**Putting It All Together**

When faced with a problem, bring many principles of different building blocks to bear on the problem at the same time.

- Evaluate the Solution
- Implement the Solution
- Decide the Course of Action
- Generate Solutions
- Define the Problem

---

**Define the Problem**

- "Start with an open mind"
- "Don't jump to conclusions"

- Collect and analyze information and data
- Talk with people familiar with the problem
- View the problem
- Confirm all findings

---

**Generating Solutions**

- "Nothing is more dangerous than an idea, when it is the only one you have."

- Evaluate the Solution
- Implement the Solution
- Decide the Course of Action
- Generate Solutions
- Define the Problem

---

**Define the Problem**

- Find out where the problem came from
- Problem Definition Techniques
- Present state
- Desired state & Ducker diagram

---

**Generating Solutions**

- Once you have defined the problem you want to make sure you generate the best solution.
- Many times mental blocks hinder your progress toward a solution.
Recognizing Mental Blocks

The first step to becoming a better problem solver is to understand what conceptual blocks are and how they interfere with problem solving.

A conceptual block is a mental wall that prevents the problem solver from correctly perceiving a problem or conceiving its solution.

The most frequently occurring conceptual blocks are perceptual blocks, emotional blocks, cultural blocks, environmental blocks, intellectual blocks, and expressive blocks.

- A technique used to generate additional ideas related to those already defined

Osborn's Checklist for Adding New Ideas

Adapt? How can this idea be used as is? What are other uses it could be adapted to?
Modify? Change the meaning, material, color, shape, odor, etc?
Magnify? Add new ingredient? Make longer, stronger, thicker, higher, etc?

Minify? Split up? Take something out? Make lighter, lower, shorter, etc?
Substitute? Who else, where else, or what else? Other ingredient, material, or approach?
Rearrange? Interchange parts? Other patterns, layouts? Transpose cause and effect? Change positives to negatives?
Combine? Combine parts, units, ideas? Blend? Compromise?

Random Stimulation

Random Stimulation is a technique which is especially useful if we are stuck or in a rut. It is a way of generating totally different ideas than previously considered and can "jump start" the idea generation process and get it out of whatever current rut it may be in.

Introduce "weird" ideas during brainstorming.

Choose randomly a word from the dictionary. Use that word to generate other words that can simulate the flow of ideas.

Other People's Views (OPV)

When approaching a problem that involves the thoughts and feelings of others.

Imagining yourself in the role of the other person allows you to see complications of the problem not considered previously.
**Futuring**

- Examine the problem carefully to make sure the real problem has been defined.
- Now, imagine yourself at some point in the future after the problem has been solved. What are the benefits of having a solution?
- "Look around" in the future. Try to imagine an ideal solution to the problem at hand without regard to technical feasibility. Remember, in the future, anything is possible.
- Make statements such as: "If only (this) ______ would happen, I could solve...."
- Dare to change the rules! The best solutions to some problems are contrary to conventional wisdom.

**Analogy and Cross-fertilization**

- It is well documented that a number of the most important advances in science, engineering, art, and business come from cross-fertilization and analogies with other disciplines.
- Here ideas, rules, laws, facts, and conventions from one discipline are transferred to another discipline.
- There are four steps you can use to solve problems by analogy:
  1) State the problem,
  2) Generate analogies (this problem is like trying to . . .),
  3) Solve the analogy, and
  4) Transfer the solution to the problem.

**The Fishbone Diagram**

- Fishbone diagrams are a graphical way to organize and record brainstorming ideas. The diagrams look like a fish skeleton.
- To construct a fishbone diagram the following procedure is used:
  1. Write the real problem in a box (or circle) to the right of the diagram. Draw a horizontal line (the backbone) extending from the problem to the left side: Real Problem
  2. Brainstorm potential solutions to the problem
  3. Categorize the potential solutions into several major categories and list them along the bottom or top of the diagram. Extend diagonal lines from the major categories to the backbone. These lines form the basic skeleton of the fishbone diagram:

**Deciding the Course of Action**

- Problem solvers must juggle priorities all the time
  - Evaluate the Solution
  - Implement the Solution
  - Decide the Course of Action
  - Generate Solutions
  - Define the Problem
Once the real problem is defined and you have generated a number of possible solutions, it time to make some decisions:

- Decide which problem to work on first
- Choose the best alternative solution
- Decide how to successfully implement the solution

**Deciding the Course of Action**

**KT Approach (Kepner-Tregoe Approach)**

**KT Situation Analysis**

KT Situation Analysis can be helpful in deciding which problem receives the highest priority.

- Measure each problem using the following criteria:
  - Timing
  - Trend
  - Impact

- Each of the criteria are evaluated for there degree of concern:
  - High (H)
  - Medium (M)
  - Low (L)

**KT Problem Analysis**

What is the problem and what is not the problem?
- Where did the problem occur? Where is everything OK?
- When did the problem first occur? When was everything OK?
- What is the magnitude of the problem?

**KT Decision Analysis**

How to choose the "best" solution from a number of alternatives

- Write a concise decision statement
  - Collect and analysis information and data
  - Talk with people familiar with the problem
  - If possible, view the problem first hand
  - Confirm all findings

**Situation Analysis**

What are we? How are we? What do we need to do?

**Problem Analysis**

Past: What is the faults?
Present: How to correct the fault?
Future: How to prevent future faults?
Specify the objectives of the decision
- Divide these objectives into two categories: **musts** and **wants**

- **Musts** are mandatory to a successful solution
  - If a solution satisfies all musts then the solution is a "go"
  - If a solution does not satisfy any one of the musts then the solution is a "no go"

- **Wants** are desirable but not mandatory

Assign a **weight** (1 - 10) to each want on how important it is to you

Assign a **rating** (0 - 10) as to how well it satisfies the wants

A score for the solution can be determined by multiplying the rating by the weight

Identify how serious each problem is
- How probable is it that the problem will occur?

Once Problems are identified
- List all possible causes
- Develop preventive actions for each cause

There are a number of techniques that will facilitate the implementation process
Many people use a personal organizer to keep track of activities and commitments.

We will discuss four types of organization methods:
- Gantt Chart
- Coordination and development
- Critical path
- Necessary resources

**Critical Path** - Organizing critical tasks along a time line

- Develop an understanding of how one task affects other tasks in the project
- Use extensively in the construction industry
- Constructing a critical path is a dynamic process
Critical Path Example

Critical Path for Thanksgiving Dinner

- Bake sweet potatoes at 350° for 1 hr
- Prepare casserole with potatoes, spices, butter and milk
- Bake casserole at 350° for 2.5 hrs
- Bake pie @ 425°
- Serve meal

Planning

Necessary Resources

- Typically resource are divided into five categories:
  - Personnel
  - Equipment
  - Travel
  - Supplies
  - Overhead

Planning

I. Salaries and Wages

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Principal Investigator, C. V. Camp (Summer)</td>
<td>$14,925</td>
</tr>
<tr>
<td>B. Winter Research Assistant (Summer)</td>
<td>$14,925</td>
</tr>
<tr>
<td>C. Undergraduate Research Assistant (Winter)</td>
<td>$5,986</td>
</tr>
<tr>
<td>Subtotal I</td>
<td>$35,836</td>
</tr>
</tbody>
</table>

II. Fringe Benefits @ 17.65% of IA+IB

- $7,903

III. Travel

- $2,006

IV. Operating Expenses

- $15,000

V. Subcontract - Dr. Russell Deaton - The University of Arkansas

- $37,597

Total Direct Costs

- $122,634

VI. Facilities & Administration Costs @ 15% MTDC

- $18,395

Total Project Costs

- $141,029

Planning

Revealing the Solution - "It's like peeling an onion"

- Evaluation - qualitative and quantitative judgements about how material and methods satisfy problem criteria
- Synthesis - formulation of problem statement and testing procedures from "fuzzy" situations
- Analysis - break the problem into parts, identify missing, redundant, and contradictory information
- Knowledge - remembering previously learned material

Planning

Revealing the Solution

- Application - organize which set of activities will be applied
- Comprehension - understanding, manipulation, and/or extrapolation of information generated or identified in the application step
- Knowledge - remembering previously learned material
**Evaluation**

- After implementation, a final evaluation of the solution is needed

| Define the Problem | Generate Solutions | Decide the Course of Action | Implement the Solution | Evaluate the Solution |

Guidelines for evaluating your solutions
- Does it completely solve the problem?
- Is the solution ethical?
- Does the solution endanger people or the environment?

**General Guidelines**
- Evaluation should be an ongoing process
- Examine your solutions at each phase of the project
- Have an independent review of your work
- Do a KT Potential Problem Analysis
- Ask questions!!

**The McMaster Five-Point Strategy**
- Check that the solution is blunder-free
- Check that criteria and constraints are satisfied
- Check the reasonableness of results
- Confirm ALL findings!

**Ethical Considerations**
- “Solutions are not always black and white with regard to ethics, but shades of gray”

<table>
<thead>
<tr>
<th>Ethics Checklist</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is it legal?</td>
</tr>
<tr>
<td>Is it balanced?</td>
</tr>
<tr>
<td>How will it make me feel about myself?</td>
</tr>
<tr>
<td>Will it make me proud?</td>
</tr>
</tbody>
</table>

**The Five P’s**
- Purpose
- Pride
- Patience
- Persistence
- Perspective
End of Chapter 8