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A Review of Creativity and Problem Solving Techniques

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Here is a catalogue of twenty operational techniques that can serve as a starting point for selecting particular methods for specific needs.

The purpose of this paper is to serve as a quick reference or catalog of operational techniques for stimulating the generation of creative ideas. The reader should note that although the techniques reviewed here can be expected to assist in the generation of embryonic ideas, these techniques must be viewed as only one of several important considerations in the design of a total innovation system. For best results, the techniques need to be combined with organizational methods which provide the necessary care, feeding, and implementation of embryonic ideas (*27, 31*).

There are, of course, no formulae for obtaining the right amounts of creativity under various conditions and circumstances. This is due in part to the multitude of factors which can influence the creative process and the dynamic nature of such factors. However, experience (*2, 17, 21, 25*) suggests that the latent creative potentials of many individuals are often blocked by various perceptual, cultural and emotional factors. There are also many organizational factors that influence creativity. These are described elsewhere, e.g., see (*27*) and (*29*). One possible means for unlocking these latent potentials is to utilize some type of "operational" creativity technique which aids in circumventing the blockages. Operational techniques are used to mass-produce ideas, as opposed to educational techniques, which are designed to make people more aware of their creative powers. For examples, see (*25*). This paper critically reviews a total of twenty operational techniques which the authors feel are among the most effective. Table 4 summarizes the major attributes of the techniques.

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Brainstorming

Brainstorming is perhaps the best known operational technique for idea generation (*6, 8, 14*). It is an intentionally uninhibited technique that is most frequently used by groups, but has also been successfully employed by individuals. The objective is to generate, in a classroom type setting, the greatest number of alternative ideas from uninhibited responses. Nothing is rejected or criticized. Any attempt to analyze, reject or evaluate ideas is prohibited during the brainstorming process. However, all ideas are written down for subsequent evaluation and development. The brainstorming session is usually carried out under a time constraint, e.g., develop as many ideas as possible in five minutes. In order to have effective brainstorming, Osborn (*17*) suggests the following "rules" be imposed: judicial judgment (critical evaluation) is ruled out; free-wheeling is welcomed; quantity (not quality) of ideas is the objective; combinations and improvements are sought. Brainstorming thus appears to be most effective when applied to specific rather than general problems. The problem should be limited, simple, open-ended, talkable, and familiar. Also, problems having only one correct solution and/or only a few sensible alternatives do not lend themselves well to brainstorming.

Most authorities feel that group brainstorming is more productive than individual brainstorming (*35,40*). The group brainstorming setting is usually a lively session. Participants eagerly shout out and verbally submit suggestions that are catalyzed and/or build on other ideas that are suggested. Thus, a chain of ideas can often cascade into unique items. Ingenious creations can be brought into existence as the direct result of the mutual support and encouragement of the group. In this regard, Von Fange (*40, 41*) lists the following reasons why group brainstorming is effective: no one stops to evaluate the ideas that are presented; in the absence of evaluation, no one feels restricted or inhibited; competition evolves from the receptivity of the ideas; praise and encouragement stimulate even greater attainment; idea-finding takes place on what has gone before. However, experience with groups also shows that repression and specious persuasion can lock out some "wallflower" types of personalities, who might otherwise have creative contributions to make if they were placed in a more quiet setting. For this reason, cycled individual and group brainstorming sessions have been developed. There is some experience which shows that these cycled settings are superior to either individual or group settings (*29, 30, 32*).

Reverse Brainstorming (Tear-Down, Purge)

"Reverse" brainstorming (sometimes called the tear-down or purge method) may be useful prior to a brainstorming session, or in conjunction with other methods. (*38*) It consists of being critical instead of suspending judgment. This initial attack effort is sometimes necessary to pave the way for serious efforts at innovative thinking. Reverse brainstorming prepares one to deliberately go outside the situation to generate so called "idea hooks" — new viewpoints that are often quite remote from the actual situation. A typical approach would be to first list all the things wrong with the operation, process, system, or product. Then, one would systematically take each flaw uncovered and suggest ways of overcoming, improving or correcting it (*4, 6, 8, 25*). Care must be exercised to insure that the negative ambience of a tear-down session does not completely overrule a group's optimism.

Synectics

Synectics is a technique that has been developed and modified by Gordon, (*11*) Prince, (*22*) and others (*9*). It operates like a mental pinball game. Creative solutions to a specific problem are sought through the two-stage process outlined in Figure 1. In the first stage, participants consciously reverse the order of things and "make the strange familiar," through analysis, generalization, and model-seeking. In the second stage, an attempt is made to "make the familiar strange," through personal analogy, direct analogy, symbolic analogy, and fantasy analogy (*21, 31*).

A Synectics session is a lively and dynamic maneuver in which rational or obvious solutions are abandoned for what might seem irrelevant or bizarre approaches. Participants act like flints, igniting sparks in other members with their "off-beat" approaches. The intermittent involvement and detachment brought about by the analogies is subsequently culminated in a "force fit" to the original problem (Figure 1). Through the strain of this new fit, the problem is stretched, pulled and re-focused in order that it may be seen in a new way. A force-fit suggests new contexts and thus provides the raw material for new lines of speculation (*8, 21, 22, 23, 24, 43*).

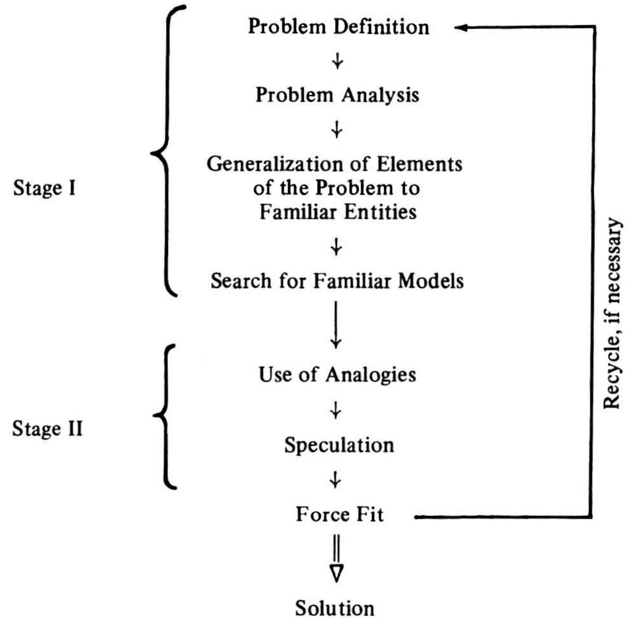

Figure 1/The Synectics Process.

Prince gives an excellent example (see [*21*], pp. 128–137) of the use of Synectics to develop a bottle closure device. The problem was defined as: "to devise a thermos bottle with an integral closure." The generalization of elements of the problem to familiar entities (stage I, Figure 1) focused the group discussions around the concepts of "tightness" and "effectiveness of closure." The discussions generated several familiar examples of tight, effective closures, such as a clam's shell. The search for familiar models (stage I, Figure 1) swung the discussion to the concept of plastic closure, and the iris of the human eye as an example of a familiar model of an "integral closure." The group then used elements of personal, symbolic and fantasy analogy (stage II, Figure 1) to speculate on the exact functioning of the iris and to apply this awareness to the thermos bottle problem. A force fit exercise was then undertaken, in which the group was directed to focus on the use of their awareness of the human iris to devise an integral plastic closure. From this exercise, the group suggested a thermos bottle with a rubber sleeve that would close as the top was twisted. One participant developed the key thought: "it's like twisting a long balloon at both ends; if you twist the ends in different directions, you close down the middle" (paraphrased from [*21*], p. 136).

Gordon Method

The Gordon method is a technique for generating new viewpoints (idea hooks). It is used with a small group who is not initially made aware of the exact nature of the actual problem (*12*). The intent is to minimize preconceived ideas and habit patterns, so as to avoid a premature solution from being reached before there has been a thorough discussion of the general problem area. The Gordon method forces an unencumbered initial discussion that avoids the danger of a participant becoming so infatuated with his own solution that he ceases to be an effective contributing member. It also avoids inhibitions and/or prejudices that group members may bring to the problem that would adversely affect their performance (*11*).

The session leader, who is the only one knowing the actual problem, gets the group to think out loud about a related subject. For example, if the problem were to invent a new toy for a toy manufacturer, the leader might choose the topic play for discussion. He would first focus the discussion on aspects somewhat remote from the actual problem, then on aspects closer to it, and finally on aspects very close to the actual problem. At the end of these discussions, the problem is revealed to the group and then analyze the tape recording of their discussions for possible idea hooks. Each idea hook is then brainstormed (or some other operational creativity method is used) to develop a solution to the actual problem.

Experience suggests (*31*) that the method works best with a diverse group of persons who are not experts. Moreover, best results seem to be obtained when the group contains some persons whose skills will be required for implementing the solution. One obvious limitation of the Gordon method is that the group leader may be the only participant doing relevant creative thinking. Thus, a great deal depends upon his innate ability to recognize a possibility when it is brought up in a discussion (*14*, *25*).

Checklist Method

In this method, the problem is analyzed against a prepared list of challenges until an idea hook is sparked. Following are a few selected examples of checklists. Osborn: How can we modify, magnify, minify, substitute, rearrange, reverse or combine it (*17*). Reise: How can we make it look like something else, animate it, take it literally, make it a parody or imitation (*24*). Mortimer: How can we give it convenience of form, time, place, quantity, packaging, readiness, combination, automation, selection (*16*). Flesch: What am I trying to accomplish? Have I done this before? How? Could I do it another way? What if I do the opposite? What if I do nothing (*7*)? Von Fange: What about shape, size? What if reversed, inside out, upside down? What else can it do? What can be left out? What if carried to extremes? Can it be safer? Can it be cheaper (*39*)? From the nature of these lists, it is apparent that checklists work best when applied to familiar problems or things.

Attribute Listing Method

This approach is a variation on the checklist method which is suitable for improving tangible objects. The properties, basic qualities, or attributes of a product are listed. This list is then reviewed, one attribute at a time, with a view toward improving each attribute. For example, consider how the attributes of the common picture frame might be modified by applying this method (*34*). Rectangular shape: Could be round, oval, trapezoidal, three-dimensional, continuous. Covered with glass: Why not lucite, plastic film, nothing, a drawn shade? Wooden frame: How about extruded aluminum, plastic, no frame, built-in frame? Opens from back: Why not a slot in top or side, hinge it to open from front, no opening at all, seal completely? Hangs by wire: Could use suction cups, magnetic holder, hooks over a ledge.

The virtue of attribute listing is that it causes an immediate focus on the basic product or problem. It is not based upon a historical accumulation of checkpoints, but rather upon an individual analysis of the product or problem in question (*5*, *6*, *14*).

Input-Output Technique

The input-output technique is a method for solving dynamic system design problems. General Electric (*13*) is credited with the development of this scheme, which proceeds by defining the problem in terms of system inputs, outputs and limiting requirements. Then, ways to bridge the gap between inputs and outputs is sought. The object is to produce a number of possible solutions which can then be tested, evaluated, and developed.

As an example, consider the problem of designing a device to automatically shade a room during bright sunlight (*41*). The input could be: solar energy (light and heat). The output could be: making windows alternately opaque and transparent. The specifications could be: must be usable on various sized windows, must admit not more than 20 foot-candles of illumination anywhere in the room, must not cost more than $100 per 40 square foot of window. The input-output procedure would then continue as follows (*13*). Step 1: What phenomena respond to the application of heat? Light? Step 2: Can any of these phenomena be used directly to shade the window? Step 3: What phenomena respond to Step 1 outputs? Step 4:

Can any of these phenomena be used directly to shade the window? Step 5: What phenomena respond to the Step 3 output? (It must be noted that the most direct path from input to desired output is not always the most economical.) General Electric has found that, given a little practice, this technique is efficient and effective for the solution of design problems (*13*).

Like attribute listing, the input-output technique is based on an analysis of the problem in question. Unlike attribute listing, this technique concentrates on the job to be done. Thus, it seems to be best suited for discovering new or alternative ways to accomplish some desired end (*27,31*).

Buffalo Method

The title of this technique refers to the method developed at the University of Buffalo by S. J. Parnes (*18*) and others (*19*) in their creativity training program. In this method, a total approach to problem solving is used. It begins with a difficult and/or complex problem, then proceeds through four major steps: (1) fact-finding; (2) problem-finding; (3) idea-finding; and (4) solution finding. The procedure also includes steps which are relevant in a social or business setting: acceptance finding, and applying the total process. As in some other methods, the actual route from beginning to end is apt to be disorganized. Feedback, iteration and guidance are essential to success with this approach. The limitation of the approach is its nearly completely dependence upon the quality of leadership and training provided.

Free Association

Free association is a method of stimulating the imagination to some constructive purpose. The objective of this approach is to produce new combinations, intangible ideas, designs, names, etc. The general approach is to first jot down a symbol — a word, sketch, number, picture — which is related to some important aspect of the problem or subject under consideration. Then, jot down another symbol suggested by the first one. Repeat; ad lib until ideas emerge. This technique can be used effectively by individuals or groups, with ideas "feeding" upon one another, often resulting in imaginative outputs (*6, 25, 34*).

Forced Relationship

This is a technique which has essentially the same basic purpose as free association. But it attempts to force associations by the following five-step process (*42*). First, isolate the elements and possible forms of the problem at hand. Second, find the relationships between/among these elements and forms (e.g., similarities, differences, analogies, causes and effects). Third, record the relationships in an organized fashion. Fourth, analyze the record of relationships to find ideas or patterns. Finally, develop new ideas from these patterns. As an example, Table 1 illustrates a forced-relationship analysis of the elements "paper" and "soap." The forced relationship technique may be used by itself, or in combination with the Buffalo method and others (*14, 34*).

Table 1/*Illustration of the Forced Relationships Technique [Adapted from Taylor (34)].*

Elements: Paper and Soap		
Forms	**Relationship/Combination**	**Idea/Pattern**
Adjective	Papery soap	Flakes
	Soapy paper	Wash and dry travel aid
Noun	Paper soaps	Tough paper impregnated with soap and usable for washing surfaces.
Verb-correlates	Soaped papers	Booklets of soap leaves
	Soap "wets" paper	In coating and impregnation processes.
	Soap "cleans" paper	Suggests wallpaper cleaner.

Collective Notebook (CNB) Method

In the CNB method (*14*) each participant receives a notebook in which is printed a problem of major scope and a very broad-front presentation of preparative material, including a variety of suggested training aids. Each participant independently records daily in this notebook his thoughts and ideas on the problem for a period of a month. Each then summarizes what he feels are his best ideas on the problem, his suggestions for fruitful directions to explore, and other ideas aside from the main problem. The notebooks are then given to a coordinator (who must be creative-minded and skilled in organizing and summarizing material) who prepares a detailed summary of all the notebooks. These summaries are then discussed by all the parties in a final creative discussion, in which brainstorming, Synectics, etc. techniques may be used. This technique enables a number of individual, independent and open-ended ideas to be developed and documented, which then benefit from a group evaluation. This format — an individual, independent ideational period lasting over a one-month time span, followed by a group evaluation and collective thought exercise — has been found to be superior to other behavioral formats for conducting creativity sessions (*29, 30, 32*). However, the obvious dependence on the major role of the coordinator is probably the most significant limitation of the CNB method.

Bionics

From its very name, Bionics, one realizes that this approach is somehow related to living organisms. In the bionics approach, one asks the question, How is this (the problem, phenomena, etc.) done in nature? Proponents of this technique contend that nature's scheme of things is revealed to those who search. Although often listed as a separate technique, bionics is probably best used at the "Use of Analogies" stage of the Synectics process (Figure 1) (*10, 38*).

Morphological Analysis

Morphological analysis is a comprehensive way to list and examine all of the possible combinations that might be useful in solving a given problem (*1*). These combinations may then be subsequently tested, verified, modified, evaluated and developed (*25, 34*). An example is presented in Table 2. The problem was to develop a low cost, fully portable, high validity color TV receiver. The four circuits (tuner, picture, sound and color) could each be achieved in three ways: using all tubes, using all IC's, using all LSIC's. However, at the time this problem arose, it was expected that the IC tuner and sound devices would not be perfected for another two years, and the LSIC tuner, picture and color devices would not be perfected for another five years. As the "analyses" section of Table 2 shows, a compromise product had to be specified until the technology could be developed. The manufacturer entered the market with a less-than-ideal product, to be updated with a new model at a later time. It should be noted that morphological analysis methods have been used to identify emerging technologies and to forecast technical needs, e.g., the analyses in Table 2 point out the need for LSIC's.

Table 2/*Example of Morphological Analysis.*

	Could be performed using either:		
	Tubes or	IC's or	LSIC's
Function	Types:	Time frame:	Time frame:
Tuner	Pentodes	2 yrs.	5 yrs.
Picture	Pentodes	Now	5 yrs.
Sound	Pentodes	2 yrs.	Now
Color	Triodes	Now	2 yrs.

Analyses:

Lowest cost	=	Pentode Tuner + IC Picture + Pentode Sound + Triode Color
Lowest weight	=	all LSIC's (5 years away)
Best validity	=	all LSIC's (5 years away)
Compromise	=	Pentode Tuner + IC Picture + LSIC Sound + IC Color

Inspired (Big Dream) Approach

This technique is sometimes referred to as a breakthrough approach which can lead to spectacular advancements (*6, 34*). It predicates itself on the premise of think-big. The procedure is: think the biggest dream possible. Then, read, study, and think about every subject connected with your big dream. Finally, drop down a dream or so; then engineer your dream into reality (*34*). The objective is to make the greatest possible achievement (*6*).

		MODIFICATIONS								
Sequence/Attribute Description	Item No.	Eliminate A	Substitute B	Rearrange C	Combine D	Reverse E	Enlarge F	Reduce G	Modify H	Separate I
Heat Steel Slag to Pliable State	1							X		
Transfer from Heating Furnace	2									
Position Rolls to Desired Setting	3			X	X					
Pass Slab Through Rolls (Elongate)	4			X	X					
Check Slag Gauge	5					X				
Shear Slab to Desired Length	6	X								
Transfer Sheared Product	7							X		

Key: X = possible priority items that can be modified, combined, etc.

Figure 2/SAMM Illustration

Sequence-Attribute/Modifications Matrix (SAMM) Approach

The SAMM approach (*3*) is most applicable to sequential situations where step-by-step activities can be listed logically, described briefly and explored for possible creative modifications. An illustration of the SAMM technique is provided in Figure 2, using an actual hot steel slab rolling operation. The operating sequence of activities listed along the left-hand side of the matrix is examined for possible modifications. In the matrix in Figure 2, the analyst has identified (with an "X") several priority areas to look into. For instance, he has noted that the positioning and passing sequences (items 3 and 4) can possibly be combined and rearranged. The SAMM matrix does not describe how this is to be done; it simply identifies the areas. A number of other operational mechanisms, e.g., brainstorming, analogies, etc., can then be employed in the subsequent evaluations. This technique seems to have proven more effective in group settings than in individual settings (*3, 34*).

Kepner-Tregoe Method

This method is particularly suited for isolating or finding the problem, and then deciding what to do about it. A systematic outline is made to precisely describe the problem, what lies outside the problem and what is closely related to it. An example is shown in Table 3. This outline then reveals the possible causes of the problem, and facilitates decision-making (*33*). Clearly, the technique is geared more to creative problem solving than to far-out ideation.

Table 3/*Example of Kepner-Tregoe Method.*

	Is	Is Not
WHAT		
Deviation:	Carbon Deposit	Blackening
Object:	Filament from Machine A	Other filaments
WHERE		
On object:	On surface	In filament materials
Observed	On Machine A	On other filaments
WHEN		
On object:	After filament is formed	Before filament is formed
Observed:	In trough at 3:50	Before 3:50 P.M.
EXTENT		
How much:	Heavy	Slight
How many:	All Machine A filaments	Machine B filaments

Value Analysis

Value analysis is a specialized application of creative problem-solving which may be used to increase the value of a product, process, object, etc. It may be defined as an objective, systematic, and formalized method of performing a job to achieve the necessary functions at minimum cost. To use the value analysis process, one asks the following questions concerning each part (*15*): What is it? What must it do? What does it do? What did it cost? What else will do the job? What will that cost? This approach tends to reward the logical thought process. It is very effective in applied areas, e.g., engineering development work (*40*).

Scientific Method

Many scientists today do not agree that there is one best scientific method (*10*). However, the following general approach is by now regarded as traditional: define the problem; analyze the problem gather data to solve the problem; analyze the data; arrive at potential solutions; test these solutions; select the best one. Clearly, this methodology can serve as a guideline for creative inquiry. The problem analysis and solution testing steps provide opportunities for applying some of the afore-mentioned creativity techniques, e.g., Synectics, etc.

Heuristics

Heuristics are methods of demonstration and rules of thumb which tend to lead a person to investigate further. Some operational techniques based upon heuristics are: the techniques of close comparison of neighbors and similar cases the examination of the simplest (naive) case; the examination of special cases; the search for a modified structure to which a rule applies (*14*). Heuristics are best suited for the detection of useful preparative material and problem elaboration. Some suggested heuristics are summarized by Polya (*20*).

Edisonian Method

The Edisonian method is an approach consisting principally of performing a virtually endless number of trial-and-error experiments (*34*). It is often considered to be a last-ditch approach, resorted to only when more systematic methods have failed to produce the desired results. But it is also useful when one is delving into the unknown (*40, 41*), e.g., for exploratory work.

Managing a Group Creativity Session

Successful scientists and engineers are often their own worst enemies in a creativity setting. Their training and prior successes compel them to blot out things that seem silly, or that smack of irrational thinking and fanciful excursions. Yet, these are the very practices that lead one down new alleys and passages that may culminate in creative new solutions. Participants in group ideation sessions are often surprised to listen to their own negativeness in tapes of their sessions. It seems a

Table 4/*Summary of Operational Techniques and Experiences With Them.*

Problem/Situation Nature	Output or Result Desired	Appropriate Operational Technique	Comments and Experiences
1. Problem is open-ended; Problem is well-defined; Simple solution is sought; Problem is easily understood; Problem has more than one acceptable solution; Participants are able and willing to freewheel and emphasize the positive.	One or more simple, feasible, creative solutions to a well-defined problem that is well understood.	Brainstorming Free Association Heuristics	Methods are often restricted by biases and social inhibitions of one or more participants.
2. Problem is open-ended; Problem is ill-defined; Simple solution is sought; Problem is not well understood; Problem has more than one acceptable solution; Participants are initially unable to freewheel and unable to emphasize the positive.	Analysis of faults, failure modes, things to be corrected in an area that may be incompletely understood.	Reverse Brainstorming Edisonian Method Kepner-Tregoe Method	Methods are often useful starting points for other methods.
3. Problem is open-ended; Problem is fairly well-defined; A complex illogical solution may be sought; Problem is fairly well understood; Problem has one best solution; Participants are able to emphasize the bizarre, analogize and emphasize the positive.	A "far-out" solution, that may be toned down if desired.	Synectics Bionics Inspired (Big Dream) Approach Gordon Method Buffalo Method	These methods require skilled and trained participants for complete success; methods are good for areas where the technology is ill-defined.
4. Problem may not be open-ended; Problem is fairly well-defined; Problem is not well understood; Problem has many acceptable solutions; Participants are able to work in the abstract.	A solution that cannot be visualized, conceptualized or described before the sessions; the elaboration of concepts; dimensions or ideas for further refinement.	Gordon Method Inspired (Big Dream) Approach Synectics	Methods are fully dependent upon the skill of the leader; methods can be good where the technology is ill-defined; methods are good where participants would otherwise rush toward an obvious solution.
5. Problem need not be open-ended; Problem is well-defined; Problem is well-understood; Problem has several acceptable solutions, but one best solution; Participants are able to visualize combinations and attributes; Attributes are well-defined; Combinations and variations are meaningful.	New combinations, forms, shapes or means.	Checklists Attribute Listing Morphological Analysis Forced Relationships Input-Output Technique	Methods are limited by ability of participants to visualize combinations; methods work best in well-defined state-of-art technologies.
6. Problem may be either open or closed-ended; Problem is well-defined; Simple, logical, solution is sought; One best solution is desired; The technology or discipline being studied is well-known; a logical process may be followed to reach a solution; An algorithmic approach may be taken to solution.	A far-out solution is not desired; the bits and pieces of the problem are laying around, waiting to be properly assembled.	Input-Output Technique Buffalo Method CNB (Collective Notebook Method) SAMM (Sequence-Attribute/ Modifications Matrix) Value Engineering Scientific Method Heuristics Kepner-Tregoe Method	Methods require that some participants be highly knowledgeable about the technology/discipline under study; group must be heterogeneous (some creative thinkers, some resident experts, some confronters); methods may be good starting points for other methods, e.g., may be followed by synectics, Gordon method or brainstorming.
7. Problem is closed-ended; Problem is well-defined; A best, logical solution is desired; An engineered solution that can be immediately put into effect is desired; The technology or discipline being studied is highly refined.	Only incremental changes are sought, e.g., a change in form, type or process.	Buffalo Method CNB (Collective Notebook) Method Value Engineering Scientific Method	Methods normally yield success here because the problem is well-defined and there is little uncertainty in recognizing an acceptable solution.

common trait to pay lip service to openness, and yet to rebuff new ideas. Thus, it is not unusual for participants to feel that group creativity sessions are boring and useless. The group often doesn't come to grips with the real problem, spends most of the time arguing about the problem definition, and generates criticisms of the ideas that do arise. This effectively shuts off further ideation, and only bland ideas emerge. The individuals may go away feeling that they could have done better on their own. Yet, it has become clear that group settings can provide essential stimuli to creativity (*29, 30, 31, 32*).

In order to achieve best results, the creativity group should be properly constituted, structured, and guided. Experiences (*31*) indicate that the group should consist of at least one resident expert in the technology being discussed, one persuader, one confronter, one helper, and one dreamer. The resident expert supplies the depth of technological knowledge. The persuader is a friendly personality type who persistently persuades the group to accept ideas and approaches on the basis of their inherent logicalness. The confronter is the bull-nosed personality type who won't let anything remain hidden under the rug. The dreamer supplies the far-out fanciful inputs. The helper maintains the group process — by periodically rephrasing and summarizing the work of the group and by smoothing ruffled feelings as needed. The presence of each personality type in the group adds essential ingredients; each offsets and complements the other. Naturally, the selection of these personality types can be an involved trial and error process. However, there are several instruments that can assist in their selection (*30*).

In addition to the above members, a process leader and a client should be present. These persons are not group members; they are outside helpers. The process leader is the expert on dealing with and guiding groups. He formulates the meeting plan and sets the frame-work for the operation of the group process. He gives the group corrective steerage and feedbacks on whether or not they are being too confrontive, too passive, etc. The client is the person who will use the groups' outputs. He supplies factual knowledge to the participants, and provides the criteria for judging the "goodness" of the ideas which the group generates (*30, 31*).

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