Needed Research in Creativity for Business and Industrial Applications

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In an article entitled "Research in Creative Problem-Solving Training in Business and Industry" (Basadur, 1982), I described both how I had learned to apply creative problem solving methodology on an ongoing basis in a large industrial organization and the research that work had spawned. As the application of processes and techniques of creative problem solving penetrated throughout this organization, opportunities for further research began to emerge. The organization became a laboratory of its own, consisting of real people learning to apply creative processes in ongoing everyday business and technical situations. Since that time, my "laboratory" has grown much larger, extending to many varied organizations. New knowledge has been gained and many new questions raised.

A trained practitioner can be of great help to any organization in a variety of creative problem-solving applications. The design of each application opportunity must be developed uniquely and creatively. A thorough consulting diagnosis involving the client(s) and the practitioner is required to develop an appropriate creative plan. The plan includes the selection, development and sequence of creativity techniques to be used. It may include pre-meeting work. It always includes provisions for post meeting action planning and follow-up.

The first part of this paper describes some aspects of implementing and consulting in small group creativity. Specific different types of applications and techniques that I have found successful are identified. Also described is an original piece of research that provides evidence that creativity training does work. It also provides some theoretical models of how it may work in an organization. The research is a field experiment indicating that training in a complete process of creative problem solving can improve attitudes and behaviors associated with creativity.

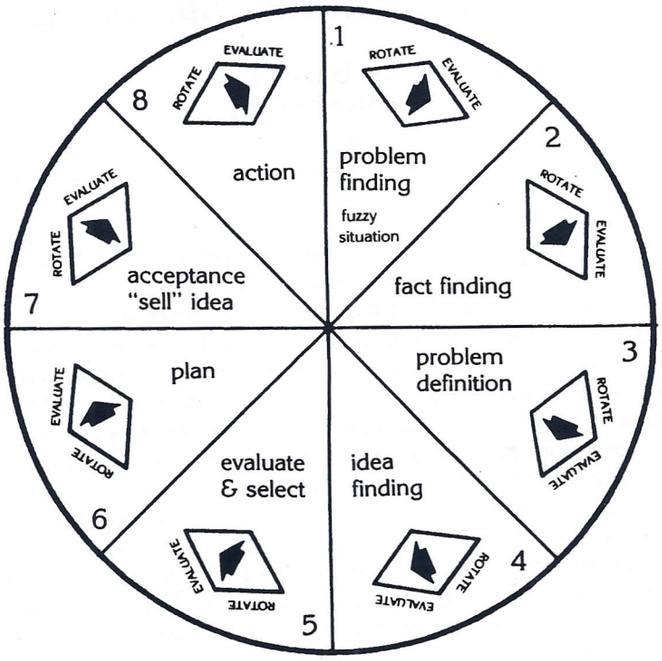
The second part of this chapter reviews six broad issues relating to practical concerns of using creative problem solving in organizations. Some research findings are shared and directions for future research are suggested.

PART ONE

I have long felt that the success I achieved in my career in new product development and product management had less to do with my formal engineering training than with other skills. These include such things as an ability to get things done, to initiate new ideas and projects, and to "keep many balls in the air" at once. I usually felt quite comfortable with the ambiguity of unstructured situations, and found the many differing aspects, both technical and non-technical, of any particular problem or question stimulating. This led to the realization that I had in some way acquired or developed a set of divergent thinking and feeling qualities in addition to the standard qualities emphasized in engineering school. Many of these thoughts and feelings were confirmed for me during my first exposure to creativity in a formal sense

Figure One.

Complete Process of Creative Problem Solving: Simplex.



at the Creative Problem-Solving Institute at Buffalo, New York in 1971. The week had a dramatic effect on me, and upon my return to work, I resolved to begin developing and implementing creative processes and concepts more deliberately in myself and within the large corporation where I was employed.

My first two steps were to (1) announce informally to the company's R & D community that I was available as a part-time consultant to try to help people or teams solve real world technical problems, and (2) begin using a model of the creative process deliberately and systematically on my own laboratory projects both alone and in conjunction with teams of peers and subordinates. Many of these applications proved quite successful in moving all kinds of projects ahead. These applications included developing new ideas for patentable products, circumventing process patents held by competitors, and meeting test market and national expansion deadlines.

A particular approach to creative problem solving began to evolve and prove itself very useful. The model is called *Simplex* (see Figure One).

Each step of the Simplex approach contains a divergent thinking component followed by a convergent thinking component. This is termed the two-step "ideation-evaluation" pro-

cess. Ideation is defined as the generation of ideas, information, and opinions without evaluation. Evaluation is defined as generation of judgments relating to these ideas, and performs a filtering function, selecting out the more important ideas. The model is circular, indicating problems once solved merely create new opportunities and challenges, and many problems require an iterative attack.

My consulting process began to evolve into a pattern. The pre-consultation period was the key. The client (the person owning the problem), would meet with me to plan the creative meeting. During this planning meeting I would familiarize the client with the Simplex model including the ideation-evaluation principle. Then we would use the model for the planning process, beginning with the first step. Treating the client's apparent objective as a "fuzzy situation" would allow me to ask fact-finding questions (step two) and to develop a specific meeting objective (problem definition, step three). Often the final meeting objective would turn out to be quite different and more insightful from the one held by the client originally. I soon realized the importance of these first three diagnostic steps for the success of the process. From this base, the client and I would then generate some ideas (step four) of how to best organize the upcoming creative meeting, what specific techniques to employ, and whether or not to ask the group to repeat the first three steps. This is important to consider. The client and I needed to decide whether it would be best for the group to develop their own problem definition or to continue directly with generating solutions (step four). Except in the most straightforward of problems, it is almost always vital to begin in step one again. It is also possible that we would decide that the session should begin in step five (evaluation and selection of alternative solutions) or in any of the following steps. This would depend on the project's development to date.

The client and I also would determine at this time who should participate and where the meeting would be held. I prefer an off-site location to remove the participants from familiar surroundings and increase the probability of novel output. Attendees are notified by a letter inviting their participation. The criteria for selecting participants is based on contribution potential and, where appropriate, team building considerations. Also desirable is the right blend of technical knowledge and "blissful ignorance." This blend allows fresh viewpoints and a certain novel perspective on the problem. The invitation letter always provides a statement of the objective of the meeting, and may also provide some simple imaginative prework to be brought to the meeting. Such prework provides a starting point for ideas, and allows participants to incubate on the problem ahead of the meeting time. The pre-meeting period is usually one to three weeks.

As time went on, the consulting sessions began to "spill over" from R & D to other corporate functions such as engineering, marketing, advertising, and confidential personnel problems. The marketing and advertising problems ranged from complex name brand strategy formulation sessions to more simple brand promotion and new brand name idea-generation sessions. The personnel problems ranged from "how to make our team more effective" to "what to do with a 20-year employee who no longer seems to be productive" or "is no longer seen as fitting in with new and evolving organizational directions and needs." The engineering problems ranged from "how to attach the string to the tampon in the most efficient way" to "how to map out a strategy for a staff engineering group to help line engineering groups improve their cost improvement programs."

The complex brand strategy meetings often ran two days or more in length and primarily focused on the fact-finding and problem definition steps of the Simplex process. They almost always involved representatives of a complete team such as product development, the advertising agency, marketing, packaging development, and sales. In strategy formulation work, it was much more important to determine the best problem definition, that is the *question* to be considered, rather than the subsequent solutions and actions. Since each functional group had its own insular point of view to contribute, it was vital to get all of these views represented.

The less complex, more straight forward brand promotion and new brand name idea generation meetings often ran shorter, about three to six hours. Simple brainstorming was a very effective tool for predetermined specific challenges. An example of such a challenge would be, "how might we entice more New Yorkers to get excited about purchasing Oxydol?" Each small group (six to seven people) would be asked to pause every 40 minutes or so to evaluate their ideas up to that point and report their best five or so. At the end of the session the "very best" of the best would be selected by the participants. An action plan, specifically detailing who would do what came out of every meeting to ensure that action (step eight of Figure One) would take place.

The work on generating new brand names evolved the following theory and practice. New brand names for products were found to range on a spectrum as follows:

Highly Descriptive Names	**Secondary Meaning Names**	**Fabricated Names**
Mellow Yellow (soda) (soda)	Escort (car)	Crisco (shortening)
Head & Shoulders (anti-dandruff shampoo)	Downy (fabric softener)	Prell (shampoo)

Simple brainstorming for new brand names was found to lead to a long list of "highly descriptive" names. Highly descriptive names were easily imitated by other companies and were sometimes found wanting in this respect. Imagery techniques were found an excellent way of obtaining "secondary meaning" names. For example, imaging various scenes of refreshment might give rise to a "sea coast" analogy concept which might (and did) lead to the brand name "Coast" for a new "refreshment" bar soap.

The third kind, "fabricated" names, are often the ones most highly desired because they are the most difficult to copy by competitive companies. Here a variation of the "forced relationships" technique of idea generation was found highly effective. "Headline" words pertaining to the product's important properties or benefits or qualities (e.g., softness, absorbency, etc.) are listed across the top of newsprint pages. Participants write in words under each headline which they associate with that quality or benefit. Then participants take two or more columns of these words and start forcing syllables or other parts of words together to form nonsense words. For example:

	Benefit: Soft	**Benefit: Absorb**
Associated words:	Fluffy	Soak
	Pillowy	Slurp
	Mushy	Drain
	Gentle	Inhale
	etc.	etc.

Forcing pieces of the words above together might produce names such as Sopil, Pip, Sluffy, Pif, Drillo, Gain, Murain, Slush, etc. Forcing together portions of words like "Crisp" and "Corn" might provide a name for a good-frying (Benefit No. one), all vegetable (Benefit No. two) shortening, for example, such as "Crisco" (It probably didn't really happen that way, but it *could* have!).

During this period of time, 1971-1974, I began to believe a full-time corporate-wide position was justifiable for consulting in creative processes and so proposed this to the company. This led to a position for me as "Methods Consultant" within the corporate-wide "Management Systems Division" (a hybrid of data processing and industrial engineering personnel). This base permitted the expansion of applications of small group creativity to

manufacturing (e.g. cost improvement, plant modernization, energy conservation, etc.), engineering (new plant and process design), qualitative market research (using consumers as participants), systems analysts (how to consult with clients more effectively), R & D matrix team formation, critical path scheduling, and strategic planning from corporate level to project team levels. Also, an increasing demand for training in creative problem solving began to develop, largely by word of mouth. For example, some of the sales departments began to find such training not only highly pertinent to gaining new business (by more creatively solving customers' problems), but also highly motivational. This led to training sessions of various duration for new sales employees, seasoned sales veterans and entire sales districts.

By this time, I had learned how to incorporate both ideational and evaluative techniques such as metaphors, psychodrama, music and paired comparison analysis into Simplex on the job. Thus the eight-step model had demonstrated itself to be very versatile.

I had become convinced that deliberate, planned, individual and small group creativity process application was a powerful tool in industry for at least two reasons. First, it could be applied to virtually any situation or function across the corporation. Second, it was an excellent way of getting a great deal more depth out of problem solving than was possible by traditional methods. By depth, I refer to breaking through superficiality. For example, often group members would dig up and share information they might normally "hide" in a competitive business environment. This occurred because of the trust level built up in the group by the process. Also, the tendency of the group members to see the same problem from differing viewpoints brought forward information that members were not even consciously aware of as individuals. This caused more imaginative and risky ideas to flow forth.

It was important to get participants to *internalize* the deferral of judgment principle as opposed to having a simple understanding of it. I would often help achieve this by modeling the opposite of this principle. I would ask the members for an idea related to the objective. Then when someone volunteered such an idea I would immediately proceed to destroy it with various "killer phrase" remarks (i.e. "yes, but . . . "). This vividly demonstrated the negative effect of premature judgment on idea flow. Another technique I found valuable involved asking participants to choose a partner from a different department or section with instructions to exchange information they felt was relevant to the session. This increased the tendency to share differing ideas and thoughts. Finally, as the process leader, I continually would demonstrate that I would enforce the deferral of judgment principle (at all times) and that sharing any thoughts occurring to any participant at any time during the session was most desirable and welcome. There were *no* wrong answers.

The Effectiveness of Training

During this period, I became highly intrigued with the possibility of obtaining a better theoretical understanding of the mechanics of these creativity applications and training sessions in addition to being a practitioner. However, when I reviewed the literature on creative problem solving, I found the scientific support to be sparse. There was a particular scarcity of research evaluating real-world applications of creativity training. I found myself desiring more theoretical and scientific grounding in many of the small group dynamics principles and teaching techniques I was employing. As a result, in 1974, I enrolled in a Ph.D. program at the University of Cincinnati, majoring in Organizational Behavior and minoring in Social, Cognitive, and Educational Psychology. Over a period of time, this led to my being able to blend together the theoretical understandings and concepts I was learning in my classes with my work as a creativity practitioner. I found myself feeling much more confident as an "expert" consultant in subsequent sessions and training.

In late 1977, a golden opportunity came my way to convert a company project into my dissertation research because of two unrelated happenings: (1) I was asked to consult with

an R & D staff group interested in exploring the question, "Can engineers and scientists be trained to increase their creativity on the job?" and (2) an applied research organization within the company asked me to provide Creativity training to its members. I found a way to combine the above two events into one project which eventually became a controlled field experiment on which my dissertation was based. (The dissertation was designed to be both a direct test of the value of training in creativity in an organizational setting and an attempt to understand the mechanics by which such training might work.) Over the next two years, with considerable cooperation from many people within the large corporation I was employed at, the University of Cincinnati, the Creative Education Foundation, and other organizations, I was able to conduct a controlled field experiment whose results scientifically supported the belief that training in creativity results in positive on-the-job performance improvement.

A particular problem with this kind of research is the difficulty of measurement. In fact, a primary feature of the dissertation turned out to be the development, application and analysis of many different ways of measuring creativity training effects. These went far beyond "paper-and-pencil" tests and "trainee reaction" data, yet they remained compatible with environmental constraints. These measurements were developed gradually during pilot testing with three cooperative R & D project teams over a nine-month period in 1978.

In addition to the measurement difficulty, previous industrial training effectiveness research in general (i.e., not only creativity training research) seemed to be characterized by other problems and inadequacies (Goldstein, 1980; Hinrichs, 1976). The literature contained vigorous debate as to whether or not it was even appropriate to try to evaluate any organizational behavior training (Campbell, Dunnette, Lawler, & Weick, 1979; Campbell, 1971). Other problems included shortcomings in methodology, such as inadequate control or being overly mechanistic, and a lack of investigation of real-world portability effects. Thus, the field experiment was carefully designed to minimize all of the above inadequacies.

The research below was presented at the 1980 annual convention of the American Psychological Association. Participants in the study were engineers, engineering managers, and technicians of a large engineering department. This department was involved in applied research and wanted more new projects initiated and completed. An experimental (trained) group was compared to two control (placebo and non-placebo) groups. The training employed was described as a three-stage "complete process" of Problem Finding, Problem Solving and Solution Implementation (Figure Two). This was actually the 8 step Simplex approach described earlier in Figure One, but simplified for research reporting purposes.

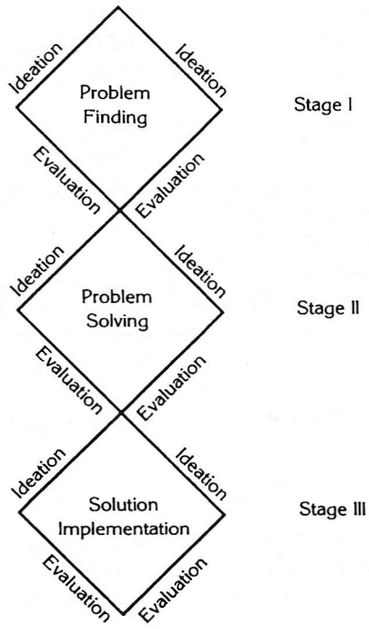
Six hypotheses were tested, both immediately after training and later back on the job. There were three methods of measurement (questionnaire, tape recorded task, and interview) and 22 different measures. The hypotheses were as follows:

> In an applied research setting, given a sample that has a relatively low ideation tendency, training in a "complete process of creative problem solving" emphasizing the ideation-evaluation process in all stages (see Figure Two) will lead to:
>
> H1A: An increase in preference for ideation in problem *finding*
> H1B: An increase in preference for ideation in problem *solving.*
> H2A: An increase in the practice of ideation in problem *finding*
> H2B: An increase in the practice of ideation in problem *solving*
> H3A: Improved performance in problem *finding*
> H3B: Improved performance in problem *solving*

Fundamental to the above hypotheses was a firm belief, based on experience, that group members (or individuals working alone) must be able to internalize the "ideation-evaluation" and the "deferral of judgment" principles. In other words, the creative model proposed is successful only when actual separation of ideation and evaluation is achieved in thinking, attitude, and behavior. Cohen, Whitmeyer and Funk (1960) show that given a substantial

Figure Two.

A "Complete Creative Problem – Solving Process" Emphasizing Ideation – Evaluation as a two step process in each of three stages.



training period, trained subjects provided better ideas then untrained subjects. However, Rickards (1975), with training confined to only a warm-up activity, found little or no difference between the output of trained and untrained groups. Training must be of sufficient duration and intensity to bring about increased preference for the two-step ideation-evaluation process. Thus, the process is not simply cognitive but also affective in nature. It is due to the fact that changes are experienced at both of these levels that results are significantly improved.

Summary of Field Experiment Results

Thirty-two out of a total possible of 44 supportive contrasts were statistically significant. None of the 22 contrasts between placebo and untreated groups were significant. Moreover, each of the six hypotheses was supported by at least one significant contrast.

Overall, the results strongly supported four of the six hypotheses. In particular, individuals receiving such training in an applied research setting, especially if they are relatively low in ideation tendency, seem to show significant differences compared to controls in:

1. Preference for ideation in problem *solving* (H1B), but maybe not in problem *finding* (H1A);

2. Practice of ideation in both problem *finding* and problem *solving* (H2A and H2B); and
3. Problem *finding* performance (H3A), but maybe not in problem *solving* performance (H3B).

The effects of the training appear to be fairly "generalized." That is, there was evidence of changes in cognitive (e.g., openness to ideas), and behavioral (e.g., number of negative judgments made on ideas; and not jumping to conclusions) processes. Both arenas (cognitive and behavioral) seemed actively involved by this training. Our belief that the effects of training are more likely to be long lasting when several aspects of behavior are influenced was encouraged by this evidence.

Some changes in the behavior patterns of trainees were readily observable by co-workers even back on the job. Thus, the training appears to translate (at least in the short run) into actual changes in job behavior. This relationship was stronger for the "practice of ideation" than for "problem-solving performance."

One interesting anomaly in the results is that preference for ideation in problem finding was only weakly affected by the treatment, yet "practice of ideation" and performance in problem finding showed strong effects. It may be the case that training can get participants to *do* problem finding (cognitive and behavioral) yet still not *like* it (affective or attitudinal). Problem finding for many people in our culture appears to be a somewhat unfamiliar chore, especially for people who tend to operate more in problem solving or solution implementation modes (e.g., business people in more programmed jobs and engineers in applied work).

Future Directions for Research

One future direction is to test the elements of the model (Figure Two) more completely, particularly the evaluation steps and implementation stage. Furthermore, creativity talent identification research could be integrated into empirical tests of the model (Gough, 1976; Guilford, 1967; MacKinnon, 1962, 1977; Roe, 1976). For example, it remains to be shown whether this training influences different personality or cognitive traits differentially, or whether one can identify more creative people by their behavior during such training. Perhaps greater gains in organizational creativity could be realized by focusing training only on people possessing certain traits.

A second research direction involves generalizability. One of the limitations of this study is that it concerns only one organization sample. Future studies should cover different types of organizations, different organizational functions and other organizational levels.

A third research direction would be to attempt to clarify and replicate the training effects discovered in this study. Increasing base size and strengthening the internal consistency and reliabilities of measures, especially for some of the on-the-job observational measures, is in order. Further, developing improved methods to measure all hypothesized constructs would appear to be a fruitful opportunity for some creative methodological work.

A fourth research direction would be to negotiate opportunities to study transferability of effects for longer periods, say ten weeks, six months, one year or several years.

Finally, an interesting line of research would be to explore the relative contributions of ideation and evaluation at each of the three stages of the process (Figure Two). Also, one might question whether these relative contributions differ by task. For example, perhaps in high implementation-oriented jobs the contribution or importance of evaluation is relatively higher than ideation. Perhaps there are optimum "ideation-evaluation" ratios which differ by stage for any job or organization.

In conclusion, it appears that creativity, in the narrow sense of this research, can be influenced by training. As always, more new questions have been raised than answered as

understanding has deepened. Sockman's saying, "the larger the island of knowledge, the longer the shoreline of wonder" is supported by this experience.

PART TWO

Since the original research, six broad practical issues have guided my selection of research projects from the wide array of options. The summaries that follow are organized around these six issues.

The six broad issues are: (1) inducing more managers, professionals and other organizational members to try using creative problem solving processes and techniques in their daily work; (2) increasing understanding among all parties interested that a systems approach is a must; (3) increasing understanding of how problem solving processes overcome inadequacies in real world human problem solving and decision making processes; (4) furthering understanding of how creative problem solving processes and techniques can serve to operationalize various new management tools; (5) using the extended effort principle for idea generation; and (6) gaining a better understanding of the exogenous factors which may increase organizational creativity and effectiveness.

1. *Inducing the use of processes and techniques.*

One of the major problems to be solved in bringing more creativity into organizations is inducing the key managers and professionals to try using creative problem solving processes and techniques in their daily work and to model the necessary attitudes and thinking skills consistent with creativity. Because of their previous traditional training, many managers and professionals tend to have a negative view of creativity. For example, in two recent studies, Basadur and Finkbeiner (1983a; 1985) identified four managerial attitudes relating to ideation in organizations. One attitude is "preference for ideation," confirming the construct developed in the research described earlier. This is a positive attitude, as is one other of the four attitudinal factors uncovered, "valuing new ideas." However, the other two were both negative; "tendency to make premature critical evaluations of ideas," and "belief that creative thinking is bizarre." Experience confirms that such negative attitudes are held by many managers and professionals in business and industry. More is said of their study later in this section.

Methods of inducing managers to try creative problem solving processes and techniques on-the-job include improving their understanding of such processes and techniques, providing scientific research evidence that they are valuable to use in their jobs, and improving their attitudes toward such processes and techniques. The following is one example of research into attitude change (Basadur, Graen, and Scandura, 1985).

The purpose of the research was to find out if training of manufacturing engineers in a complete process of creative problem solving will result in a positive change in attitudes which are associated with the effective use of creative problem solving techniques on the job. Below are the hypotheses for the effects of the training.

1. Training manufacturing engineers in creative problem solving will lead to the following attitude changes which will persist five weeks after the training:

   H1a: An increase in preference for ideation (active divergence)
   H1b: A decrease in tendency to make premature critical evaluations of ideas (premature convergence)

2. Training manufacturing engineers in creative problem solving as members of a natural work group which returns to work to the same location as a unit all

having experienced the same training compared to members that come to the training from different work groups then return to diffuse work locations following the training will lead to the following attitude changes which will persist five weeks after the training:

H2a: A greater increase in preference for ideation (active divergence)
H2b: A greater decrease in tendency to make premature critical evaluations of ideas (premature convergence)

The participants were drawn from a large consumer goods manufacturing organization. These manufacturing engineers were known to be "efficiency minded," achieving excellence in performing their routine work assignments. However, this same tough-minded orientation toward optimizing the day-to-day routine was working against the manufacturing engineers attempting to also be "innovation-minded," that is, using creativity to develop new routines, anticipate new opportunities and find new problems (opportunistic surveillance) (Simon, 1960), and solve old persistent problems in new ways.

From this manufacturing organization, 65 manufacturing engineers from eight different locations were invited to a three day (24 hours) intensive training program in this complete process of creative problem solving as described above. A second similar group of 47 manufacturing engineers were invited to a second training program five weeks later. The only major difference was that the second group of manufacturing engineers were all from the same single location.

The design is a field experiment using non-equivalent groups (Cook and Campbell, 1976). The procedures of this research were such that the experimental design and measures were meshed with organizational events. The measures were introduced to the participants as non-evaluative aids to developing future training.

The six item "preference for ideation" scale was used to measure the "active divergence" attitude and the eight item "tendency to make premature critical evaluations of ideas" scale was used to measure the "premature convergence"/"not deferring convergence" attitude. The two scales were randomly mixed into one 14-item questionnaire identical to the procedure used by Basadur and Finkbeiner (1985).

The overall multivariate analysis of variance demonstrated significant ($p < .001$) time and treatment by time effects for both self-report and supervisor report. All gains over both five-week periods were significant (time effects). In contrast, the differences between the gains of the two groups (treatment x time effects) were not all significant. The gains in preference for ideation measures taken from both self and supervisor reports failed to show significant differences between groups for the period from the pretest to post-test one. Though these two treatment x time effects were insignificant, the remaining six treatment x time effects were significant (five at .001 and one at .05).

Thus, the results showed support for the effectiveness of training on both preference for ideation and reduction in the tendency to make premature critical evaluations under family-type training. However, under missionary-type training only the tendency to make premature critical evaluations yield significant results.

Thus, this field experiment illustrated that training in a complete process of creative problem solving improves attitudes toward creativity even among subjects likely to be highly skeptical. Trained manufacturing engineers were found to be significantly higher in preference for ideation and significantly lower in tendency to make premature evaluations of ideas than untrained engineers five weeks after return to their jobs. That is, from before to after the training, the engineers increased their preference for generating different points of view and new or novel solutions to problems and increased their preference for keeping an open mind on ideas until they can be further explored and developed.

This study demonstrates that training can positively influence manufacturing engineers' attitudes toward creative problem solving and identifies an important aspect of the training situation, the use of intact work groups. Attitudes are important antecedents to the use of creative problem solving on the job. The results of this research point to methods of training that can positively change those attitudes and therefore enable the development of more creative organizations.

2. *Increasing understanding among all interested parties.*

The next study represents the approach of improving understanding of creative problem solving processes and techniques as a method of inducing trial. The above research was made possible in part because of the previous efforts of Basadur and Finkbeiner (1983 a, b, 1985) to develop reliable, and valid measures of two attitudes associated with ideation: (1) preference for ideation and (2) low tendency to make premature critical evaluations of ideas. These two attitudes were identified and measures developed in a study attempting to "sharpen up" a "deferral of critical judgment" scale as an early measure of "preference for ideation."

The research is presented here and directed specifically at furthering the understanding of attitudes apparently related to ideation. Effective ideation may require specific attitudes favoring this kind of thinking, perhaps to help participants truly "let loose" and use more fully their unencumbered imagination. Thus, for training to succeed, it may have to have sufficient impact to increase such attitudes.

The research explored this question: What attitudes may be associated with the ideation thinking process? Basadur (1979) and Basadur et al. (1982) identified one such attitudinal construct "preference for ideation," and offered a preliminary seven-item scale to measure it. The research discussed here attempted to strengthen the internal consistency, reliability, and external validity of that scale. Thus, one purpose of this research was to construct a new scale with additional items that could provide better internal consistency. We call this Study Number One.

In Study Number One, a group of 36 middle managers and professionals, drawn from across all the functions of a large industrial company and familiar with creative problem-solving concepts such as ideation and deferral of judgment, were asked to suggest scale items to add to the two strong items from the original preference-for ideation scale. This exercise produced 101 new items. A questionnaire including the total 103 items was sent out to a broad cross section of 186 middle managers and professionals from several companies, who were asked to evaluate the items on a five-point scale, ranging from "strongly agree" to "strongly disagree." This latter sample included both people who had and had not been exposed to training. We extracted four factors.

We examined the four factors for item content and labelled them accordingly. One factor, which included the two original scale items, was identified as "preference for ideation"; we designated it factor number one to indicate we considered it of primary interest. Then, to construct a meaningful and relatively pure measure of factor number one, we selected only those six items that loaded solely on it and higher than 0.30 to comprise the first scale. We tentatively named the other three factors "tendency for premature critical evaluation of ideas"; "valuing new ideas"; and "belief that creative thinking is bizarre," designating them factors number two, three and four respectively.

Study Number Two was an independent study to establish the internal validity, reliability, and external validity of Scale Number One ("preference for ideation") from Study Number One. A new sample of 238 managers and professionals from a variety of industrial, business, and hospital organizations completed a 14-item questionnaire derived by combining in random order the six items from Scale Number One with eight items selected from factor number 2. We chose the eight items constituting Scale Number Two, "tendency for premature critical evaluation of ideas," by using a procedure similar to that used for Scale Number One.

The data from the 238 panelists were factor analyzed to confirm that the two sets of items indeed constituted two separate factors, as Study Number One had led us to believe. We used factor analysis procedures identical to those of Study Number One. A two-factor solution emerged. All six items from Scale Number One loaded on one factor and all eight items from Scale Number Two loaded on the other factor. The Cronbach alpha reliability estimate was then calculated for each scale (Cronbach, 1951). Thus, internal validity and reliability had been assessed.

Next, to assess external validity, the panelists' response scores in each of the two scales were calculated. From the large sample, we selected two nearly equal, smaller "known" groups. These consisted of panelists whom two independent expert judges had identified as being either high or low in their preference for ideation on the job (the judges were two people familiar with both the concept of ideation and also with the individuals' on-the-job attitudes and behaviors.

A significant difference occurred in the hypothesized direction between the "known high" and "known low" group mean scores on the "preference for ideation" scale. There was no evidence of a significant difference between the same groups on the "tendency for premature critical evaluation of ideas" scale. Thus, significant evidence indicated that the "preference for ideation" scale can discriminate between the two groups while the other scale does not. This supports the idea that the "preference for ideation" scale agrees with the expert judges in identifying participants' preferences for ideation. Thus, we found evidence of the external validity of the "preference for ideation" construct.

In discussing these results, Basadur and Finkbeiner proposed that the instrument described as Scale Number One acts as a valid and reliable measure of the "preference for ideation" of an individual in an organizational setting. Factors number two, three and four, tentatively identified as possible valid and useful constructs on their own, are particularly intriguing for future research.

The above concepts may help clarify the attitudes and cognitions relating to Osborn's four brainstorming operations: (1) defer judgment, (2) strive for quantity, (3) welcome freewheeling, and (4) hitchhike. The first operation seems more passive, the latter three more active. Speculatively, a high "preference for ideation" appears associated with performing the latter three operations well–and thereby "triggering ideation"–while a low "tendency for premature critical evaluation of ideas" might be associated with performing the first operation well, thereby allowing "freedom for ideation." An examination of the items in factors number three and four (Basadur and Finkbeiner, 1983a) suggested that the attitudes of low "belief that creative thinking is bizarre" and high "valuing new ideas" might be similarly associated with the "welcome freewheeling" and "hitchhike" operations, respectively. How the attitudes actually relate to the thinking processes is a matter for further research (See Figure Three).

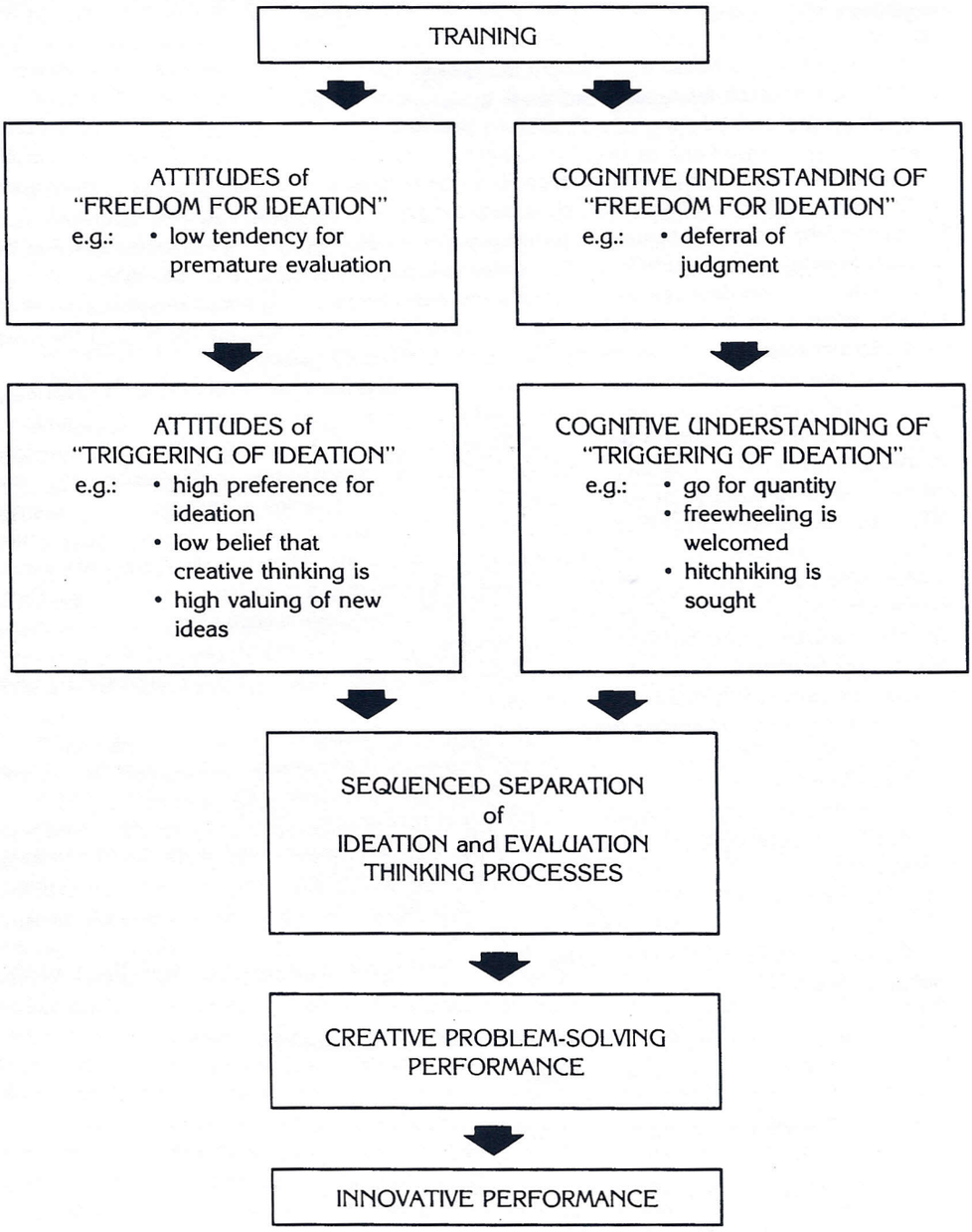
In summary, we have identified four separate attitudinal factors relating to ideation and have developed a reliable and valid measure for one of them. This differentiation may prove particularly useful in helping organizations and individuals better understand specific attitudes and thinking processes affecting creative behavior–and understand how training in creative problem solving works, thereby increasing its effectiveness. For example, an organization may seek to preferentially target its training to modify whichever of these four attitudes it diagnoses as most critically needed. Also, when such training is provided, the concept of ideation may now be better and more completely explained to participants. At the beginning of training, organization members are likely to have substantially different interpretations of the meaning of constructs associated with creative problem-solving training such as "ideation." This research may thus reduce some of the "mystery" of creativity training.

3. *Increasing the understanding of the value of process for solving real-world problems.*

Both organizational adaptability and efficiency are important for organizational effective-

Figure Three.

Revised model of Creative Problem-Solving Training emphasizing Ideation and differentiating between "Ideation Freeing" and "Ideation Triggering".



ness. Clarifying these two as distinct components of effectiveness represents another approach to increasing managerial understanding of the need for creativity. For example, Basadur (1986) described the concepts of adaptability, efficiency, and effectiveness as well as horizontal and vertical leadership for members of business and industry.

In many companies which have thrived on functional excellence and organizational efficiency, the need to expand managerial competence in the following new ways is being increasingly recognized:

- More idea generation and thought leadership
- More horizontal leadership and team work
- More strategic thinking

In the following section, a unique, proven, managerial productivity process is described which helps maintain profits in spite of inflationary and market pressures. The centerpiece of this productivity process is a trainable thinking process called a "Complete Process of Creative Problem Solving" (See Figure Two). This process is action-oriented, facilitates teamwork and team leadership, and develops thinking skills and attitudes for taking problem solving initiative and idea generation. It is a practical, research-based process. It expands the kind of thinking skills and attitudes prevalent among most North American managers.

There are two very different kinds of problems and decisions people encounter in business, industry, and their personal lives. The first kind is of a more "programmed" nature. Solutions to this first kind are based on rigorous training, experience, analytical skills and knowledge of rules and procedures. The second kind are of a more "non-programmed" nature. Solutions require additional skills such as problem sensing, problem defining, fact gathering, seeing different points of view, and creating and selecting from diverse options. They require the use of the imagination, non-linear thinking and some risk-taking. They usually have never been encountered before and have no pre-set rules and procedures to guide their handling. They are sometimes caused by changing circumstances. Such problems are typically less structured, more unpredictable, and ambiguous as to "what is wanted." Often the main job is to discover and define "what is wanted" because no one really knows. Often sensing, anticipating and defining the problem is much more difficult than solving it.

In today's rapidly changing business environment, managerial skills in *both* of the above kinds of problems are vital for effective performance. Unfortunately, our traditional formal training addresses primarily the former, the more "programmed" kind of problem. We tend to learn formulas, problem "types" and rules and procedures. The focus of the "Complete Process of Creative Problem Solving" is to help with the second kind of problem which is less structured and less programmed and where higher level initiative, imagination and tolerance of ambiguity is vital. The process enhances problem initiation, solution, and implementation skills in non-programmed decision-making.

Research (Mott, 1972) shows that highly productive organizations have three major characteristics in common:

1. Efficiency (the ability to organize for routine production)
    - High quantity of "product"
    - High quality of "product"
    - High output/input (O/I) ratio

2. Adaptability (the ability to organize to change routine)
    - Anticipating problems
    - Staying abreast of new technology
    - Prompt and prevalent acceptance of new solutions

3. Flexibility (the ability to organize to cope with temporary emergencies and maintain the routine)

Efficiency is the ability to organize for routine production. A routine is something that we do over and over again. In addition to being efficient, productive organizations are also flexible, that is that they have the capacity to cope with, to respond to and react to temporary changes or interruptions and maintain the routine. They can deal with interruptions and get back to normal routine and highly productive work. Flexibility thus can be lumped in with efficiency. They are both necessary in the short run.

Adaptability is a longer-range characteristic. It refers to an organization's capacity to intentionally change its routines and to find new, ongoing, better ways to do the business that it does. Adaptability requires no more programmed thinking skills and tends to be consistant with problem *finding* performance. Efficiency requires more programmed thinking skills and tends to be consistent with solution *implementation* performance. Flexibility is more of a blend, and tends to be consistent with problem *solving* performance.

Non-programmed thinking skills become more vital as the amount of change confronting the organization increases. To summarize:

High efficiency means excellent mastery of the routine while high adaptability means a high rate of change in the routine.

In pursuing high efficiency, we are highlighting and measuring absolute performance. In pursuing adaptability, we are highlighting and measuring progressive rate of change. The most effective organization would be the one which combined highest efficiency (e.g., as measured by lowest cost) with highest adaptability (e.g., as measured by highest progressive rate of lowering cost).

The problem-solving process used in training (See Figure Two) is based on two major concepts. First, it is seen as having three different stages. It separates problem finding from problem solving and from solution implementation. The second important feature of the process is that within each of the three critical stages, there is a common fundamental process. This is a two-step process called "ideation-evaluation." Both aspects are believed essential to creativity.

There are three major premises underlying training based on this view. First, for most people, the ideation step is more difficult than the evaluation step of the ideation-evaluation process. Our society, general training and school systems tend to reward and hone our evaluation capabilities and preferences and promote their use virtually to the exclusion of ideation. (MacKinnon, 1962, 1977; Osborn, 1963; Thurstone, 1950; Wallach, 1971). Over a period of time, evaluation starts to dominate. For example, some research has shown that engineering students upon graduation are less able to use their imaginations than when they entered four years earlier (Altemeyer, 1966; Doktor, 1970). Second, even within the above context, there are individual differences. People differ in their relative preferences, aptitudes, and/or abilities in the two steps of the ideation-evaluation process (Guilford, 1967). Some people may be relatively better in ideation or evaluation. Third, while the training is designed to strengthen both steps of the ideation-evaluation process, it is expected to have the most effect on that step of the ideation-evaluation process that is least developed in each trainee.

In practice, the three stages are reshaped into a circular eight-step process (Figure One). The process must be "learned by doing" and therefore the training is experiential. The training is accomplished by a series of diverse tasks and then direct application to real world problems.

Training in the "Complete Process of Creative Problem Solving" encourages people to explore new territory, to find new ideas and to continually bring new energies to problem solving. New breakthroughs are more likely to occur under this process of different points of view, relaxed supportiveness and increased energy. The process is trained to be used on the

job both by individuals and groups in day to day business activities as well as in formal problem solving meetings.

In summary, the use of the "Complete Process of Creative Problem Solving" and supportive environments result in the kinds of corporate behaviors exhibited by employees who:

- Search for new opportunities and new problems;
- Have a positive attitude that problems can be solved;
- Value interfunctional problem solving activities;
- Rely on different points of view;
- Appreciate the value of investing time in identifying the "real problem" before searching for solutions, believing that "a problem well stated is half solved."

4. *Problem solving as new management tools.*

There are three keys to assure the success of the process corporate wide. First, it is vital that top management makes sure everyone knows the "business need." Top management planners must calculate and present the business need to the function heads in a "bullet-proof" case for adaptability improvement at the very beginning of the process. Furthermore, the function heads need to be involved in the planning and tailoring of the overall approach and receive training first. At least one high ranking member of management should be present at virtually every training program to share the overall company business need and position the particular local business need. Cost and profit data should be openly shared with employees at all levels. People want to help, but they can't solve cost and profit problems without the cost and profit facts. Before a training program is designed, an extensive "preconsultation" with the leaders of the organizational sub-unit should be conducted to ensure the appropriate business need is addressed. Corporate strategy decisions and commitments need to be openly shared with employees. Anticipated cost improvements are calculated directly into next year's budget. Successful realization is thus expected. In essence, just as good management sets efficiency goals, it must also set adaptability goals.

Second, interfunctional profit improvement teams need to be formed to attack specific problems. The idea is to leverage traditional functional performance. This is because the problems of sustaining profit in today's accelerated competitive arena require an interdisciplinary approach. Most times the problems require knowledge about several parts of the business. Furthermore, the best solutions often affect or require the cooperation of other functions (e.g., a manufacturing idea to reduce cost may cause sales to have an additional "headache," yet the net result is very positive).

One example of how the use of the "Complete Process of Creative Problem Solving" expanded the range of thinking follows. A manufacturing management interfunctional team was concerned with crewing a new process designed to improve the way seasoning was applied to a snack food product. As originally perceived, the problem was "how might we crew the new seasoning loop?" With further fact finding and shifting of points of view, the problem was redefined first as "how might we minimize cost and maximize output labor when crewing the loop?", and finally sharpened to "how might we obtain 'crew buy-in' for how we crew the new seasoning loop?" Several good ideas were generated and an action plan developed as soon as this new problem definition was recognized. For most teams, the problem sensing and redefinition process is the most powerful aspect of the Complete Process of Creative Problem Solving. Investing creative effort in fact finding and in problem definition always pays off in saving time by finding superior solutions which can be implemented more quickly.

Third, there must be training provided in the new attitudes, behaviors and thinking skills expected. However, it is not sufficient to simply train members in the "Complete Process of

Creative Problem Solving." All key managers must also receive training in how to manage the organizational factors to make the training "stick." Some of these factors are listed below:

(a) Help organizational members understand the business need and the adaptability concept.
(b) Give teams the right tools and attitudes to perform creatively.
(c) Provide expertise in the thinking skills and attitudes to help members find and solve tough, important problems.
(d) Train higher management how to nurture adaptability and horizontal leadership performance via structural methods.

In summary, the complexities of managing a successful business in the 1980's and beyond are increasing. National markets are now international markets. Regional competitors are being merged to form national competitors. Inflation wanes and waxes but never disappears. Consumers demand more value and will continue to do so. Planned productivity and the employment of minds, as well as bodies may have been optional in the past . . . it's mandatory today. The process provides a method of aligning business need, teamwork and creative problem solving to improve key business results *and* at the same time, deepen and strengthen the partnership between a company and its employees. The development of increased adaptability will no doubt dictate the survival and continued profitability of many a well-known firm over the years ahead.

5. *The extend-effort principle*

Several theorists have suggested that extending effort in idea generation improves creative problem solving performance and skills. Extended effort involves generating additional possible solutions to a problem beyond the first crop of ideas that come to mind, deferring the impulse or tendency to "quit early" when a good idea may seem to be already in hand. For example, extended effort is one of the four operational rules of Osborn's (1963) brainstorming process ("quantity breeds quality"). Gordon (1956) writes of the principle of "deferment," the capacity to discard the glittering "immediate" in favor of a shadowy but possibly richer "future."

There has been empirical support for this extended effort principle in laboratory research in solving non-real world problems. Parnes, (1961), showed that when effort was deliberately extended under Osborn's four rules, the number of good ideas generated was greater in each of the two latter thirds of the idea generation time period than in the first third of the time period. These results, plus Gordon's theory of deferment led Parnes to speculate that under extended effort, the *single best idea* might occur more often in the chronologically latter part of the series of ideas generated.

If there were empirical evidence that the best idea frequently would come later (rather than earlier) in a series of ideas produced by deferment, that is, by extending effort to pile up a list of ideas prior to selecting one, perhaps more managers could be induced to try these principles of deferment and extended effort. Ultimately they could become skilled at these non-sequential thinking techniques and thus boost their managerial decision making effectiveness. They would less often "grab the first idea and run with it" and more often develop several ideas prior to selecting one as the "best bet." The research reported here represents an attempt to provide such empirical evidence.

These hypotheses, as tested in this field research, were specifically worded as follows:

In creative problem solving, when extended effort is used to generate a series of ideas to solve a meaningful real world technical or managerial problem, the most preferred idea:

H1: Will occur more often among the *latter two thirds* of the ideas in the series than among the first third.

H2: Will occur more often among the *last third* of the ideas in the series than the first two thirds.

Two studies were conducted to test the above hypotheses. One study involved individual problem solving, the other involved group problem solving.

In the first study, participants received four hours of training, then applied the training (See Figure One) individually to a common real problem. Participants devoted five minutes to each of the three steps preceding idea generation (total 15 minutes). They shared their work at the end of each step. At the end of the third step one common problem definition was selected as useful and meaningful to everyone. The idea generation step was then done individually for five minutes on this common problem definition. Individuals then chose their most preferred idea (MPI) from the series (list) of ideas they had just generated. No formal evaluation criteria were used. The total number of ideas in the series and the chronological or serial position in the series of the MPI were reported by each individual.

In the second study, managers and professionals were trained for one to two days (8 to 16 hours) in the same "Complete Process of Creative Problem Solving" described above and applied it to their own individual problem from the beginning. (There was no common agreed problem or problem definition). Each individual received help from a small group comprised of three other trainees. Individuals chose the MPI individually from the list generated for their problem definition using their own criteria selected from the list of potential criteria. As in the first study above, individuals then reported their total number of ideas in the series and the chronological (serial) position in the series and the chronological (serial) position in the series of the MPI.

The base size in the first study was 101, and 264 in the second. The training groups involved 10 to 30 participants each. There were 6 training groups in the first study, and 14 in the second.

The research design was a field study in which the data were gathered by questionnaire following the problem solving activity. Each participant reported three numbers:

1. the total number of ideas that were generated for the problem selected;
2. the chronological number (serial position) of their four MPI's generated;
3. the chronological number (serial position) of their single MPI generated.

The data for both studies were analyzed by tabulating how frequently the MPI occurred in the first third, middle third, and last third of the serial list of ideas generated for each problem. This analysis follows Parnes' approach (1961). The data collection procedure is described above. The hypotheses were tested as follows:

H1 was tested by calculating if significantly more often the MPI was to be found among the latter two thirds of the ideas listed serially rather than among the first third.

H2 was tested by calculating if significantly more often the MPI was to be found among the last third of this idea listed serially rather than among the first two thirds.

In addition, in the second study only, the data were also analyzed by using the *four most preferred ideas* rather than the *single* most preferred idea. H1 and H2 tested again accordingly.

These data were not available from the first study because many of the idea lists were not sufficiently long to permit four ideas to be selected as "most preferred" in a meaningful way.

To summarize, in Study Number One, 39.6% of the participants chose their MPI from the first third of their serial list of ideas, while 25.7% chose it from the middle third, and 34.7% from the last third. For the tests of hypothesis, this meant that 39.6% chose their MPI from the first third and 60.4% from the latter two thirds. Conversely, 65.3% chose it from the first two thirds, 34.7% from the last third.

In study Number Two, 42.7% of the *four* MPI's came from the first third, 33.4% from the middle third, and 23.9% from the last third. Thus, for the tests of hypotheses, 42.7% were

chosen from the first third, and 57.3% from the latter two thirds, while 76.1% chose from the first two thirds, and 23.9% from the last third.

In both studies, there is firm support for H1. In all three comparisons, the frequency of occurrence of the MPI's in the combined latter two thirds was higher than for the first third. In two of the three comparisons the difference was statistically significant.

Neither study provides any support for H2. In none of the three comparisons was the frequency of occurrence of the MPI's in the last third higher than the combined first two thirds. In fact, the reverse was true in all three cases.

The above results support the belief that extended effort is useful in creative problem solving for real world managerial and technical problem solving. While it does not appear that the most preferred ideas are more likely to come more often at the very end than at the very beginning of the idea series, nevertheless, it does appear that they are more likely to occur in the later two-thirds that is after the first early burst of ideas (first third). The apparent difference in dispersion pattern between the two studies may be important to consider (there is some evidence of a downward trend in Study Number Two in frequency of occurrence of the MPI with serial position). A very interesting future research direction would be to explore the reasons for the difference. For example, the possible causes of the difference may have to do with any or all of the following:

1. Group vs. individual idea generation ("normal group" effect?) See Taylor, Berry, and Block, 1985: Do groups inhibit extended effort effects?)
2. Duration of training (4 hours vs 8-16 hours)
3. Length of time of idea generation (5 min. vs 10 min.)
4. Greater use of a "complete process of creative problem solving," that is, more time spent on problem finding, fact finding and problem definition before idea generation (2 hours vs. 15 min.).

For the author, possibility number four above is perhaps the most intriguing. The literature attributes the following sayings to John Dewey and Albert Einstein respectively: "a problem well-stated is half solved," and "the formulation of a problem is much more important than its solution" (Parnes, et al., 1977). Einstein is further quoted as saying if he were asked to solve a problem of world wide importance (to save the world) in only one hour, he would spend the first 55 minutes defining the problem and the last five minutes solving it. Thus, is it possible that the most preferred idea should come earlier when significantly more attention is paid to developing a good problem definition? This would lead to research testing the hypothesis such as "the greater the time/effort devoted to defining the problem using a complete process of problem solving, the earlier the occurrence of the most preferred idea in a serial list of ideas."

Overall, the results of this study are consistent with the previous research in supporting the usefulness of the extended effort principle in training and application of processes of creative problem solving. In particular, these results indicate it is worthwhile for an individual or a group to use extended effort when generating ideas on real world managerial and technical problems. Significantly more people will find their most preferred idea in the combined latter two thirds of their idea list than in the first third. Thus, "quitting early" in idea generation reduces the chances of obtaining the idea that would be most preferred if given the opportunity to surface.

In summary, Parnes and Meadow (1959) and Parnes (1961) found that extended effort provided significantly more good ideas in a given time period. Cohen et al. (1960) and Basadur et al. (1982) found better ideas result from extended effort in a given time period. In this study, we have found that extending effort significantly increases the odds of finding a more preferred idea than the early ideas in a given time period. All of these findings suggest that

quality and quantity are related positively in idea generation when the ideation principle is employed.

6. *Exogenous organizational factors*

The foregoing series of research efforts was focused on increasing awareness in business and industry that there are tools available to increase organizational creativity and effectiveness. The tools can be learned and systematically applied with training. However, increasing the creative performance of an organization requires more than just training. To sustain such increases over time requires the managing of many mediating variables, which if unattended, can totally undo training effects.

These other variables could be termed exogenous factors. These are factors outside the individual which affect his or her creative behavior. The way these exogenous factors are managed has tremendous potential for affecting the short and long term use of creativity training in the organization as a whole. We know we can build individual skills in creative problem solving by training. Now the question is how do we ensure those increased skills? First, key exogenous variables must be identified and second, skills must be developed in managing them. What might this "system" look like?

The conceptual model in Figure Four could serve as a starting point. The research summarized earlier in this chapter indicated the internal mechanisms for increasing creative problem solving performance. The exogenous factors can be categorized as being either organizational, group or individual in scope. What do we know about these exogenous factors and what more needs to be known? The following attempts to throw light on these questions from practical experience and research.

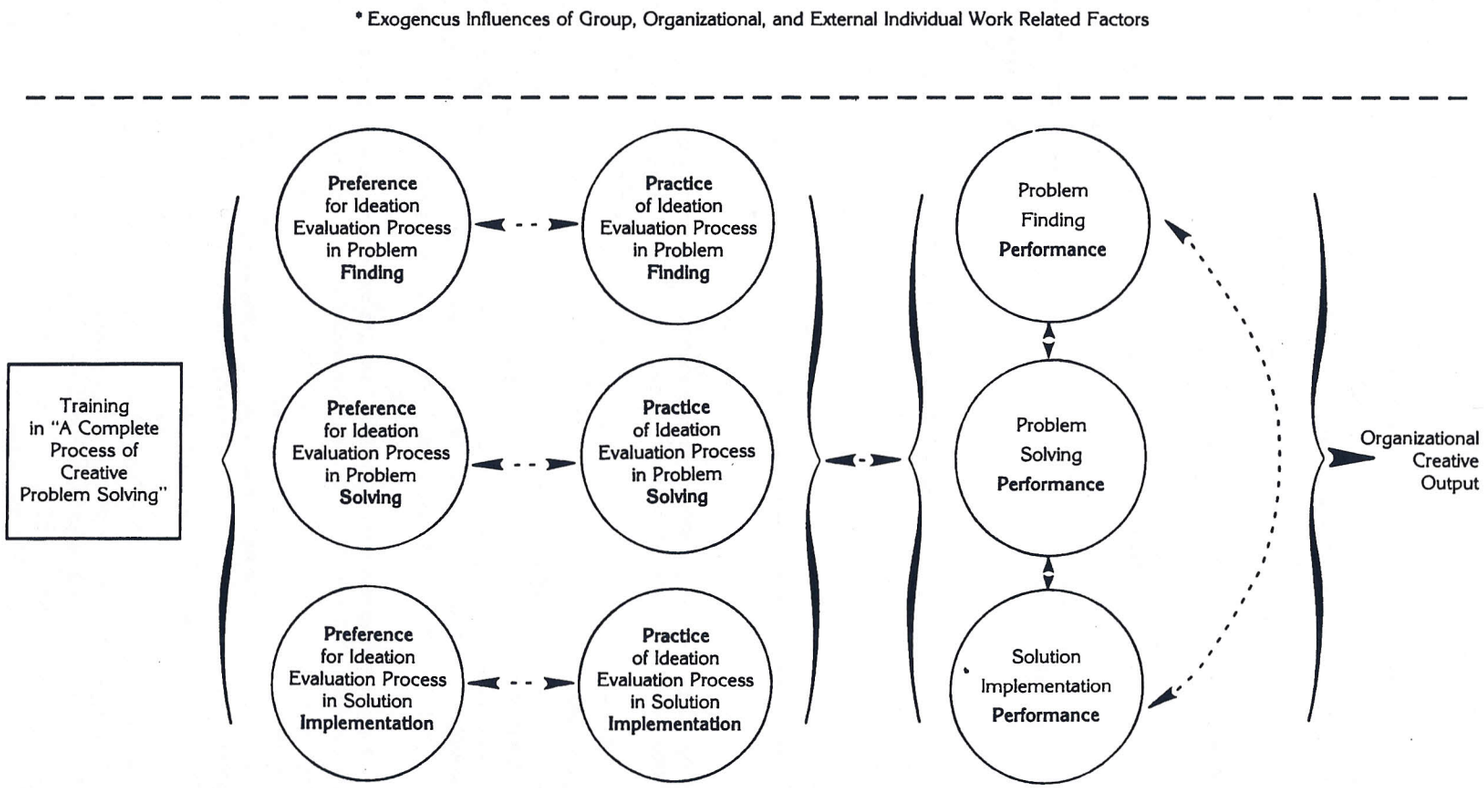
Basadur, Graen & Scandura (1985) shows the positive impact of returning to a supportive home base populated by co-workers, superiors and subordinates who have undergone similar training. Cohen, et al. (1960) found that work group cohesiveness importantly enhances the impact of creativity training. Experience shows that when senior managers visibly model the attitudes and thinking skills associated with creative problem solving training, subordinates are much more likely to try using them on the job. This is to differentiate modelling from supporting. It is not enough to support the new attitudes and thinking skills. They must be used visibly by higher managers. Mott (1972) found that more adaptable organizations had higher levels of rational trust–the extent to which higher managers are seen as "practicing what they preach."

Baker et al. (1976) made an extensive review of the empirical literature relating organizational, structural and behavioral variables to the enhancement or inhibition of idea generation at the individual and work group level in R&D organizations. The most important organizational influences found can be placed into three categories: (1) Diversity of Information (enhancing effective divergence in problem finding and problem solving); (2) Clarifying Information, Organizational Goals, Needs, and Opportunities (enhancing effective convergence in problem finding and problem solving); and (3) Flexibility of Organizational Resources (enhancing solution implementation).

Diversity of information refers to the availability to organizational members of a wide array of information about diverse factors in the environment and is the result of two factors: (a) frequent contact with many diverse colleagues (diverse interests and backgrounds) especially "gatekeepers" and (b) variety of work activity. Gatekeepers are people who differ from their colleagues in the degree to which they expose themselves to sources of information outside their organization about their fields. Diversity of information is enhanced by factors such as participation in extra-organizational professional activity, increased number of occupational specialties within the organization, low formalization of tasks or jobs and high participation in organizational decision making.

Figure Four.

Model for training individual creative behavior in an organization.



* For example, Group Cohesiveness; Diversity of Information; Organizational Values and Norms such as Time Pressures, Resources, and Incentive Systems; Commitment to and Familiarity with the Work or Problem.

Clarifying information, organizational goals, needs and opportunities refers to specific detailed information which helps organizational members to effectively evaluate and select from alternative opportunities for problem solving and form alternative solutions to problems. The availability of such information is enhanced by: (1) formal statements of the firm's goals and objectives; (2) by appropriate attitudes of the primary work group and ample interaction with the group; (3) by appropriate supervisory behavior and attitudes including quality of perceived enthusiastic receptivity to and helpful evaluation of ideas offered; (4) facilitation of problem solving activities; (5) and influence both upward and downward organizationally to assure the appropriate rewards, resources, and work environment to make individual contributions available and assessable; (6) by an appropriate organizational incentive system rewarding creative performance; (7) by appropriate time pressures permitting enough time for divergence activity and also encouragement for convergence; and (8) by providing a system of control which permits a proper balance of freedom and direction to organizational members in their work.

Flexibility of organizational resources refers to the availability of uncommitted resources and funds available to help organizational members respond more quickly to new opportunities, do more long range planning and research, feel less risk of failure, and less need to compete for resource allocation thus reducing internal friction with other organizational members.

The above variables are quite general, and need to be researched and developed into much more specific factors. For example, a sample of engineers and scientists from private industry identified the specific factors in Table One as the most significant organizational factors affecting their creative performance.

Such preliminary data above need to be made more broadly based, prioritized, categorized, validated and developed into an integrated conceptual model. Also it must be determined

Table One.

Innovation barriers cited in a private industry R&D organization.

1. LIMITED TIME AVAILABLE TO SPEND ON BEING INNOVATIVE.
2. OVER-MANAGEMENT BY IMMEDIATE SUPERVISOR
   - Too many guidelines/lack of freedom
   - Over critique of new ideas
   - Early killing of fledgling ideas
   - Over-censorship of both "good" and "bad" ideas
3. LIMITED OR INVISIBLE INCENTIVES TO BE INNOVATIVE
4. INADEQUATE UPWARD COMMUNICATION OF IDEAS VIA PYRAMIDAL HIERARCHY
   - Need more direct communication between staff and upper management
5. INADEQUATE DOWNWARD COMMUNICATION FROM UPPER MANAGEMENT ON RESEARCH AND MARKETING STRATEGIES
   - Poor or so screened by pyramid that full message not received by staff
6. PHYSICAL ENVIRONMENT NOT CONDUCIVE TO INNOVATION
7. INADEQUATE CONTACT WITH OUTSIDE TECHNICAL ACTIVITIES VIA MEETINGS AND PUBLISHING
8. ORGANIZATION STRUCTURE NOT OPTIMUM FOR INNOVATION
9. LACK OF TECHNICAL CRITIQUE BY PEER EXPERTS
10. LOW RISK-TAKING BY MANAGEMENT
11. LACK OF SUPPORT FOR USE OF CREATIVITY/INNOVATION PROCESSES AND TRAINING

how such general variables and specific factors may be different in organizations other than R&D. For example, what about manufacturing operations attempting to become more profitable or to improve the quality of work life by tapping the creative potential of its employees? What management and organizational factors enhance the likelihood of individuals' using creative behavior? What factors cause manufacturing teams to be successful in creative problem solving? Similarly, what about hospitals, department stores, sales and distribution organizations, and other kinds of industries?

At a group level, what exogenous factors other than cohesiveness affect creativity? The literature on small group structure and dynamics provides considerable information on variables that affect various aspects of group performance. Some of these, include sources of tension and conflict, mix, size, goal clarity, time pressures, trust, openness of communication, competition-creating conditions, power and authority influences, social stratification and complexity of task. These variables now need to be explored more specifically in their impact on and interaction with creative processes and performance.

Finally, at an *individual* level, what are the exogenous factors affecting creativity and application of creative processes and techniques in the business and industrial setting? Experience and some empirical work indicate that two such variables are: (1) problem significance to the individual (ego-involvement) and (2) familiarity with the problem. Cohen et al. (1960) and Basadur et al. (1982) showed positive results for creative process application when there was more broadly based ego-involvement and familiarity with the problem being addressed among the problem solving participants. This is in contrast to a study by Rickards (1975). Each problem brainstormed in the Rickards study was chosen by "one or more" of the group participants, raising the possibility that the other group members were not very familiar with or ego-involved in each problem. In contrast, the Cohen et al. and Basadur et al. studies used problems of high interest and general knowledge to all subjects.

What other factors impact individual creative performance and success in applying creative processes in business and industry? The personality and cognitive identification work spearheaded by MacKinnon (1962) and Guilford (1967) needs to be integrated into performance models. We need to discover other individual variables that exist to fill out or change or deepen the model in Figure Four.

Miscellaneous Areas for Research

It would be valuable to learn if and why there are specific learnings from training in processes such as the "complete process of creative problem solving" which are considered relatively more significant and useful by members of different occupational groups (e.g.: engineers, accountants, etc.), organizational functions (e.g.: manufacturing, marketing, etc.), organizational designs (bureaucratic, organic, tall/flat structures, etc.), organizational types (electronics, chemicals, engineers, accountants, etc.), and organizational levels (e.g.: vice-president, first-line supervisor, hourly worker, etc.). How and by what mechanisms do skills in creative processes and techniques improve the basic fundamental work processes in the classic business and industry functions, such as product development, market research, and engineering? For example, can such skills increase the effectiveness of market research focus groups by increasing openness among group members? In focus group interviews, members usually limit themselves to discussing problems which they believe are possible to solve, rather than expressing their true wants and needs. Companies should rather have them defer judgment as to feasibility and creatively express how they would like to see their world–a more problem *finding* mode than problem solving. As a further example, can multi-functional critical path scheduling meetings be made more productive if participants are trained to use creative attitudes and thinking skills to increase trust and risk-taking among themselves in the face of uncertainty about future events?

Summary

Most of the literature pertaining to creativity in business and industry consists of non-empirical articles attempting to convince managers to learn to use creative problem solving processes and techniques. There are also a few theoretical pieces organizing previous knowledge and ideas about creativity in organizations. These are designed to help managers increase their awareness about the role of creativity in organizations. Such literature is useful, but what is sorely needed is more empirical work. From the author's perspective the following are the five most important areas for such new research.

First, new and improved instruments must be developed to measure and identify attitudes and thinking skills associated with the successful application of creative problem solving processes and techniques by individuals and groups. Constructs and systems models describing the mechanisms by which organizational members can perform more creatively need to be built. Attitudes and thinking skills associated with solution implementation and evaluation within the complete process of creative problem solving are specific examples of concepts needing exploring (Basadur, Graen & Green, 1982). Can the model in Figure Two be validated? The external validities and reliabilities of the attitudinal concepts "valuing new ideas" and "belief that creative thinking is bizarre" need to be established and measured reliably. Is there any such thing as an optimum ideation-evaluation ratio for a given field of endeavor or stage of creativity? The internal relationships of Figure Two modelling the complete process of creative problem solving need to be tested and further developed. How does training in such a process actually work to increase individual creative performance? Are the three stages, problem finding, problem solving and solution implementation and the ideation-evaluation two step process within each stage sufficient as a basic model?

Answering such questions will serve many additional purposes. It will increase awareness and understanding so more people will learn the process. It will improve the quality yet reduce the mystery of training in the process. It will help potential trainers realize the importance of behavioral *change* in the form of new attitudes and thinking skills such as increased deferral of judgment, preference for ideation, and cognitive ideation skill before any short or long term impact of training can be expected. It will help remove some of the misunderstandings developed over the years concerning terms like "brainstorming." It is one thing to "go through the motions" of following Osborn's four rules; it is totally another thing to *learn* the ideation-triggering skills of piling up a quantity of ideas, deliberately free wheeling, and skillfully building ideas from fragments of other ideas. Some researchers have confused "brainstorming" with "group brainstorming," attempting to show that pooling the brainstorming responses of untrained individuals (kept apart) is better than using interacting brainstorming groups of untrained individuals (Taylor, Berry & Block, 1958). The issue is not individuals versus groups, but rather, can we train individuals to really increase ideation attitudes and thinking skills? Can we isolate and identify the group effects that affect the exercising of such skills and teach individuals how to maximize ideation in groups and minimize negative impacts on individual ideation skill? You cannot get something for nothing. Unless there is sufficient training and follow-up to produce significant attitudinal thinking skill improvements in trainees, no on-the-job improvements in creativity will result. The kind of research described above will help people in business and industry understand this and manage training opportunities accordingly.

Second, what kinds of support from higher management best help insure that trained creative problem solving attitudes, behaviors and thinking skills will become permanent in the organization? How can we best get higher managers to understand those support variables once identified? What blend of reward systems, boss-subordinate interface behaviors, managerial behavior-modelling, and other extrinsic and intrinsic variables are important to be managed so that trained skills and attitudes will be transformed into on-the-job habitual usage? A much

better understanding of the exogenous factors that moderate short-term impact and long-term stickability of training in creative problem solving is needed by both the managers and the trainers. Otherwise, valuable attitudes and thinking skills will continue to be left in the classroom. Trainers of processes of creative problem solving must see themselves as organizational consultants. Their work begins long before the training begins and continues long after it ends. Their job is to help their managerial clients learn how to make the new *habits* about to be trained stick permanently on the job. Their job is to transform the daily attitudes, behaviors and thinking skills of the organization. How this can be done needs thorough research and documentation.

Third, the improvement of ongoing work processes in business and industry (including the implementation of new human resource managerial concepts and techniques) by creative problem solving processes needs to be better understood and documented. It is not sufficient that trainers and consultants go into such organizations promising that training in creative problem solving will somehow "increase creativity in the organization." What does this actually mean? Such training must be preplanned with a view toward impacting selected processes and concepts. Then the training effects and mechanisms must be documented and models developed. Experience shows that the attitudes and thinking skills of the "Complete Process of Creative Problem Solving" can serve to operationalize most new and old managerial processes. Now, *how* this occurs needs understanding and documentation.

Fourth, the whole field of managerial problem solving and decision-making needs to be "de-fragmentized" and pulled together into a coherent model or systematic set of models. The complete process of creative problem solving needs to be made more visible to theorists and researchers. It offers the opportunity to incorporate many other models within it. Getting terms such as "analytical problem solving," "econologic model," "bounded rationality model," "implicit favorite model," and "programmed thinking and non-programmed thinking" systematized would be a valuable contribution to managerial and organizational science. It would provide the basis for a much more systematic approach to improving managerial thinking and decision making skills. In addition, it would help explain much better what it is that training in processes of creative problem solving can do to improve such skills.

Fifth, there is a great deal of research to be done to understand and document the effects of training and application of creative processes across different types of business and industry, different organizational designs, functions and levels, different occupational groups, and different work processes including managerial/non-managerial and professional/non-professional. Concepts such as optimum ideation-evaluation ratio by field of endeavor would fit neatly into such investigations. Developing instruments to measure individual, group and organizational thinking and problem solving styles in terms of relative preferences for various parts and stages of the complete process of creative problem solving would also be valuable. Comparing such styles across international boundaries in business and industry could be most informative. For example, most literature attempts to explain Japanese vs. North American differences in managerial problem solving and style are anecdotal or at best qualitative in nature. Solid quantitative concepts and measures are needed to make any real headway in understanding those differences.

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