

part 5

# Creativity

## **Introduction**

Creativity is the development of ideas new to the individual.

It is the one basic element in the methodology that singles out effective VE performance by bringing one closer to the attainment of optimum value.

It takes creativity to discover alternate designs, construction methods, systems or processes that will accomplish the required functions of the present way of performing.

## **Individual creative capability**

Analysis of function through use of creativity is a principal root of VE requiring that individuals create on schedule.

To some, this challenge seems overwhelming.

It is similar to asking one to invent a useful object by noon on Friday of every week.

Fortunately, everyone possesses some degree of creative ability.

Normally an individual's creative potential is much more than he assumes.

As a result, innate creative ability can be developed and improved through training and practice.

While there is no precise scientific way of measuring creative action, creative behavior and potential can be subjectively evaluated.

One can evaluate himself by reviewing the indicators of creative behavior shown in *Figure 19*.

## **Problem solving methods**

There are two approaches to problem solving: the analytical and the creative.

### **a. Analytical approach.**

The strictly analytical approach is substantially singular in purpose.

The problem is stated exact.

A direct approach to the solution is taken, proceeding through a step-by-step progression of experiments, evaluations and mathematical manipulations to arrive at a single answer.

An analytical problem is one that frequently has only one solution that will work.

For example, excessive sweating had been observed on the interior of windows and window frames in a large office building.

In addition, the plaster adjacent to the windows had started to powder and cause paint to chip and peel, resulting in costly maintenance and inconvenience.

**"Find the cause of the failures" is an analytical problem.**

One pursues the problem through a progression of suppositions to be proved or disproved by experimentation, tests, calculations, etc., until the problem is successfully narrowed to a single cause for each failure.

Once the cause is ascertained, that problem is solved.

### **b. Creative approach.**

The creative approach is appropriate when there appears to be either no solution or more than one solution to a particular problem.

The creative approach is an idea-producing process specifically intended to generate a number of solutions, any of which will solve the problem at hand.

Although all solutions will work, one is the optimum solution among them.

In the example cited above, the situation posed by "excessive sweating on windows and

frames, plaster powdering and paint peeling" may be resolved into two problems:

- (1) Determine the cause of trouble (analytical problem); and
- (2) Prevent recurrence in this and future construction (creative problem).

The cause was found to be build-up of humidity in the space coupled with the low temperature of the glass, metal frames and frame supporting system.

Plaster powdered and paint peeled when moisture formed on the metal frame and supporting system.

What is the solution to this portion of the problem? A number of ideas may be proposed:

- Use wood-frame windows.
- Use thermopane glazing.
- Reduce the source of humidity build-up.
- Change the frame support system.
- Use Keene's cement plaster.
- Install thermal insulation between the frames and supporting systems.

Any of the above may solve the problem.

One of them is better than the rest.

Its selection is an analytical problem.

**But the best solution that could be found may not even be on the list.**

## **The creative process**

The creative process is a mental process in which past experience is combined and recombined (frequently with some distortion) to form a new combination which will satisfy some need.

**Creative thinking must produce useful ideas, not just ideas.**

The daydreamer can produce ideas, but unless his ideas have a useful purpose, he is not being creative.

### **a. Steps in the creative process.**

To give a greater understanding of the nature of creativity, we need to study the creative process.

The process follows a step-by-step sequence in the solving of problems.

However, don't conclude from this approach that innovation or creation is always the result of conscious or even logical effort.

The creative process is that process which the mind normally follows in seeking the solution to a problem.

*It follows the steps shown in Figure 20.*

### **b. Mental blocks to creativity.**

There are mental attitudes or influences which serve to retard or block the creative process.

These blocks may be categorized as habitual, perceptual, cultural, and emotional.

*Figure 21 defines these blocks.*

One can enhance his creativity by specifically counteracting them.

### **c. Positive factors affecting creativity.**

On the positive side of creativity, there are factors that make an individual "creative."

Some of these attributes are shown in *Figure 22*. Concentrated effort to develop these factors through individual self examination and practice will enhance creative ability.

#### CREATIVE BEHAVIOR IS COURAGEOUS BEHAVIOR

It takes "guts" to be creative. If you have a new idea, a really unique idea which no one has ever had before, you are a minority of one. Further, you must demonstrate to the world that your idea is a profitable idea.

#### CREATIVE BEHAVIOR IS CONFIDENT BEHAVIOR

You must operate on the premise that you have imagination. Nothing attempted, nothing gained. In fact, one creative principle is "Realize You Have Imagination." Albert Einstein said, "Imagination is more important than knowledge."

#### CREATIVE BEHAVIOR IS DIVERGENT BEHAVIOR

It seeks many answers. It is divergent in contrast to convergent "one answer" behavior. It is not merely two-valued, it is multivalued as is scientific behavior. It does not assume things are hot or cold, it knows there are many degrees of temperature and that everything is relative.

#### CREATIVE BEHAVIOR IS DISCRIMINATIVE

Creative behavior uses all the senses to be aware of all elements in the environment and to discriminate between those elements. The creative person is also verbally discriminative which accompanies his ability to be verbally manipulative.

#### CREATIVE BEHAVIOR CONTAINS HUMOROUS BEHAVIOR

Surprise is actually the basis of all humor; the new, the unexpected, surprise us and we laugh. For this reason, we have always cartooned inventors as quaint characters. They surprise us with newness. Unfortunately, too often laughter is considered criticism. Especially do our curious children cringe when we laugh at their surprising questions. All too soon they learn to avoid our laughter. With that learning comes conformity, stupid uncreative conformity.

#### CREATIVE BEHAVIOR IS QUESTIONING BEHAVIOR

It is exploratory; it probes and questions. Further, and most important, questioning behavior has a sense of timing. It senses when to ask questions which evoke divergent, many-answer behavior, when to ask fact-finding questions, and when to ask evaluative questions. It knows that there is a successful sequence of such questions and an unsuccessful sequence of such questions and that there even is a time to be silent and allow people to think.

#### CREATIVE BEHAVIOR CREATES CREATIVE BEHAVIOR

It can improve itself, it can invent new techniques, new sequences, new learning techniques, to improve itself. Further, cooperative creative behavior can improve and optimize group creative behavior.

#### CREATIVE BEHAVIOR IS PERSISTENT BEHAVIOR

We think very slowly. It took Galileo 34 years -from 1604 to 1638- to become confident, as he wrote to a friend, that the velocity of a freely falling body is a function of time. Thomas Edison said, "It takes about seven years to convert the average man to the acceptance of a solved problem."

#### CREATIVE BEHAVIOR IS INSTINCTIVE BEHAVIOR

Creative behavior can not be correlated with "intelligence," whatever that is. Average intelligence is necessary; but if we went by IQ tests alone, we would overlook 70% of our highly creative people. Charles Kettering said, "An inventor is simply a person who doesn't take his education too seriously."

#### CREATIVE BEHAVIOR IS MANIPULATIVE

A creative person physically manipulates things when studying them. He picks them up, feels them, turns them over, examines all sides closely, even smells and tastes them. A creative person is also verbally manipulative. His sense of expression permits him to combine, rearrange, reverse, magnify or minimize words to satisfy his need.

#### CREATIVE BEHAVIOR IS EVALUATIVE

Evaluation is a process of comparing or contrasting. When evaluating, the creative person understands the degree to which we actually compare "words" rather than "things" or "events" and, therefore, the need to have a close correlation between those words and things.

#### CREATIVE BEHAVIOR IS EMOTIONAL

Like scientific behavior, creative behavior contains both intellectual and emotional factors. One must have the "urge," the "desire," to create in order to create.

#### CREATIVE BEHAVIOR IS LEARNED BEHAVIOR

Although creative potential must first exist, a large part of creative behavior is learned behavior. Edison as a baby could not invent anything. He had to learn to invent. Something in his environment reinforced his persistent exploratory responses was learned. Creative behavior can be deliberately developed and creative behavior can be impressively improved.

#### CREATIVE BEHAVIOR IS FREE BEHAVIOR

Its divergent -many-answer- approach gives us more choices. Having more choices is the essence of freedom. Incidentally, some people believe that cooperation negates the individual's freedom. Actually, because cooperation can generate many more choices, cooperation can generate more freedom.

Figure 19. Creative Behavior Indicators

ORIENTATION	Defining the problem to be solved and selecting the approach that should be taken to solve It.
PREPARATION	Information-gathering and fact-finding.
ANALYSIS	Evaluation and analysis of the data gathered.
IDEATION	Production of alternative solutions to the problems.
INCUBATION	Sorting and combining the Information (slowing the pace to invite illumination).
SYNTHESIS	Bringing all the Ideas together into a complete whole.
VERIFICATION	Evaluation of the proposed solution or, resultant ideas.

Figure 20. Creative Process Steps

1. HABITUAL BLOCKS
  - a. Continuing to use "tried and true" procedures even though new and better ones are available.
  - b. Rejection of alternate solutions which are incompatible with habitual solutions.
  - c. Lack of a positive outlook, lack of determined effort, conformity to custom, and reliance on authority.
2. PERCEPTUAL BLOCKS
  - a. Failure to use all the senses of observation.
  - b. Failure to investigate the obvious.
  - c. Inability to define terms.
  - d. Difficulty in visualizing remote relationships.
  - e. Failure to distinguish between cause and effect.
3. CULTURAL BLOCKS
  - a. Desire to conform to "proper" patterns, customs or methods.
  - b. Over-emphasis on competition or on cooperation.
  - c. The drive to be practical above all things and being too quick to make immediate judgments.
  - d. Belief that all indulgence in fantasy is a waste of time.
  - e. Having confidence and faith only in reason and logic.
4. EMOTIONAL BLOCKS
  - a. Fear of making a mistake or of appearing foolish.
  - b. Fear of supervisors and distrust of colleagues and subordinates.
  - c. Over-motivation to succeed quickly.
  - d. Refusal to take any detour in reaching a goal.
  - e. Inability to reject decisions which are adequate but which are obviously sub-optimum.

Figure 21 - Blocks to Creativity

PROBLEM SENSITIVITY

Being aware that a problem exists.

IDEA FLUENCY

Being able to produce ideas in copious quantities.

FLEXIBILITY

Being open-minded and adaptive In the approach to a problem.

ORIGINALITY

The ability to produce a great @r of new and unique ideas.

CONSTRUCTIVE DISCONTENT

A dissatisfaction with existing conditions with an attitude of mind which seeks to improve the conditions. This type of person usually asks why and how.

OBSERVATION

Alertness to the environment.

FACILITY AT COMBINATION

The ability to combine and recombine information in a variety of ways.

ORIENTATION

Development of the proper frame of mind toward creativity.

MOTIVATION

The mustering of the necessary energy to work toward the goal, drive and energy.

PERMISSIVE ATMOSPHERE

The environment in which new ideas are encouraged. A permissive atmosphere is characterized by freedom of expression, job satisfaction, effective communications and mutual respect and encouragement from co-workers.

Figure 22. Factors Conductive to Creativity

## **Creative techniques**

There are a number of creativity techniques available for problem-solving situations.

Some are for use by individuals working alone, others for use by groups.

All the techniques provide a method or mechanical procedure to help the user generate more solutions to his creative problems.

The various techniques provide formats for mental stimulation.

However, during their use, it is necessary to make the conscientious effort to think creatively.

The ground rules to be followed may be summarized as shown in Figure 23.

The two basic rules for the use of all creative techniques are:

- (1) to eliminate all judgment or evaluation in the Idea-producing stage, and
- (2) to consider all ideas, even the most impractical.

These two simple rules must never be forgotten; they must be followed if successful results are to be derived from any operational technique.

### **a. The first principle**

-- the elimination of all judgment and evaluation from the idea-producing stage -- allows first for a maximum accumulation of ideas for consideration.

It prevents the premature death of a potentially good idea before it gets a chance to be heard.

It conserves the time of the group or individual working on the problem because there is no continual shifting from creation of original ideas to evaluation, as happens in an ordinary conference or in one's usual thought pattern.

In a group, this common intermixture of creation and criticism can be especially

harmful; time that could be devoted to the creation of additional new ideas is devoted to discussion and frequently destructive criticism.

By concentrating on the production of ideas alone, and postponing evaluation until some later date, a far greater number of original ideas will increase the chances of obtaining a creative idea which will solve the problem.

**b. The second principle**

-- the consideration of all ideas, even the obviously impractical -- is equally important.

By ranging far and wide, one is encouraged to explore new ideas, thus breaking through the barriers that too often restrict our thought processes.

In other words, we are using artificial means to force us to develop new and daringly creative approaches -- approaches which can be really rewarding.

1. Do not attempt to generate new ideas and to judge them at the same time. Separate these aspects by time, by place, and by different personnel, if possible.
2. Generate a large quantity of possible solutions. As a goal, multiply the number of ideas produced in the first rush of thinking by 5 or even 10.
3. Seek a wide variety of solutions that represent a broad spectrum of attacks upon the problem.
4. Watch for opportunities to combine or improve ideas as they are generated.
5. Before closing the book on possible solutions, allow time for subconscious operation on the problem while consciously performing other tasks.
6. Consider all ideas, even the most impractical. Do not ridicule any idea.

Figure 23. Creativity Technique Ground Rules

## **Brainstorming technique**

Brainstorming is a problem-solving conference method that is based upon the stimulation of one person's mind by another's. An average brainstorming session consists of a group of 4 to 6 people sitting around a table and spontaneously producing ideas designed to solve a specific problem. During this session, no attempt whatsoever is made to judge or evaluate the ideas. Evaluation takes place after the brainstorming session has ended.

### **a. Group brainstorming rules.**

Prior to opening the session, the group leader will set the stage by reviewing the following group brainstorming rules.

- (1) Criticism is ruled out. Adverse judgment of ideas must be withheld until later. No criticism by word of mouth, tone of voice, shrug of shoulders or any other method of indicating rejection is allowed.
- (2) Free-wheeling is welcomed. The wilder the idea, the better; it is easier to tame down than to think up.
- (3) Quantity is wanted. The greater the number of ideas, the more the likelihood of a winner.
- (4) Combination and improvement are sought. In addition to contributing ideas of their own, participants should suggest how ideas of others can be turned into better ideas, or how two or more ideas can be joined into still another idea.

### **b. Using a group.**

Two or more people working together under these ground rules can generate more ideas than one person working alone.

This is mostly due to the fact that ideas generated by various members of the group can be modified or improved upon and be offered by other members as suggestions for solution of the problem.

The efficiency of the group goes up as its size increases above two until it reaches the point where its operation becomes so

cumbersome as to discourage some members participation.

The members of the group may be selected to represent different work backgrounds.

Some should have a working familiarity with the subject under study.

Group members need not all know one another before the session.

However, they should all come from equal levels within the organization.

**c. Conducting the session.**

During brainstorming sessions it is important not to exercise critical judgment of any offered idea.

Critical judgment will tend to Inhibit the thinking of the judged and will have a stifling effect upon the offering of ideas.

Some brainstorming conference leaders have been known to ring a bell when a judicial statement is made during an idea producing session.

With practice, people can adjust to the brainstorming method.

This means following the rules and controlling the natural tendency to instantaneously evaluate ideas.

- (1) The group leader opens the session by posing a problem expressed in functional language.

In brainstorming, it is important to list all ideas on a blackboard or flip sheet so that all members of the group can see as well as hear the ideas.

This is difficult since the ideas usually come too fast to be recorded.

- (2) It is also important in brainstorming when general ideas are given, to ask creative questions which evolve more specific ideas. For instance, if a suggestion such as "Solicit ideas" is given, a question

such as "From whom might we solicit Ideas?" is usually helpful.

**d. Attaining a solution.**

Brainstorming does not always directly provide final solutions or ideas ready for immediate implementation.

However, it is always capable of suggesting the final solution or giving a lead for further development of a solution.

## **The Gordon technique**

This technique is closely related to brainstorming in that it is a group conference method in which an unevaluated free-flowing discussion is encouraged.

But in its pure form, there is one basic difference -- no one except the group leader knows the exact nature of the problem under consideration.

### **a. Benefits of the technique.**

- (1) One of the principal reasons for keeping the rest of the group members in the dark, so to speak, is to avoid "a solution too soon arrived at."

The proponents of the Gordon technique feel that a brainstorming session of the Osborn variety often only scratches the surface.

They believe that if suggestion of ideas occurs as soon as the session begins, most of them will tend to be superficial -- more often a "gimmick" than a true innovation.

- (2) The Gordon technique seeks to avoid what has been termed "egocentric involvement." Gordon feels that there is danger in an ordinary brainstorming session of a participant becoming convinced that one of the ideas he has proposed is the best possible solution to the problem.

This self-satisfaction with his own prowess as a "creative person" might cause him to cease producing additional ideas, and to devote his energies to defending and selling his "creation."

Naturally, this makes him a most ineffective participant.

A Gordon session avoids this danger since there can be no best solution proposed for a problem that has never been stated.

- (3) The Gordon technique can be highly profitable but highly frustrating since creative people usually, instinctively, strive for leadership when none is provided.

Naturally, when no specific direction towards a specific problem is provided, creative goal-seeking people attempt to establish it.

Fortunately, with only a broad area to discuss, they go in circles around and around, talking about the problem but never getting anywhere.

The profitable thing is that they usually cover aspects which it would never dawn on them to discuss if they did know the specific problem.

This is the power of the technique. It does not allow people to get into a verbal rut.

**b. Selecting the topic.**

The first and most difficult step in is to select a topic for discussion. The subject must be closely related to the problem at hand, but its exact nature must under no circumstances be revealed.

Usually, this subject will be a physical principle which is related to the problem that must be solved.

The following problem situations are examples of how this technique works:

- (1) The problem is one of seeking solutions to the parking problem of a large city, so the group leader might have the group discuss ways to "store things."
- (2) The problem is to design a new roofing system, so the group leader might have the group discuss "enclosures" or "ways things are enclosed."
- (3) The problem is to review procedures for washing windows, so the group leader selects the topic of "removing dirt."

This process may produce some unusual approaches which otherwise may not have been associated with the problem at hand. It is well to remember that these leads are important since they direct you toward the final solution.

## **Checklisting technique**

A checklist is an accumulation of points, areas or possibilities that serve to provide idea-clues or "leads" by checking (or comparing) the items on a prepared list against the problem or subject under consideration.

The objective is to obtain a number of ideas for further follow-up and development.

The checklist is one of the most commonly used aids in the search for new ideas.

Checklists range in type from the specialized to the extremely generalized.

An example of a generalized checklist (developed by the Massachusetts Institute of Technology) is shown by *Figure 24*.

### **a. Keep checklists open-ended.**

The Checklist Technique can be helpful and dangerous.

It can be dangerous unless open-ended.

For instance, the Value Engineering Job Plan is a comprehensive checklist of required VE tasks.

Yet each phase is infinitely open-ended.

One cannot specify in detail each value engineering step within each phase since the individual specific actions vary with the item being value engineered.

Checklists are aimed at solving some specific problem. They help our faulty memory.

They make sure we have checked those steps which have been successfully used to solve that type of problem in the past.

But we must be sure to keep them open-ended. We must be sure that each checklist does not become a sure-fire way to go wrong with confidence.

### **b. Apply the correct checklist.**

Be sure to apply the correct checklist to the

correct problem.

A checklist on how to club bunnies is no good for finding Bunny Clubs.

Of course, VE's most famous checklist is:

What is it?

How might we define the function?

How might we perform the function?

What does that cost?

How else might we perform the function?

What does that cost?

## **The synectics technique**

This is a technique that forces one to talk about the problem in another manner, to use other descriptive words in another form.

Mainly, by using analogies as the mechanisms for making the familiar strange and the strange familiar.

It is the going beyond the common place descriptive terminology of the experts, releasing us from the functional fixedness of every day behavior.

### **a. Personal analogy**

is an individual objective mental concentration which makes you part of a thing you are designing and puts you in the shoes of the idea you are improving.

For instance, imagine yourself as a guard and list the various ways you could redesign yourself to be a better guard at a lower cost.

### **b. Direct analogy**

is an actual comparison of parallel facts which identifies one element with another element of knowledge, function or method; also using one idea for another application as when the inventor used the carpeting process for the idea of developing artificial grass.

### **c. Symbolic analogy**

uses mental images to symbolically represent or allude to something in your memory recorded through your senses that you have seen, heard, smelled, felt, or tasted. Such as "small as a peanut"; "large as a house"; "strong as a horse"; "tall as a tree"; "graceful as a swan".

### **d. Fantasy Analogy**

is sort of a Freudian wish fulfillment. Using a way-out wild idea, optimize to the farthest degree of your imagination.

Let your imagination really SOAR to develop ideas like training some animals to roam the halls of office buildings after midnight to ferret out unauthorized inhabitants.

### BORROW OR ADAPT?

"What else is like this?" - Like the studies of birds made by the aircraft pioneers

"What parallel does the past provide?" - Like what modern dress designers do in devising new creations from ancient art.

"Could other processes be copied?" - Like the Japanese copying nature by sticking grains of sand into oysters so as to produce cultured pearls.

"What other ideas might be adaptable?" - Like Diesel who got his engine ideas from a cigar lighter.

### MINIFY OR LESS SO?

"What if lower?" - Like the recent trend in motor cars.

"Narrower?" - Like brims on now style of men's hats.

"Lighter?" - Like new Talgo railroad cars that weight no more than trailers.

"Streamline?" - Like tank-type vacuum cleaners.

"Condense?" - Like full-size umbrellas that fit into purse.

"Eliminate?" - Like tires without tube.

### COMBINE

How about alloys?" - Like the newest mixtures of synthetic fibers.

"What old Ideas could be merged? - Like window washers that combine\_a brush with a built-in hose.

"Ensembles?" - Like shirts, with neckties and handkerchiefs to match.

"Combine appeals?" - Like drugstores selling blades to those who ask for shaving cream, and vice versa.

"Combine purposes?" - Like Benjamin Franklin did when to avoid changing from one pair of glasses to another, he cut the lenses in two and stuck them together with the reading halves below. Thus, he invented bifocals.

### SUBSTITUTE?

"Other parts?" - Like fluid drive instead of gears on cars.

"Materials?" - Like argon instead of vacuum in electric light

bulbs.

"Other process?" - Like stamping instead of casting.

"Other Power?" - Like using air to run windshield wipers.

"Other way?" - Like the airlift that saved Berlin.

#### REARRANGE?

"Change pattern?" - Like one-way streets.

"Revise layout?" - Like new wrinkles in super markets.

"Alter sequence?" - Like flashbacks in movies.

"Transpose cause and effect?" - Like doctors do in diagnoses.

"Repackage?" - Like the new popcorn that comes in its own popping pan.

Figure 24. Generalized Creativity Checklist  
(Part 1 of 2)

#### PUT TO OTHER USES?

"New way to use as is?" - Like using helicopters to patrol high-tension wires over mountains.

"Other ways if modified?" - Like fishing rods made from fiberglass embedded in plastic.

"What could be made from this?" - Like the wallboard manufacturer who added a lime of jigsaw puzzles.

"How about salvaging?" - Like the rubber maker who found that wasted strips of surgical tubing could be sold as rubber bands.

"What other use could be added?" - Like telephone companies installing transcribed records to furnish correct time and latest weather report.

#### MODIFY OR GIVE A NEW TWIST?

"What other shape?" - like the buggy-maker who tapered the roller bearing which Leonardo da Vinci had invented 400 years before.

"What other form?" - Like detergent powders instead of bars of soap; like liquid soap instead of either.

"How to create a new look?" - Like higher or lower skirt.

"What could color do?" - Like what the automobile industry did to make 1955 the biggest now-car year in history.

"How about motion?" - Like Christmas tree lights that bubble.

MAGNIFY OR MORE SO?

"Longer time?" - Like the baker who featured slow-baked bread.

"Greater frequency?" - Like the doctor who originated the idea of lighter but more frequent meals for ulcer patients.

"Increase strength?" - Like reinforced heels and toes in hosiery.

"Height?" - Like circus clowns on clear plastic stilts.

"Greater width?" - Like the center strip on new thruways.

"Include 'plus' ingredient?" - Like chlorophyll in toothpaste

REVERSE?

"Transpose?" - Like putting engine in rear of bus.

"Down instead of up?" - Like furrier who attaches his label up side down, so it can be read when the coat is over the chair.

"Switch roles?" - Like female executives with male secretaries.

"Up instead of down?" - Like dining room light which throws beam upward from floor to reflector on ceiling.

"Do the opposite?" - Like Howe who perfected his sewing machine by designing a needle with the hole at the bottom instead of at the top.

Figure 24. Generalized Creativity Checklist  
(Part 2 of 2)

## **Morphological analysis technique**

Morphological analysis is a structured comprehensive way to list and examine all of the possible combinations that might be useful in solving a problem.

The steps in morphological analysis are first, define the problem in terms of its parameters; second, develop a model which makes it possible to visualize every possible solution.

If a problem has only two parameters, or variables, the model takes the form of a large rectangle divided into a series of small squares.

The horizontal axis represents one variable and is subdivided into the different forms of this variable.

The vertical axis represents the other variable and is similarly subdivided.

Each small square represents a combination of two versions of the variables.

If the problem had three variables, the model would take the form of a cube or a parallelepiped.

More than three variables can be used, but the technique usually becomes unmanageable by usual paper and pencil techniques.

The technique can be illustrated by approaching the problem of analyzing the possible combinations of windows for a new building.

The three variables might be size (shape), type, and glazing material.

One axis of the cube lists all the different sizes (shapes) that might be considered.

Another axis is subdivided into the different types that the windows might be.

The third axis lists the various materials with which the windows might be glazed.

Each of the possible combinations could be considered in turn.

## **Attribute listing technique**

There are two steps in the attribute listing technique.

The first is to list all of the various characteristics of an object.

The second is to deliberately change or modify these characteristics.

By means of this technique, it is possible to bring together new combinations of characteristics or attributes that will better fulfill some existing need.

### **a. Example 1.**

Consider one type of cast-iron radiator which was common a few years ago.

Its characteristics are multiple Iron tubes, four legs to allow freestanding, high inlet and low outlet, valve for control, 22 to 26-inches high by 4 to 8-inches deep and installed 1 to 2-inches from walls.

Each attribute could be changed as follows:

- (1) Multiple tubes changed to single tube with fins to increase heat transfer.
- (2) Legs eliminated to allow attachment to wall brackets.
- (3) Inlet and outlet placed at same low level.
- (4) Dampers and attractive cover added for control and beauty.
- (5) Height decreased to 10-inches and width to 2-112 inches.
- (6) Installed flush with wall.

### **b. Example 2.**

Consider the standard venetian blind developed years ago.

Its characteristics are multiple horizontal slats, horizontally pivoted for opening and closing, opened and closed by vertical pull on a cord, and stored in use by vertical raising.

Each attribute could be changed as follows:

- (1) Horizontal slats changed to vertical slats.
- (2) Horizontal pivoting changed to vertical pivoting.
- (3) Pulling on a cord changed to twisting on a fiberglass rod.
- (4) Overhead storage through vertical raising changed to side storage by horizontal sliding.

### **The evaluation comparison technique**

This is a forcing technique for developing unique verbal solutions by forming measurable comparison between the elements of dimensions, physical properties, mechanical properties, electrical and magnetic properties, cost considerations and other properties.

*Figure 25* is a Creative/Evaluation by Comparison checklist

### **Large group session techniques**

Following are two techniques useful to develop creative ideas from large audience situations:

#### **a. The Phillips 66 Buzz Session Technique.**

In this technique the audience is divided into a number of groups of six people each.

Within each group a leader and recorder is appointed.

They should be selected and briefed before the meeting.

The problem to be attacked may be announced before the meeting gets started.

Using the group brainstorm method, each group develops creative alternatives and after a period of time and a signal from the leader, each group stops producing ideas and starts evaluating the ideas and selecting and adopting

the best solution.

The leader of each group is called upon to present the ideas produced and selected by the group to the entire audience.

The multiplicity of excellent and diversified ideas makes an excellent large group-convincing creative demonstration.

**b. The Crawford Slip-Writing Technique.**

This technique is a form of individual brainstorming.

The advantage of this technique is that it provides many ideas for a wide range of different problems in one session in a short period of time.

Each person in a large audience is given a colored slip of paper upon which he is asked to write down his ideas relating to the slated problem.

A different color paper is used for each problem. The slips are collected to be evaluated later.

**Using idea  
stimulators**

When the flow and development of ideas seems to be slowing down during use of one of the creative solving-problem techniques the use of idea stimulators can then be forced into play.

## DIMENSION

Size	Volume
Shape	Perpendicularity
Geometry	Parallelism
Configuration	Circumference
Height	Complexity
Length	Simplicity
Depth	Angularity
Width	Area
Breadth	Proportions
	Amplitude

## PHISICAL PROPERTIES

Weight	Taste
Density	Appearance
Thermal conductivity	Radiation effect
Boiling point	Wet-ability
Freezing point	Porosity
Melting point	Bonding
Shrinkage	Cementability
Corrosion resistance	Chemical stability
Alkalinity	Reflectivity
Acidity	Absorptivity
Inertness	Water absorption
Color	Impurities
Smell	Viscosity
Texture	Temperature
Feel	Hardness

## MECHANICAL PROPERTIES

Compressibility	Damping
Elongation	Wear resistance
Tensile strength	Formability
Elasticity	Moldability
Compressive strength	Machinability
Shear strength	Flexibility
Creep strength	Impact Strength
Ductility	Stiffness
Hardness	Resilience
Fatigue strength	Toughness

## ELECTRIC AND MAGNETIC PROPERTIES

Resistance	Permeability
Capacity	Coercive force
Power factor	Residual flux
Conductivity	Core loss
Dielectric constant	Inductance
Dielectric strength	Field strength
Arc resistance	

## COST CONSIDERATIONS

Time	Led time
Location	Surface finish
Place	Tooling
Material	Work-in-process
Quality	Mechanization
Reliability	Direct labor
Flexibility	Setup time
	Training
Standards	Tolerance
Factor of safety	

## OTHER

Sound	Velocity
Light	Acceleration
Heat	Jerk
Power	Process
Energy	Specification
Force	Environment
Action	Customer
Position	

Figure 25. Creative/Evaluation by Comparison Checklist

## Summary

Creative problem solving techniques are the tools an individual can use to expand his creative ability.

Creative techniques are forcing techniques.

They are techniques to empty the mind of habitual responses and force one to use words he would not habitually use to talk about the situation differently.

Up to a point the human mind is greater than the most elaborate computer.

It can store an almost infinite number of data, but regrettably, it can only process and integrate up to about seven bits of these data simultaneously.

Because of our mind's limitation, we find the following rules helpful in applying either the analytical or creative approach to problem solving and developing greater creative ability  
*See Figure 26:*

- Establish specific time and place for creative thinking.
- Set a deadline or quotas for creative ability.
- Write down ideas as they occur.
- Run over the elements of the problem several times.
- Take notes on observations.
- Suspend judgment. Don't jump to or be led into false conclusions.
- Rearrange the elements of the problem. Get a new viewpoint.
- Take or break when you are stuck.
- Discuss your problem with others. Let it incubate.

Figure 26. A Guide to Expanding Creative Ability