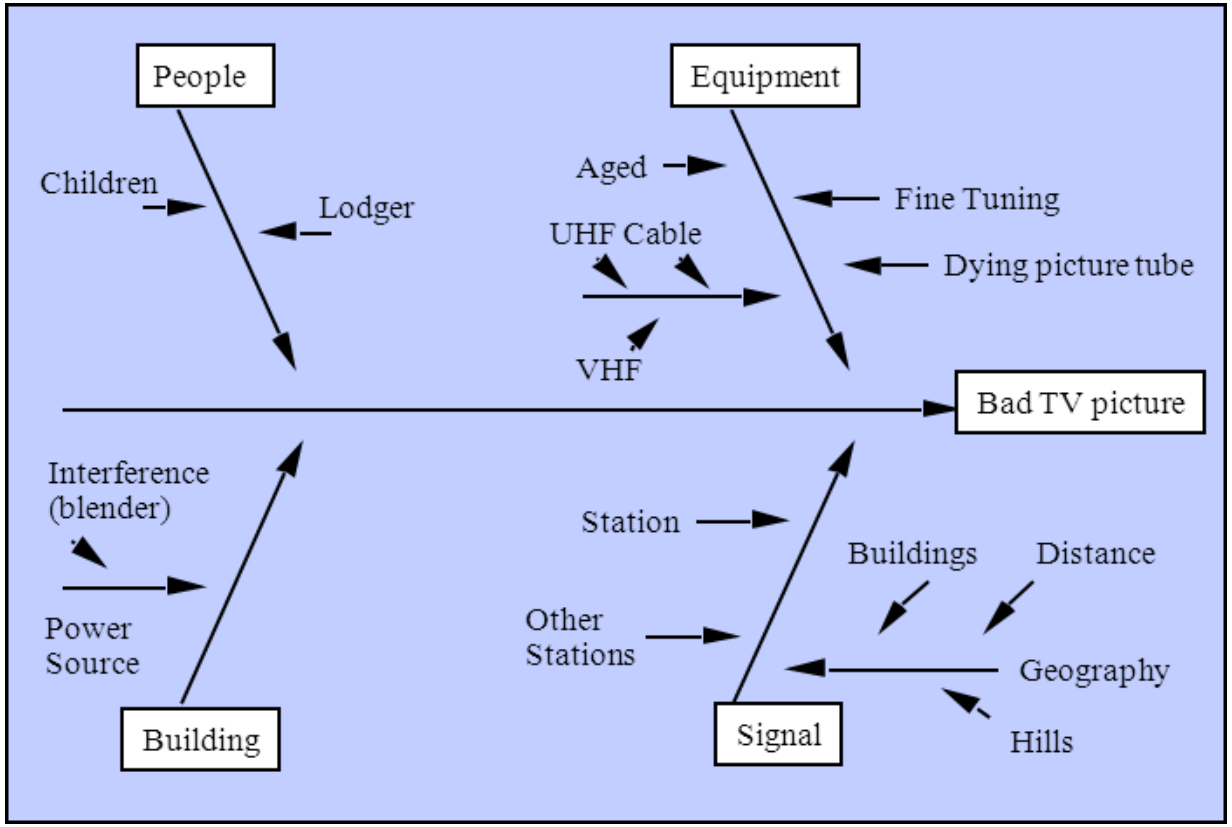
BRAINSTORMING

- Done in group
- Rapid listing of ideas on a flipchart
- Ideas spring out of other people's suggestions (cross-fertilizing)
- Build on one another's ideas
- The more ideas the better
- No discussion - keep the thoughts coming
- No idea is a bad idea - no evaluating, or making fun of other people's ideas.
- Called "brainwriting" if done individually



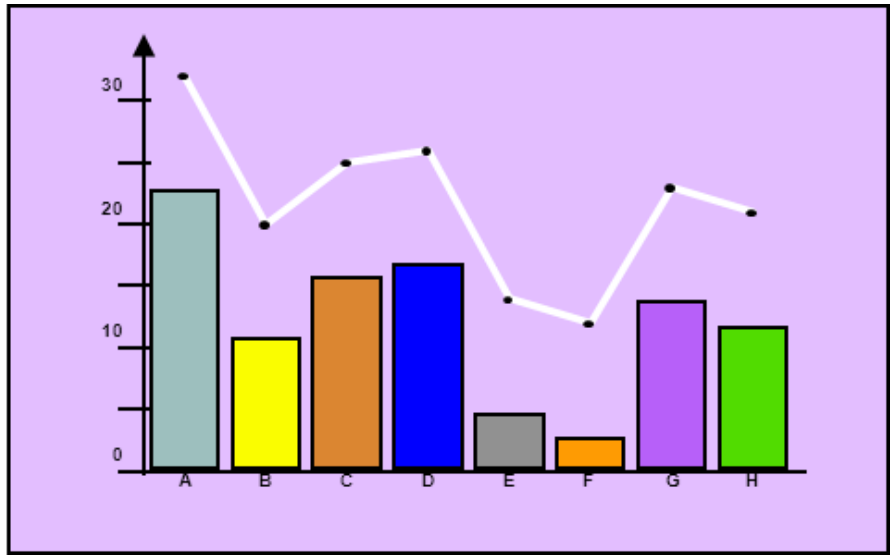
CAUSE AND EFFECT

- Also known as FISHBONE diagram
  - Structured Brainstorm
  - Problem is listed in box at far right
  - Categories of causes are proposed as “legs”
  - Brainstormed possibilities are written on the “legs”



GRAPHS/CHARTS

- Sketches, tables, graphs, computer generated drawings, blueprints are various ways in which engineers communicate via visual mediums
- Although most final drawings are computer generated, initial and freehand sketches are vital to the design process
- Freehand does not mean messy. Sketches should display an sufficient amount of details, and any relevant notes/comments relating to the drawing
- For instance, if a line is supposed to be straight, make it as straight as possible. A square will not pass for a circle.



Evaluation Matrix

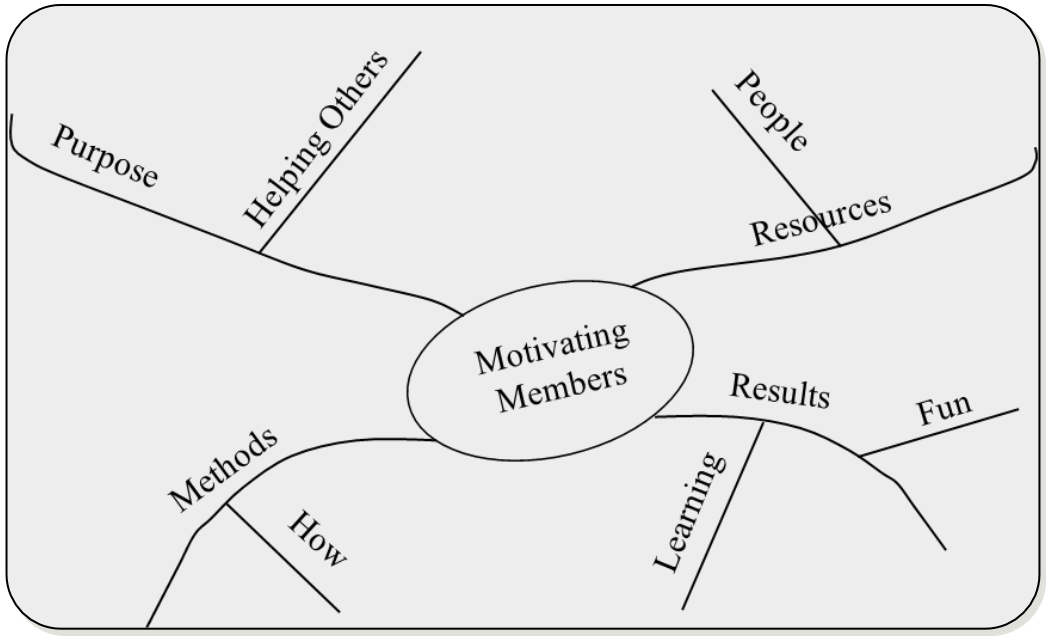
- Structured evaluation of alternatives
- Criteria for making the selection are listed along the top
- Alternative solutions are listed down the left
- The extent to which each solution meets each criteria is assessed
- A choice is made

Criteria / Alternatives	Cost	Time		Total
Buy press	4	4	1	9
Recondition	3	3	2	8
Do nothing	2	1	4	7
Contract out	1	2	3	6

MIND MAPPING

A visual picture of a group of ideas, concepts or issues.

- Purpose :
  - Unblock our thinking.
  - See an entire idea or several ideas on one sheet of paper.
  - See how ideas relate to one another.
  - Look at things in a new and different way.
  - Look at an idea in depth.



Improving Your Creative Abilities

Keep track of your ideas at all times.
Many times ideas come at unexpected times. If an idea is not written down within 24 hours it will usually be forgotten.

Ask new questions to yourself every day.
An inquiring mind is a creatively active one that enlarges its area of awareness.

Keep Updated in your field.
Read the magazines, trade journals, and other literature in your field to make sure you are not using yesterday's technology to solve toady's problems.

Improving Your Creative Abilities

Engage in creative hobbies.
Hobbies can also help you relax. An active mind is necessary for creative growth.

Avoid rigid, set patterns of doing things.
Overcome biases and predefined notions by looking at the problem from a fresh view point, always developing at least two or more alternative solutions to your problem.

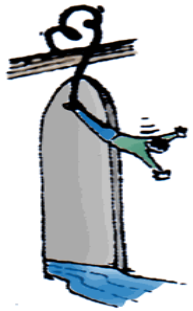
Learn to know and understand yourself.
Deepen your self-knowledge by learning your strengths, skills, weaknesses, dislike, biases, expectations and fears.

Improving Your Creative Abilities

Learn about things outside your specialty.
Use cross-fertilization to bring ideas and concepts from one field or specialty to another .

Be alert in your observations.
Look for similarities, differences, as well as unique and distinguishing characteristics in situations and problems.

Be open and receptive to ideas (yours and others).
New ideas are fragile; keep them from breaking by adopting half formed concepts and possibilities and developing them .



Adopt a risk taking attitude.
Fear of failure is the major impediment to generating solutions which are risky (i.e. small chance of succeeding) but would have a major impact if they are successful.