SKILL ASSESSMENT

- Problem Solving, Creativity, and Innovation
- How Creative Are You?
- Innovative Attitude Scale
- Creative Style Assessment

SKILL LEARNING

- Problem Solving, Creativity, and Innovation
- Steps in Analytical Problem Solving
- Limitations of the Analytical Problem-Solving Model
- Impediments to Creative Problem Solving
- Multiple Approaches to Creativity
- Conceptual Blocks
- Conceptual Blockbusting
- International Caveats
- Hints for Applying Problem-Solving Techniques
- Fostering Creativity in Others
- Summary
- Behavioral Guidelines

SKILL ANALYSIS

- Admiral Kimmel's Failure at Pearl Harbor
- Creativity at Apple

SKILL PRACTICE

- Individual Assignment—Analytical Problem Solving
- Team Assignment—Creative Problem Solving
- Moving Up in the Rankings
- Keith Dunn and McGuffey's Restaurant
- Creative Problem-Solving Practice

SKILL APPLICATION

- Suggested Assignments
- Application Plan and Evaluation

SCORING KEYS AND COMPARISON DATA

3

Solving Problems Analytically and Creatively

SKILL DEVELOPMENT OBJECTIVES

- INCREASE PROFICIENCY IN ANALYTICAL PROBLEM SOLVING
- RECOGNIZE PERSONAL CONCEPTUAL BLOCKS
- ENHANCE CREATIVITY BY OVERCOMING CONCEPTUAL BLOCKS
- FOSTER INNOVATION AMONG OTHERS

SKILL ASSESSMENT

DIAGNOSTIC SURVEYS FOR CREATIVE PROBLEM SOLVING

Problem Solving, Creativity, and Innovation

Step 1: Before you read the material in this chapter, please respond to the following statements by writing a number from the rating scale below in the left-hand column (Pre-assessment). Your answers should reflect your attitudes and behavior as they are now, not as you would like them to be. Be honest. This instrument is designed to help you discover your level of competency in problem solving and creativity so you can tailor your learning to your specific needs. When you have completed the survey, use the scoring key at the end of the chapter to identify the skill areas discussed in this chapter that are most important for you to master.

Step 2: After you have completed the reading and the exercises in this chapter and, ideally, as many as you can of the Skill Application assignments at the end of this chapter, cover up your first set of answers. Then respond to the same statements again, this time in the right-hand column (Post-assessment). When you have completed the survey, use the scoring key at the end of the chapter to measure your progress. If your score remains low in specific skill areas, use the behavioral guidelines at the end of the Skill Learning section to guide further practice.

Rating Scale

1 Strongly disagree
2 Disagree
3 Slightly disagree
4 Slightly agree
5 Agree
6 Strongly agree

Assessment

Pre- Post-

When I encounter a routine problem:

_____ _____ 1. I state clearly and explicitly what the problem is. I avoid trying to solve it until I have defined it.

_____ _____ 2. I always generate more than one alternative solution to the problem, instead of identifying only one obvious solution.

_____ _____ 3. I keep in mind both long-term and short-term consequences as I evaluate various alternative solutions.

_____ _____ 4. I gather as much information as I can about what the problem is before trying to solve it.

_____ _____ 5. I keep steps in the problem-solving process distinct; that is, I define the problem before proposing alternative solutions, and I generate alternatives before selecting a single solution.

When faced with an ambiguous or difficult problem that does not have an easy solution:

_____ _____ 6. I try out several definitions of the problem. I don't limit myself to just one way to define it.

_____ _____ 7. I try to be flexible in the way I approach the problem by trying out several different alternative methods rather than relying on the same approach every time.

_____ _____ 8. I try to find underlying patterns among elements in the problem so that I can uncover underlying dimensions or principles that help me understand the problem.

_____ _____ 9. I try to unfreeze my thinking by asking lots of questions about the nature of the problem before considering ways to solve it.

_____ _____ 10. I try to think about the problem from both the left (logical) side of my brain and the right (intuitive) side of my brain.

_____ _____ 11. To help me understand the problem and generate alternative solutions, I use analogies and metaphors that help me identify what else this problem is like.

_____ _____ 12. I sometimes reverse my initial definition of the problem to consider whether or not the exact opposite is also true.

_____ _____ 13. I do not evaluate the merits of an alternative solution to the problem before I have generated a list of alternatives. That is, I avoid selecting one solution until I have developed several possible solutions.

_____ _____ 14. I often break down the problem into smaller components and analyze each one separately.

_____ _____ 15. I have some specific techniques that I use to help develop creative and innovative solutions to problems.

When trying to foster more creativity and innovation among those with whom I work:

_____ _____ 16. I help arrange opportunities for individuals to work on their ideas outside the constraints of their normal job assignments.

_____ _____ 17. I make sure there are divergent points of view represented or expressed in every complex problem-solving situation.

_____ _____ 18. I sometimes make outrageous suggestions to stimulate people to find new ways of approaching problems.

_____ _____ 19. I try to acquire information from individuals outside the problem-solving group who will be affected by the decision, mainly to determine their preferences and expectations.

_____ _____ 20. I sometimes involve outsiders (e.g., customers or recognized experts) in problem-solving discussions.

_____ _____ 21. I try to provide recognition not only to those who come up with creative ideas (the idea champions) but also to those who support others' ideas (supporters) and who provide resources to implement them (orchestrators).

_____ _____ 22. I encourage informed rule-breaking in pursuit of creative solutions.

How Creative Are You?©

How creative are you? The following test helps you determine if you have the personality traits, attitudes, values, motivations, and interests that characterize creativity. It is based on several years' study of attributes possessed by men and women in a variety of fields and occupations who think and act creatively.

For each statement, write in the appropriate letter:

A Agree
B Undecided or Don't Know
C Disagree

Be as frank as possible. Try not to second-guess how a creative person might respond. Turn to the end of the chapter to find the answer key and an interpretation of your scores.

1. I always work with a great deal of certainty that I am following the correct procedure for solving a particular problem.
2. It would be a waste of time for me to ask questions if I had no hope of obtaining answers.
3. I concentrate harder on whatever interests me than do most people.
4. I feel that a logical step-by-step method is best for solving problems.
5. In groups I occasionally voice opinions that seem to turn some people off.
6. I spend a great deal of time thinking about what others think of me.
7. It is more important for me to do what I believe to be right than to try to win the approval of others.
8. People who seem uncertain about things lose my respect.
9. More than other people, I need to have things interesting and exciting.
10. I know how to keep my inner impulses in check.
11. I am able to stick with difficult problems over extended periods of time.
12. On occasion I get overly enthusiastic.
13. I often get my best ideas when doing nothing in particular.
14. I rely on intuitive hunches and the feeling of "rightness" or "wrongness" when moving toward the solution of a problem.
15. When problem solving, I work faster when analyzing the problem and slower when synthesizing the information I have gathered.
16. I sometimes get a kick out of breaking the rules and doing things I am not supposed to do.
17. I like hobbies that involve collecting things.
18. Daydreaming has provided the impetus for many of my more important projects.
19. I like people who are objective and rational.
20. If I had to choose from two occupations other than the one I now have, I would rather be a physician than an explorer.
21. I can get along more easily with people if they belong to about the same social and business class as myself.
22. I have a high degree of aesthetic sensitivity.
23. I am driven to achieve high status and power in life.
24. I like people who are sure of their conclusions.
25. Inspiration has nothing to do with the successful solution of problems.
26. When I am in an argument, my greatest pleasure would be for the person who disagrees with me to become a friend, even at the price of sacrificing my point of view.
27. I am much more interested in coming up with new ideas than in trying to sell them to others.
28. I would enjoy spending an entire day alone, just "chewing the mental cud."
29. I tend to avoid situations in which I might feel inferior.
30. In evaluating information, the source is more important to me than the content.
31. I resent things being uncertain and unpredictable.
32. I like people who follow the rule "business before pleasure."
33. Self-respect is much more important than the respect of others.
34. I feel that people who strive for perfection are unwise.
35. I prefer to work with others in a team effort rather than solo.

36. I like work in which I must influence others.
37. Many problems that I encounter in life cannot be resolved in terms of right or wrong solutions.
38. It is important for me to have a place for everything and everything in its place.
39. Writers who use strange and unusual words merely want to show off.
40. Below is a list of terms that describe people. Choose 10 words that best characterize you.

energetic	persuasive	observant
fashionable	self-confident	persevering
original	cautious	habit-bound
resourceful	egotistical	independent
stern	predictable	formal
informal	dedicated	forward-looking
factual	open-minded	tactful
inhibited	enthusiastic	innovative
poised	acquisitive	practical
alert	curious	organized
unemotional	clear-thinking	understanding
dynamic	self-demanding	polished
courageous	efficient	helpful
perceptive	quick	good-natured
thorough	impulsive	determined
realistic	modest	involved
absent-minded	flexible	sociable
well-liked	restless	retiring

Innovative Attitude Scale

Indicate the extent to which each of the following statements is true of either your actual behavior or your intentions at work. That is, describe the way you are or the way you intend to be on the job. Use the scale for your responses.

Rating Scale

5 Almost always true
4 Often true
3 Not applicable
2 Seldom true
1 Almost never true

1. I openly discuss with my fellow students and colleagues how to get ahead.
2. I try new ideas and approaches to problems.
3. I take things or situations apart to find out how they work.
4. I welcome uncertainty and unusual circumstances related to my tasks.
5. I maintain an open dialogue with others who disagree with me.
6. I can be counted on to find a new use for existing methods or equipment.
7. I will usually be the first to try out a new idea or method among my colleagues or fellow students.

8. I take the opportunity to incorporate ideas from other fields or disciplines in my work.
9. I demonstrate originality in my work.
10. I will willingly work on a problem that has caused others great difficulty.
11. I provide important input regarding new solutions when working in a group.
12. I avoid jumping to conclusions about others' proposed ideas.
13. I develop contacts with experts outside my area of interest or specialty.
14. I use personal contacts to expand my options for new jobs or assignments.
15. I make time to pursue my own pet ideas or projects.
16. I set aside resources for pursuing a risky project that interests me.
17. I tolerate people who depart from organizational routine.
18. I speak out in class and in meetings.
19. I am good at working in teams to solve complex problems.
20. If my fellow students or colleagues are asked, they will say I am a wit.

Source: *Adapted from Ettlie & O'Keefe, 1982.*

Creative Style Assessment

Four alternatives exist in each of the items below. You should divide 100 points among each of the four alternatives depending on which alternative is most similar to you. Rate yourself as you are right now, not as you would like to be or as you think you should be. No correct answers exist, so be as accurate as you can. For example, in question 1, if you think alternative "A" is very similar to you, "B" is somewhat similar, and "C" and "D" are hardly similar at all, you might give 50 points to A, 30 points to B, and 10 points each to C and D. Any combination of numbers is acceptable, including 100, 0, 0, 0, or 25, 25, 25, 25. **Just be sure that for each question, the total points add up to 100.**

1. I usually approach difficult problems by:
   _____ a. Brainstorming solutions
   _____ b. Carefully evaluating alternatives
   _____ c. Engaging other people
   _____ d. Responding quickly

   100

2. My friends and colleagues usually think of me as:
   _____ a. Creative
   _____ b. Systematic
   _____ c. Collaborative
   _____ d. Competitive

   100

3. I am good at:
   _____ a. Experimenting
   _____ b. Administering
   _____ c. Empowering people
   _____ d. Meeting challenges

   100

4. When I complete a project or an assignment, I am likely to:

_____ a. Come up with a new project

_____ b. Review the results to see how I might be able to improve them

_____ c. Share what I have learned with others

_____ d. Determine the grade or the evaluation of the results

100

5. I would describe myself as:

_____ a. Flexible

_____ b. Organized

_____ c. Supportive

_____ d. Driven

100

6. I like to work on projects that:

_____ a. Let me invent something new

_____ b. Create practical improvements

_____ c. Get other people involved

_____ d. Can be completed quickly

100

7. When solving a problem, I:

_____ a. Enjoy exploring a lot of options

_____ b. Collect a lot of data

_____ c. Communicate a lot with others

_____ d. Emphasize getting the job done

100

Source: *Adapted from DeGraff & Lawrence, 2002.*

Problem Solving, Creativity, and Innovation

Problem solving is a skill that is required of every person in almost every aspect of life. Seldom does an hour go by without an individual's being faced with the need to solve some kind of problem. The manager's job, in particular, is inherently a problem-solving job. If there were no problems in organizations, there would be no need for managers. Therefore, it is hard to conceive of an incompetent problem solver succeeding as a manager.

In this chapter we offer specific guidelines and techniques for improving problem-solving skills. Two kinds of problem solving—analytical and creative—are addressed. Effective managers are able to solve problems both analytically and creatively, even though different skills are required for each type of problem. First we discuss analytical problem solving—the kind of problem solving that managers use many times each day. Then we turn to creative problem solving, a kind of problem solving that occurs less frequently. Yet this creative problem-solving ability often separates career successes from career failures, heroes from goats, and achievers from derailed executives. It can also produce a dramatic impact on organizational effectiveness. A great deal of research has highlighted the positive relationship between creative problem solving and successful organizations (Sternberg, 1999). This chapter provides guidelines for how you can become a more effective problem solver, both analytical and creative, and concludes with a brief discussion of how managers can foster creative problem solving and innovation among the people with whom they work.

Steps in Analytical Problem Solving

Most people, including managers, don't particularly like problems. Problems are time consuming, they create stress, and they never seem to go away. In fact, most people try to get rid of problems as soon as they can. Their natural tendency is to select the first reasonable solution that comes to mind (Koopman, Broekhuijsen, & Weirdsma, 1998; March, 1994; March & Simon, 1958). Unfortunately, that first solution is often not the best one. In typical problem solving, most people implement a marginally acceptable or merely satisfactory solution instead of the optimal or ideal solution. In fact, many observers have attributed the extensive failures of Internet and dot.com firms—as well as more established companies—to the abandonment of correct problem-solving principles by managers. Shortcuts in analytical problem solving by managers and entrepreneurs, they argue, have had a major negative effect on company survival (Goll & Rasheed, 1997). Malcolm Gladwell, in his intriguing book entitled *Blink* (2005), argued that people are able to make decisions and reach conclusions on very, very little data—thin slices of behavior—because of their intuitive sense. In a one or two seconds people can reach a conclusion that is as valid as the one made after studying a problem for a long time. First impressions count, he argued, and are valid a lot of the time. These first impressions and instantaneous judgments are valid, however, mainly when problems are not complex, when people have experience with the issue they are judging, and when they have developed an attunement to their own internal cues (that is, they have developed adequate self-awareness and emotional intelligence). Most of the time, the problems we face are complicated, multifaceted, and ambiguous. In such instances, effective problem-solving techniques are required, and they rely on a systematic and logical approach. This approach involves at least four steps, which are explained next.

DEFINING THE PROBLEM

The most widely accepted model of analytical problem solving is summarized in Table 3.1. This method is well known and widely utilized in firms, and it lies at the heart of the quality improvement movement. It is widely asserted that to improve effectiveness of individuals and organizations, an essential step is to learn and apply this analytical method of problem solving (see, for example, Juran, 1988; Riley, 1998). Many large organizations (e.g., Ford Motor Company, General Electric, Hewlett Packard), for example, spend millions of dollars to teach their managers this type of problem solving as part of their productivity and improvement process. Variations on this four-step approach have been implemented in various firms (e.g., Ford uses an eight-step approach), but all the steps are merely derivations of the standard model we discuss here.

Table 3.1 A Model of Problem Solving

Step	Characteristics
1. Define the problem.	• Differentiate fact from opinion. • Specify underlying causes. • Tap everyone involved for information. • State the problem explicitly. • Identify what standard is violated. • Determine whose problem it is. • Avoid stating the problem as a disguised solution.
2. Generate alternative solutions.	• Postpone evaluating alternatives. • Be sure all involved individuals generate alternatives. • Specify alternatives that are consistent with goals. • Specify both short-term and long-term alternatives. • Build on others' ideas. • Specify alternatives that solve the problem.
3. Evaluate and select an alternative.	• Evaluate relative to an optimal standard. • Evaluate systematically. • Evaluate relative to goals. • Evaluate main effects and side effects. • State the selected alternative explicitly.
4. Implement and follow up on the solution.	• Implement at the proper time and in the right sequence. • Provide opportunities for feedback. • Engender acceptance of those who are affected. • Establish an ongoing monitoring system. • Evaluate based on problem solution.

The first step is to *define* a problem. This involves diagnosing a situation so that the focus is on the real problem, not just its symptoms. For example, suppose you must deal with an employee who consistently fails to get work done on time. Slow work might be the problem, or it might be only a symptom of another underlying problem such as bad health, low morale, lack of training, or inadequate rewards. Defining the problem, therefore, requires a wide search for information. The more relevant information that is acquired, the more likely it is that the problem will be defined accurately. As Charles Kettering put it, "It ain't the things you don't know that'll get you in trouble, but the things you know for sure that ain't so."

Following are some attributes of good problem definition:

1. Factual information is differentiated from opinion or speculation. Objective data are separated from perceptions and suppositions.
2. All individuals involved are tapped as information sources. Broad participation is encouraged.
3. The problem is stated explicitly. This often helps point out ambiguities in the definition.
4. The problem definition clearly identifies what standard or expectation has been violated. Problems, by their very nature, involve the violation of some standard or expectation.

5. The problem definition must address the question "Whose problem is this?" No problems are completely independent of people. Identify for whom this is a problem.
6. The definition is not simply a disguised solution. Saying "The problem is that we need to motivate slow employees" is inappropriate because the problem is stated as a solution. The problem should be described, not resolved.

Managers often propose a solution before an adequate definition of a problem has been given. This may lead to solving the wrong problem or to reaching conclusions that are misleading or inadequate. Effectively identifying the problem in Iraq, for example, or in the merger of Daimler and Chrysler into one company, required careful analysis. Premature problem definition can become problematic. The definition step in problem solving, therefore, is extremely important.

GENERATING ALTERNATIVES

The second step is to generate alternative solutions. This requires postponing the selection of any one solution until several alternatives have been proposed. Much research on problem solving (e.g., March, 1999) supports the prescription that the quality of solutions can be significantly enhanced by considering multiple alternatives. Judgment and evaluation, therefore, must be postponed so the first acceptable solution suggested isn't the one immediately selected. The problem with evaluating and selecting an alternative too early is that we may rule out some good ideas by just not getting around to thinking about them. We hit on an idea that sounds good and we go with it, thereby never even thinking of alternatives that may be better in the long run.

Many alternative solutions should be produced before any of them are evaluated. A common problem in managerial decision making is that alternatives are evaluated as they are proposed, so the first acceptable (although frequently not optimal) one is chosen.

Some attributes of good alternative generation follow:

1. The evaluation of each proposed alternative is postponed. All relevant alternatives should be proposed before evaluation is allowed.
2. Alternatives are proposed by all individuals involved in the problem. Broad participation in proposing alternatives improves solution quality and group acceptance.
3. Alternative solutions are consistent with organizational goals or policies. Subversion and criticism are detrimental to both the organization and the alternative generation process.
4. Alternatives take into consideration both short-term and long-term consequences.
5. Alternatives build on one another. Bad ideas may become good ones if they are combined with or modified by other ideas.
6. Alternatives solve the problem that has been defined. Another problem may also be important, but it should be ignored if it does not directly affect the problem being considered.

EVALUATING ALTERNATIVES

The third problem-solving step is to evaluate and select an alternative. This step involves careful weighing of the advantages and disadvantages of the proposed alternatives before making a final selection. In selecting the best alternative, skilled problem solvers make sure that alternatives are judged in terms of the extent to which they will solve the problem without causing other unanticipated problems; the extent to which all individuals involved will accept the alternative; the extent to which implementation of the alternative is likely; and the extent to which the alternative fits within organizational constraints (e.g., is consistent with policies, norms, and budget limitations). Care is taken not to short-circuit these considerations by choosing the most conspicuous alternative without considering others. The classic description of the difficulty with problem solving—made almost 50 years ago—still remains as a core principle in problem solving (March & Simon, 1958):

> *Most human decision making, whether individual or organizational, is concerned with the discovery and selection of satisfactory alternatives; only in exceptional cases is it concerned with the discovery and selection of optimal alternatives. To optimize requires processes several orders of magnitude more complex than those required to satisfy. An example is the difference between searching a haystack to find the sharpest needle in it and searching the haystack to find a needle sharp enough to sew with.*

Given the natural tendency to select the first satisfactory solution proposed, this step deserves particular

attention in problem solving. Some attributes of good evaluation are:

1. Alternatives are evaluated relative to an optimal, rather than a satisfactory standard. Determine what is best rather than just what will work.
2. Evaluation of alternatives occurs systematically so each alternative is given due consideration. Short-circuiting evaluation inhibits selection of optimal alternatives, so adequate time for evaluation and consideration should be allowed.
3. Alternatives are evaluated in terms of the goals of the organization and the needs and expectations of the individuals' involved. Organizational goals should be met, but individual preferences should also be considered.
4. Alternatives are evaluated in terms of their probable effects. Both side effects and direct effects on the problem are considered, as well as long-term and short-term effects.
5. The alternative ultimately selected is stated explicitly. This can help ensure that everyone involved understands and agrees with the same solution, and it uncovers ambiguities.

IMPLEMENTING THE SOLUTION

The final step is to implement and follow up on the solution. A surprising amount of the time, people faced with a problem will try to jump to step 4 before having gone through steps 1 through 3. That is, they react to a problem by trying to implement a solution before they have defined it, analyzed it, or generated and evaluated alternative solutions. It is important to remember, therefore, that "getting rid of the problem" by solving it will not occur successfully without the first three steps in the process.

Implementing any problem solution requires sensitivity to possible resistance from those who will be affected by it. Almost any change engenders some resistance. Therefore, the best problem solvers are careful to select a strategy that maximizes the probability that the solution will be accepted and fully implemented. This may involve ordering that the solution be implemented by others, "selling" the solution to others, or involving others in the implementation. Several authors (e.g., Dutton & Ashford, 1993; Miller, Hickson, & Wilson, 1996; Vroom & Yetton, 1973) have provided guidelines for managers to determine which of these implementation behaviors is most appropriate under which circumstances. Generally speaking, participation by others in the implementation of a solution will increase its acceptance and decrease resistance (Black & Gregersen, 1997).

Effective implementation is usually most effective when it is accomplished in small steps or increments. Weick (1984) introduced the idea of "small wins" in which solutions to problems are implemented little by little. The idea is, implement a part of the solution that is easy to accomplish, then make the successful implementation public. Follow that up by implementing another part of the solution that is easy to accomplish, and publicize it again. Continue implementing incrementally to achieve small wins. This strategy decreases resistance (small changes are usually not worth fighting over), creates support as others observe progress (a bandwagon effect occurs), and reduces costs (failure is not career-ending, and large allocations of resources are not required before success is assured). It also helps ensure persistence and perseverance in implementation. Calvin Coolidge's well-known quotation is apropos:

> *Nothing in the world can take the place of perseverance. Talent will not; nothing is more common than unsuccessful people with talent. Genius will not; unrewarded genius is almost a proverb. Education will not; the world is full of educated derelicts. Persistence and determination alone are omnipotent.*

Of course, any implementation requires follow-up to prevent negative side effects and ensure solution of the problem. Follow-up not only helps ensure effective implementation, but it also serves a feedback function by providing information that can be used to improve future problem solving.

Some attributes of effective implementation and follow-up are:

1. Implementation occurs at the right time and in the proper sequence. It does not ignore constraining factors, and it does not come before steps 1, 2, and 3 in the problem-solving process.
2. Implementation occurs using a "small wins" strategy in order to discourage resistance and engender support.
3. The implementation process includes opportunities for feedback. How well the solution works is communicated and recurring information exchange occurs.
4. Participation by individuals affected by the problem solution is facilitated in order to create support and commitment.

5. An ongoing measurement and monitoring system is set up for the implemented solution. Long-term as well as short-term effects are assessed.
6. Evaluation of success is based on problem solution, not on side benefits. Although the solution may provide some positive outcomes, it is unsuccessful unless it solves the problem being considered.

Limitations of the Analytical Problem-Solving Model

Most experienced problem solvers are familiar with the preceding steps in analytical problem solving, which are based on empirical research results and sound rationale (March, 1994; Miller, Hickson, & Wilson, 1996; Mitroff, 1998; Zeitz, 1999). Unfortunately, managers do not always practice these steps. The demands of their jobs often pressure managers into circumventing some steps, and problem solving suffers as a result. When these four steps are followed, however, effective problem solving is markedly enhanced.

On the other hand, simply learning about and practicing these four steps does not guarantee that an individual will effectively solve all types of problems. These problem-solving steps are most effective mainly when the problems faced are straightforward, when alternatives are readily definable, when relevant information is available, and when a clear standard exists against which to judge the correctness of a solution. The main tasks are to agree upon a single definition, gather the accessible information, generate alternatives, and make an informed choice. But many managerial problems are not of this type. Definitions, information, alternatives, and standards are seldom unambiguous or readily available. In a complex, fast-paced, digital world, these conditions appear less and less frequently. Hence, knowing the steps in problem solving and being able to implement them are not necessarily the same thing.

For example, problems such as discovering why morale is so low, determining how to implement downsizing without antagonizing employees, developing a new process that will double productivity and improve customer satisfaction, or identifying ways to overcome resistance to change are common—and often very complicated—problems faced by most managers. Such problems may not always have an easily identifiable definition or set of alternative solutions available. It may not be clear how much information is needed, what the complete set of alternatives is, or how one knows if the information being obtained is accurate. Analytical problem solving may help, but something more is needed to address these problems successfully. Tom Peters said, in characterizing the modern world faced by managers: "If you're not confused, you're not paying attention."

Table 3.2 summarizes some reasons why analytical problem solving is not always effective in day-to-day managerial situations. Constraints exist on each of these four steps and stem from other individuals, from organizational processes, or from the external environment that make it difficult to follow the prescribed model. Moreover, some problems are simply not amenable to systematic or rational analysis. Sufficient and accurate information may not be available, outcomes may not be predictable, or means-ends connections may not be evident. In order to solve such problems, a new way of thinking may be required, multiple or conflicting definitions may be needed, and unprecedented alternatives may have to be generated. In short, creative problem solving must be used.

Impediments to Creative Problem Solving

As mentioned in the beginning of the chapter, analytical problem solving is focused on getting rid of problems. Creative problem solving is focused on generating something new (DeGraff & Lawrence, 2002). The trouble is, most people have trouble solving problems creatively. There are two reasons why. First, most of us misinterpret creativity as being one-dimensional—that is, creativity is limited to generating new ideas. We are not aware of the multiple strategies available for being creative, so our repertoire is restricted. Second, all of us have developed certain conceptual blocks in our problem-solving activities, of which we are mostly not aware. These blocks inhibit us from solving certain problems effectively. These blocks are largely personal, as opposed to interpersonal or organizational, so skill development is required to overcome them.

In this chapter, we focus primarily on the individual skills involved in becoming a better creative problem solver. A large literature exists on how managers and leaders can foster creativity in organizations, but this is not our focus (Zhou & Shalley, 2003). Rather, we are interested in helping you strengthen and develop your personal skills and expand your repertoire of creative problem-solving alternatives. We spend most of our time in this chapter on the problem of conceptual blocks inasmuch as it is the obstacle people have the most difficulty addressing. However, the first problem—the need to

Table 3.2 Some Constraints on the Analytical Problem-Solving Model

Step	Constraints
1. Define the problem.	• There is seldom consensus as to the definition of the problem. • There is often uncertainty as to whose definition will be accepted. • Problems are usually defined in terms of the solutions already possessed. • Symptoms get confused with the real problem. • Confusing information inhibits problem identification.
2. Generate alternative solutions.	• Solution alternatives are usually evaluated one at a time as they are proposed. • Few of the possible alternatives are usually known. • The first acceptable solution is usually accepted. • Alternatives are based on what was successful in the past.
3. Evaluate and select an alternative.	• Limited information about each alternative is usually available. • Search for information occurs close to home—in easily accessible places. • The type of information available is constrained by factors such as primacy versus recency, extremity versus centrality, expected versus surprising, and correlation versus causation. • Gathering information on each alternative is costly. • Preferences of which is the best alternative are not always known. • Satisfactory solutions, not optimal ones, are usually accepted. • Solutions are often selected by oversight or default. • Solutions often are implemented before the problem is defined.
4. Implement and follow up on the solution.	• Acceptance by others of the solution is not always forthcoming. • Resistance to change is a universal phenomenon. • It is not always clear what part of the solution should be monitored or measured in follow-up. • Political and organizational processes must be managed in any implementation effort. • It may take a long time to implement a solution.

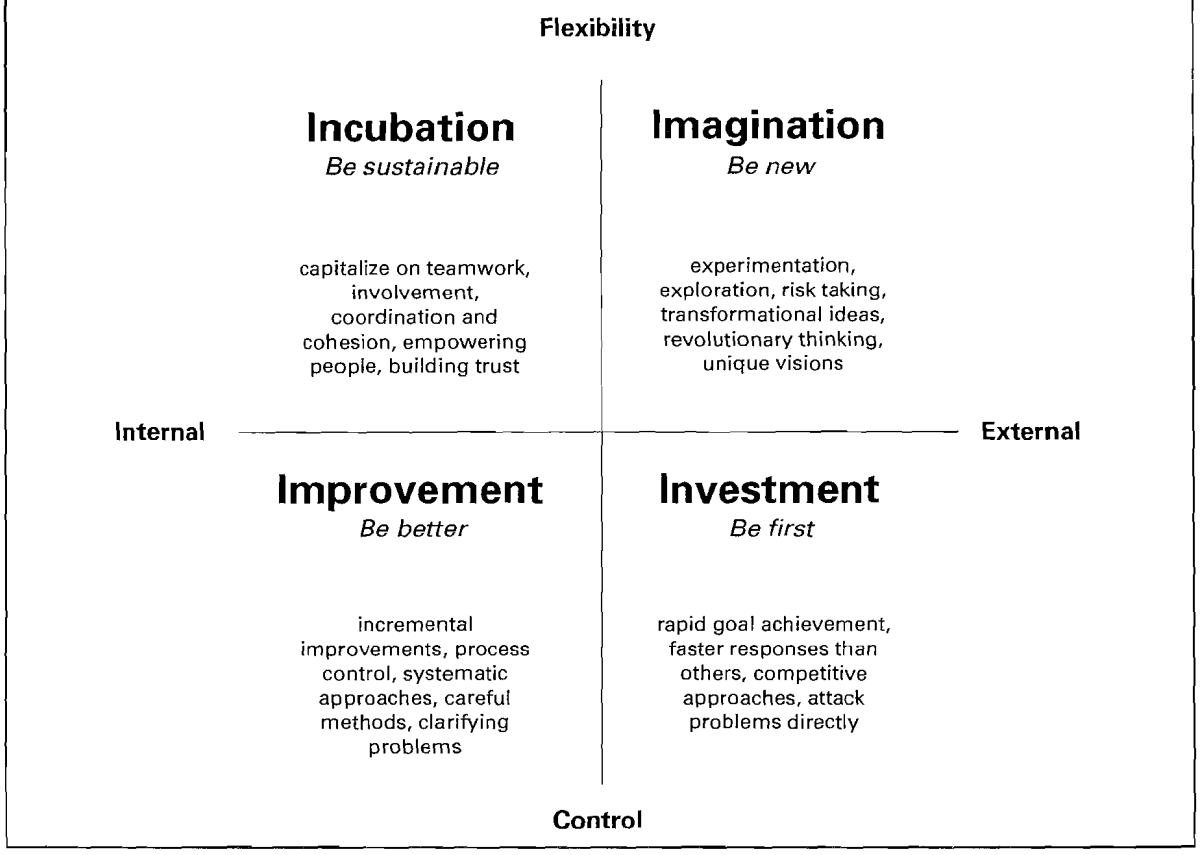
develop multiple approaches to creativity—is also important and is addressed in the section that follows.

Multiple Approaches to Creativity

One of the most sophisticated approaches to creativity identifies four distinct methods for achieving it. This approach is based on the Competing Values Framework (Cameron, Quinn, DeGraff, & Thakor, 2006), which identifies competing or conflicting dimensions that describe people's attitudes, values, and behaviors. Figure 3.1 describes the four different types of creativity and the relationships. These four types were developed by our colleague Jeff DeGraff (DeGraff & Lawrence, 2002).

For example, achieving creativity through **imagination** refers to the *creation* of new ideas, breakthroughs, and radical approaches to problem solving. People who pursue creativity in this way tend to be experimenters, speculators, and entrepreneurs,

Figure 3.1 Four Types of Creativity



Source: *Adapted from DeGraff & Lawrence, 2002.*

and they define creativity as exploration, new product innovation, or developing unique visions of possibilities. When facing difficult problems in need of problem solving, their approach is focused on coming up with revolutionary possibilities and unique solutions. Well-known examples include Steve Jobs at Apple, the developer of the iPod and the Macintosh computer, and Walt Disney, the creator of animated movies and theme parks. Both of these people approached problem solving by generating radically new ideas and products that created entirely new industries. The most famous design firm in the world—*Ideo* in Palo Alto, California—produces more than 90 new products a year and has become renowned for creating product designs that no one had ever thought of before—neat-squeeze toothpaste containers, computer mouses, flat-screen monitors, Nerf footballs. They hire radical thinkers, rule breakers, and risk takers to think "outside the box."

People may also achieve creativity, however, through opposite means—that is, by developing incrementally better alternatives, *improving* on what already exists, or clarifying the ambiguity that is associated with the problem. Rather than being revolutionaries and risk takers, they are systematic, careful, and thorough. Creativity comes by finding ways to improve processes or functions. An example is Ray Kroc, the magician behind McDonald's remarkable success. As a salesman in the 1950s, Kroc bought out a restaurant in San Bernardino, California, from the McDonald brothers and, by creatively changing the way hamburgers were made and served, he created the largest food service company in the world. He didn't invent fast food—White Castle and Dairy Queen had long been established—but he changed the processes. Creating a limited, standardized menu, uniform cooking procedures, consistent service quality, cleanliness of facilities, and inexpensive food—no matter where in the country

(and now, in the world) you eat—demonstrated a very different approach to creativity. Instead of breakthrough ideas, Kroc's secret was incremental improvements on existing ideas. This type of creativity is referred to as **improvement.**

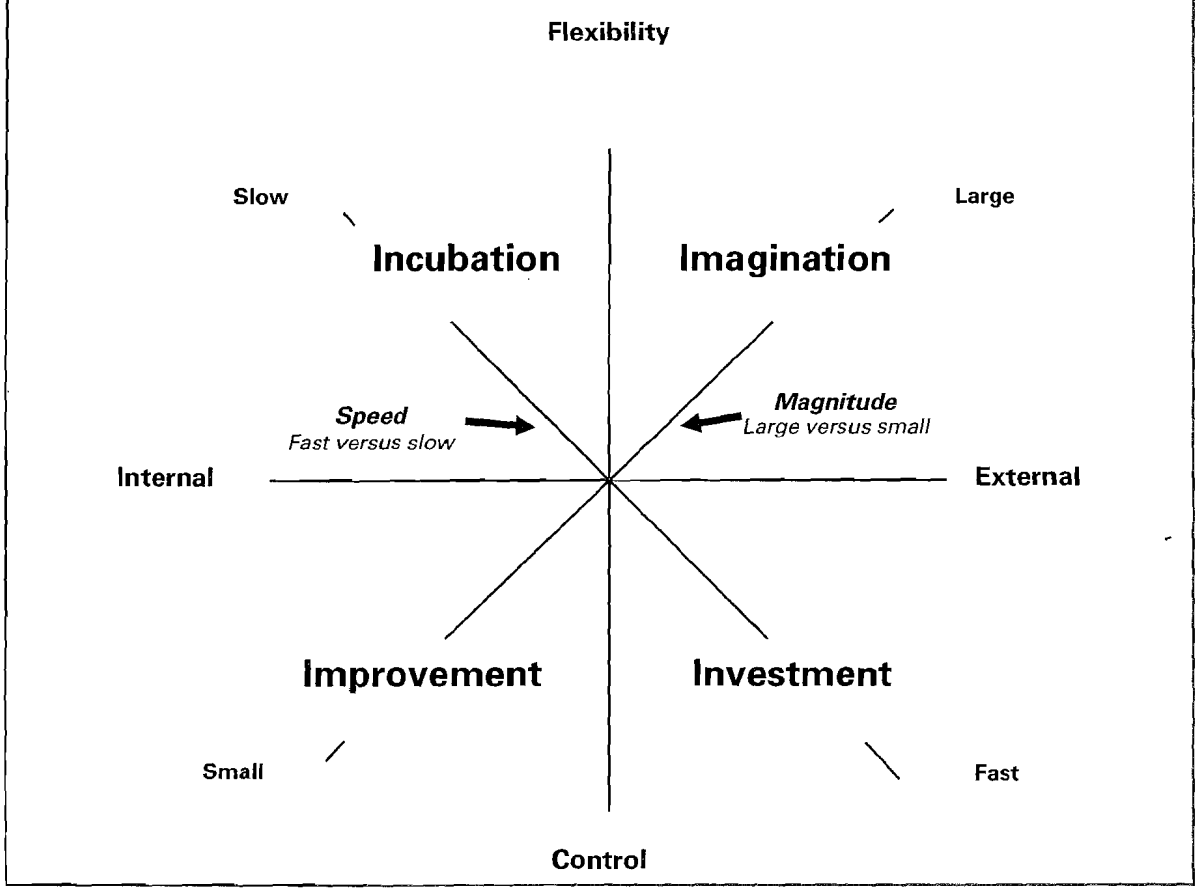
A third type of creativity is called **investment,** or the pursuit of rapid goal achievement and *competitiveness.* People who approach creativity in this way meet challenges head on, adopt a competitive posture, and focus on achieving results faster than others. People achieve creativity by working harder than the competition, exploiting others' weaknesses, and being first to offer a product, service, or idea. The advantages of being a "first mover" company are well-known. This kind of creativity can be illustrated by Honda President Kawashima in the "Honda-Yamaha Motorcycle War." Honda became the industry leader in motorcycles in Japan in the 1960s but decided to enter the automobile market in the 1970s. Yamaha saw this as an opportunity to overtake Honda in motorcycle market share in Japan. In public speeches at the beginning of the 1980s, Yamaha's President Koike promised that Yamaha would soon overtake Honda in motorcycle production because of Honda's new focus on automobiles. "In a year we will be the domestic leader, and in two years we will be number one in the world," touted Koike in his 1982 shareholders' meeting. At the beginning of 1983, Honda's president replied: "As long as I am president of this company, we will surrender our number one spot to no one . . . *Yamaha wo tubusu*!"—meaning, we will smash, break, annihilate, destroy Yamaha. In the next year, Honda introduced 81 new models of motorcycles and discontinued 32 models for a total of 113 changes to its product line. In the following year, Honda introduced 39 additional models and added 18 changes to the 50cc line. Yamaha's sales plummeted 50 percent and the firm endured a loss of 24 billion yen for the year. Yamaha's president conceded: "I would like to end the Honda-Yamaha war . . . From now on we will move cautiously and ensure Yamaha's relative position as second to Honda." Approaching creativity through investment—rapid response, competitive maneuvering, and being the first mover—characterized Honda president Kawashima's approach to creativity.

The fourth type of creativity is **incubation.** This refers to an approach to creative activity through teamwork, involvement, and coordination among individuals. Creativity occurs by unlocking the potential that exists in interactions among networks of people. Individuals who approach creativity through incubation encourage people to work together, foster trust and cohesion, and empower others. Creativity arises from a collective mindset and shared values. For example, Mahatma Gandhi was probably the only person in modern history who has single-handedly stopped a war. Lone individuals have started wars, but Gandhi was creative enough to stop one. He did so by mobilizing networks of people to pursue a clear vision and set of values. Gandhi would probably have been completely noncreative and ineffective had he not been adept at capitalizing on incubation dynamics. By mobilizing people to march to the sea to make salt, or to burn passes that demarcated ethnic group status, Gandhi was able to engender creative outcomes that had not been considered possible. He was a master at incubation by connecting, involving, and coordinating people. The same could be said for Bill Wilson, the founder of Alcoholics Anonymous, whose 12-step program is the foundation for almost all addiction treatment organizations around the world—gambling addiction, drug addiction, eating disorders, and so on. To cure his own alcoholism, Wilson began meeting with others with the same problem and, over time, developed a very creative way to help himself as well as other people overcome their dependencies. The genius behind Alcoholics Anonymous is the creativity that emerges when human interactions are facilitated and encouraged.

Figure 3.2 helps place these four types of creativity into perspective. You will note that imagination and improvement emphasize opposite approaches to creativity. They differ in the *magnitude* of the creative ideas being pursued. Imagination focuses on new, revolutionary solutions to problems. Improvement focuses on incremental, controlled solutions. Investment and incubation are also contradictory and opposing in their approach to creativity. They differ in *speed* of response. Investment focuses on fast, competitive responses to problems, whereas incubation emphasizes more developmental and deliberate responses.

It is important to point out that no one approach to creativity is best. Different circumstances call for different approaches. For example, Ray Kroc and McDonald's would not have been successful with an imagination strategy (revolutionary change), and Walt Disney would not have been effective with an incubation strategy (group consensus). Kawashima at Honda could not afford to wait for an incubation strategy (slow, developmental change), whereas it would have made no sense for Gandhi to approach creativity using investment (a competitive approach). Different circumstances require different approaches. Circumstances in which each of these four approaches to creativity are most effective are listed in Figure 3.3.

Figure 3.2 Key Dimensions of Four Types of Creativity



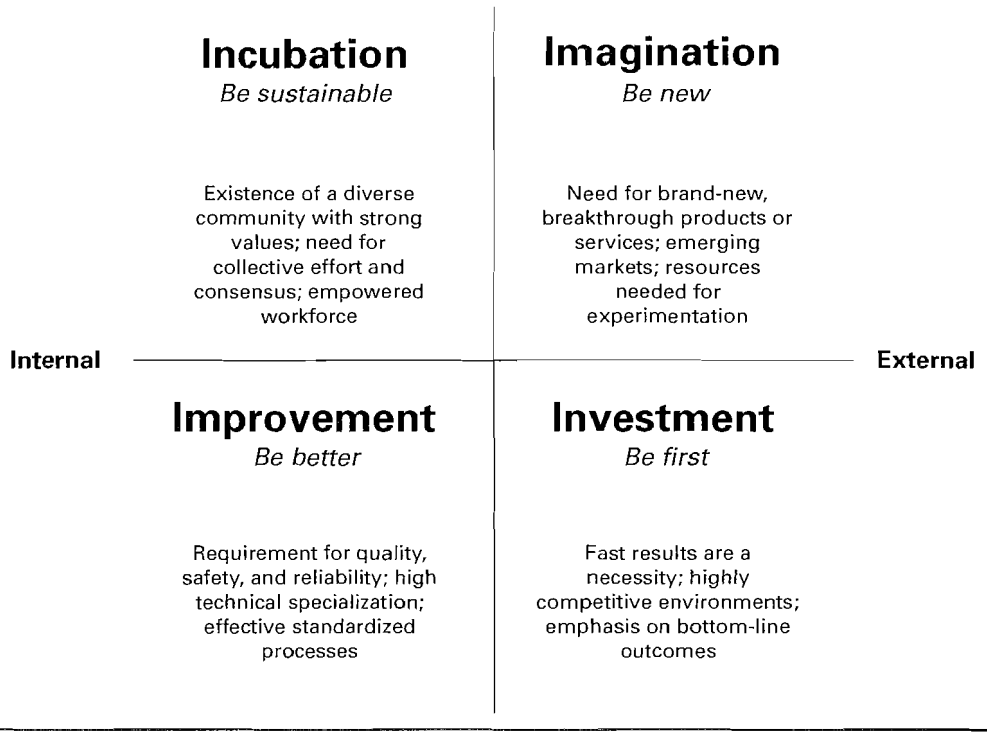
Source: *Adapted from DeGraff & Lawrence, 2002.*

This figure shows that imagination is the most appropriate approach to creativity when breakthroughs are needed and when original ideas are necessary—being new. The improvement approach is most appropriate when incremental changes or tightening up processes are necessary—being better. The investment approach is most appropriate when quick responses and goal achievement takes priority—being first. And, the incubation approach is most appropriate when collective effort and involvement of others is important—being sustainable.

The Creativity Assessment survey that you completed in the Pre-assessment section helps identify your own preferences regarding these different approaches to creativity. You were able to create a profile showing the extent to which you are inclined toward imagination, improvement, investment, or incubation as you approach problems calling for creativity. Your profile will help you determine which kinds of problems you are inclined to solve when creativity is required. Of course, having a preference is not the same as having ability or possessing competence in a certain approach, but the remainder of this chapter as well as several additional chapters in this book will help with your creative competence development.

Your profile is in the shape of a kite, and it identifies your most preferred style of creativity. The quadrant in which you score highest is your preferred approach but you will notice that you do not have a single approach. No one gives all of their points to a single alternative. Just as you have points in each of the four quadrants on the creativity profile, you also have an inclination to approach creativity in multiple ways. However, most people have certain dominant inclinations toward creativity, and those inclinations are helpful guides to you as you approach problems.

Figure 3.3 Examples of Situations in Which Each Approach Is Effective



Source: *Adapted from DeGraff & Lawrence, 2002.*

Most of us are not aware that we can be creative in multiple ways, yet anyone can be creative and add value to problem solving. Just because you are not a clever producer of unique ideas, for example, does not mean that you are not creative and cannot add value to the creative process.

Conceptual Blocks

The trouble is, each of these different approaches to creativity can be inhibited. That is, in addition to being unaware of the multiple ways in which we can be creative, most of us have difficulty in solving problems creatively because of the presence of **conceptual blocks.** Conceptual blocks are mental obstacles that constrain the way problems are defined, and they can inhibit us from being effective in any of the four types of creativity. Conceptual blocks limit the number of alternative solutions that people think about (Adams, 2001). Every individual has conceptual blocks, but some people have more numerous and more intense ones than others. These blocks are largely unrecognized or unconscious, so the only way individuals can be made aware of them is to be confronted with problems that are unsolvable because of them. Conceptual blocks result largely from the thinking processes that problem solvers use when facing problems. Everyone develops some conceptual blocks over time. In fact, we need some of them to cope with everyday life. Here's why.

At every moment, each of us is bombarded with far more information than we can possibly absorb. For example, you are probably not conscious right now of the temperature of the room, the color of your skin, the level of illumination overhead, or how your toes feel in your shoes. All of this information is available to you and is being processed by your brain, but you have tuned out some things and focused on others. Over time, you must develop the habit of mentally filtering out some of the information to which you are exposed; otherwise, information overload would drive you crazy. These filtering habits eventually become conceptual habits or blocks. Though you are not conscious of them, they inhibit you from registering some kinds of information and, therefore, from solving certain kinds of problems.

Paradoxically, the more formal education individuals have, and the more experience they have in a job, the less able they are to solve problems in creative ways. It has been estimated that most adults over 40 display less than two percent of the creative problem-solving ability of a child under five years old. That's because formal education often prescribes "right" answers, analytic rules, or thinking boundaries. Experience in a job often leads to "proper" ways of doing things, specialized knowledge, and rigid expectation of appropriate actions. Individuals lose the ability to experiment, improvise, or take mental detours. Consider the following example:

> *If you place in a bottle half a dozen bees and the same number of flies, and lay the bottle down horizontally, with its base to the window, you will find that the bees will persist, till they die of exhaustion or hunger, in their endeavor to discover an issue through the glass; while the flies, in less than two minutes, will all have sallied forth through the neck on the opposite side. . . . It is [the bees'] love of light, it is their very intelligence, that is their undoing in this experiment. They evidently imagine that the issue from every prison must be there when the light shines clearest; and they act in accordance, and persist in too logical an action. To them glass is a supernatural mystery they never have met in nature; they have had no experience of this suddenly impenetrable atmosphere; and the greater their intelligence, the more inadmissible, more incomprehensible, will the strange obstacle appear. Whereas the feather-brained flies, careless of logic as of the enigma of crystal, disregarding the call of the light, flutter wildly, hither and thither, meeting here the good fortune that often waits on the simple, who find salvation where the wiser will perish, necessarily end by discovering the friendly opening that restores their liberty to them (Weick, 1995, p. 59).*

This illustration identifies a paradox inherent in learning to solve problems creatively. On the one hand, more education and experience may inhibit creative problem solving and reinforce conceptual blocks. Like the bees in the story, individuals may not find solutions because the problem requires less "educated," more "playful" approaches. On the other hand, as several researchers have found, training focused on improving thinking significantly enhances creative problem-solving abilities and managerial effectiveness (Albert & Runco, 1999; Mumford, Baughman, Maher, Costanza, & Supinski, 1997; Nickerson, 1999; Smith, 1998).

For example, research has found that training in thinking increased the number of good ideas produced in problem solving by more than 125 percent (Scope, 1999). Creativity in art, music composition, problem finding, problem construction, and idea generation have been found to improve substantially when training in creative problem solving and thinking skills is received (de Bono, 1973, 1992; Finke, Ward, & Smith, 1992; Getzels & Csikszentmihalyi, 1976; Nickerson, 1999; Starko, 2001). Moreover, substantial data also exists that such training can enhance the profitability and efficiency of organizations (Williams & Yang, 1999). Many organizations—such as Microsoft, General Electric, and AT&T—now send their executives to creativity workshops in order to improve their creative-thinking abilities. Creative problem-solving experts are currently hot properties on the consulting circuit, and about a million copies of books on creativity are sold each year in North America. Several well-known products have been produced as a direct result of this kind of training: for example, NASA's Velcro snaps, G.E.'s self-diagnostic dishwashers, Mead's carbonless copy paper, and Kodak's Trimprint film.

Resolving this paradox is not just a matter of more exposure to information or education. Rather, people must master the process of thinking about certain problems in a creative way. As Csikszentmihalyi (1996, p. 11) observed:

> *Each of us is born with two contradictory sets of instructions: a conservative tendency, made up of instincts for self-preservation, self-aggrandizement, and saving energy, and an expansive tendency made up of instincts for exploring, for enjoying novelty and risk—the curiosity that leads to creativity belongs to this set. We need both of these programs. But whereas the first tendency requires little encouragement or support from the outside to motivate behavior, the second can wilt if it is not cultivated. If too few opportunities for curiosity are available, if too many obstacles are placed in the way of risk and exploration, the motivation to engage in creative behavior is easily extinguished.*

In the next section, we focus on problems that require creative rather than analytical solutions. These are problems for which no acceptable alternative seems to be available, all reasonable solutions seem to

be blocked, or no obvious best answer is accessible. Analytical problem solving just doesn't seem to apply. This situation often exists because conceptual blocks inhibit the range of solutions thought possible. We introduce some tools and techniques that help overcome conceptual blocks and unlock problem-solving creativity. First consider these two examples that illustrate creative problem solving and breaking through conceptual blocks.

PERCY SPENCER'S MAGNETRON

During World War II, the British developed one of the best-kept military secrets of the war, a special radar detector based on a device called the magnetron. This radar was credited with turning the tide of battle in the war between Britain and Germany and helping the British withstand Hitler's Blitzkrieg. In 1940, Raytheon was one of several U.S. firms invited to produce magnetrons for the war effort.

The workings of magnetrons were not well understood, even by sophisticated physicists. Even among the firms that made magnetrons, few understood what made them work. A magnetron was tested, in those early days, by holding a neon tube next to it. If the neon tube got bright enough, the magnetron tube passed the test. In the process of conducting the test, the hands of the scientist holding the neon tube got warm. It was this phenomenon that led to a major creative breakthrough that eventually transformed lifestyles throughout the world.

At the end of the war, the market for radar essentially dried up, and most firms stopped producing magnetrons. At Raytheon, however, a scientist named Percy Spencer had been fooling around with magnetrons, trying to think of alternative uses for the devices. He was convinced that magnetrons could be used to cook food by using the heat produced in the neon tube. But Raytheon was in the defense business. Next to its two prize products—the Hawk and Sparrow missiles—cooking devices seemed odd and out of place. Percy Spencer was convinced that Raytheon should continue to produce magnetrons, even though production costs were prohibitively high. But Raytheon had lost money on the devices, and now there was no available market for magnetrons. The consumer product Spencer had in mind did not fit within the bounds of Raytheon's business.

As it turned out, Percy Spencer's solution to Raytheon's problem produced the microwave oven and a revolution in cooking methods throughout the world. Later, we will analyze several problem-solving techniques illustrated by Spencer's creative triumph.

SPENCE SILVER'S GLUE

A second example of creative problem solving began with Spence Silver's assignment to work on a temporary project team within the 3M company. The team was searching for new adhesives, so Silver obtained some material from AMD, Inc., which had potential for a new polymer-based adhesive. He described one of his experiments in this way: "In the course of this exploration, I tried an experiment with one of the monomers in which I wanted to see what would happen if I put a lot of it into the reaction mixture. Before, we had used amounts that would correspond to conventional wisdom" (Nayak & Ketteringham, 1986). The result was a substance that failed all the conventional 3M tests for adhesives. It didn't stick. It preferred its own molecules to the molecules of any other substance. It was more cohesive than adhesive. It sort of "hung around without making a commitment." It was a "now-it-works, now-it-doesn't" kind of glue.

For five years, Silver went from department to department within the company trying to find someone interested in using his newly found substance in a product. Silver had found a solution; he just couldn't find a problem to solve with it. Predictably, 3M showed little interest. The company's mission was to make adhesives that adhered ever more tightly. The ultimate adhesive was one that formed an unbreakable bond, not one that formed a temporary bond.

After four years the task force was disbanded, and team members were assigned to other projects. But Silver was still convinced that his substance was good for something. He just didn't know what. As it turned out, Silver's solution has become the prototype for innovation in American firms, and it has spawned a multibillion-dollar business for 3M—in a unique product called Post-It Notes.

These two examples are positive illustrations of how solving a problem in a unique way can lead to phenomenal business success. Creative problem solving can have remarkable effects on individuals' careers and on business success. To understand how to solve problems creatively, however, we must first consider the blocks that inhibit creativity.

THE FOUR TYPES OF CONCEPTUAL BLOCKS

Table 3.3 summarizes four types of conceptual blocks that inhibit creative problem solving. Each is discussed and illustrated below with problems or exercises. We encourage you to complete the exercises and solve the

Table 3.3 Conceptual Blocks That Inhibit Creative Problem Solving

1. *Constancy*	
• Vertical thinking	Defining a problem in only one way without considering alternative views.
• One thinking language	Not using more than one language to define and assess the problem.
2. *Commitment*	
• Stereotyping based on past experience	Present problems are seen only as the variations of past problems.
• Ignoring commonalities	Failing to perceive commonalities among elements that initially appear to be different.
3. *Compression*	
• Distinguishing figure from ground	Not filtering out irrelevant information or finding needed information.
• Artificial constraints	Defining the boundaries of a problem too narrowly.
4. *Complacency*	
• Noninquisitiveness	Not asking questions.
• Nonthinking	A bias toward activity in place of mental work.

problems as you read the chapter, because doing so will help you become aware of your own conceptual blocks. Later, we shall discuss in more detail how you can overcome those blocks.

Constancy

One type of conceptual block occurs because individuals become wedded to one way of looking at a problem or using one approach to define, describe, or solve it. It is easy to see why **constancy** is common in problem solving. Being constant, or consistent, is a highly valued attribute for most of us. We like to appear at least moderately consistent in our approach to life, and constancy is often associated with maturity, honesty, and even intelligence. We judge lack of constancy as untrustworthy, peculiar, or airheaded. Some prominent psychologists theorize, in fact, that a need for constancy is the primary motivator of human behavior (Festinger, 1957; Heider, 1946; Newcomb, 1954). Many psychological studies have shown that once individuals take a stand or employ a particular approach to a problem, they are highly likely to pursue that same course without deviation in the future (see Cialdini, 2001, for multiple examples).

On the other hand, constancy can inhibit the solution of some kinds of problems. Consistency sometimes drives out creativity. Two illustrations of the constancy block are vertical thinking and using only one thinking language.

Vertical Thinking The term **vertical thinking** was coined by Edward de Bono (1968, 2000). It refers to defining a problem in a single way and then pursuing that definition without deviation until a solution is reached. No alternative definitions are considered. All information gathered and all alternatives generated are consistent with the original definition. De Bono contrasted lateral thinking to vertical thinking in the following ways: vertical thinking focuses on continuity, lateral thinking focuses on discontinuity; vertical thinking chooses, lateral thinking changes; vertical thinking is concerned with stability, lateral thinking is concerned with instability; vertical thinking searches for what is right, lateral thinking searches for what is different; vertical thinking is analytical, lateral thinking is provocative; vertical thinking is concerned with where an idea came from, lateral thinking is concerned with where the idea is going; vertical thinking moves in the most likely directions, lateral thinking moves in the least likely directions; vertical thinking develops an idea, lateral thinking discovers the idea.

In a search for oil, for example, vertical thinkers determine a spot for the hole and drill the hole deeper and deeper until they strike oil. Lateral thinkers, on the other hand, drill a number of holes in different places in

search of oil. The vertical-thinking conceptual block arises from not being able to view the problem from multiple perspectives—to drill several holes—or to think laterally as well as vertically in problem solving.

Plenty of examples exist of creative solutions that occurred because an individual refused to get stuck with a single problem definition. Alexander Graham Bell was trying to devise a hearing aid when he shifted definitions and invented the telephone. Harland Sanders was trying to sell his recipe to restaurants when he shifted definitions and developed his Kentucky Fried Chicken business. Karl Jansky was studying telephone static when he shifted definitions, discovered radio waves from the Milky Way galaxy, and developed the science of radio astronomy.

In developing the microwave industry described earlier, Percy Spencer shifted the definition of the problem from "How can we save our military radar business at the end of the war?" to "What other applications can be made for the magnetron?" Other problem definitions followed, such as: "How can we make magnetrons cheaper?" "How can we mass-produce magnetrons?" "How can we convince someone besides the military to buy magnetrons?" "How can we enter a consumer products market?" "How can we make microwave ovens practical and safe?" And so on. Each new problem definition led to new ways of thinking about the problem, new alternative approaches, and, eventually, to a new microwave oven industry.

Spence Silver at 3M is another example of someone who changed problem definitions. He began with "How can I get an adhesive that has a stronger bond?" but switched to "How can I find an application for an adhesive that doesn't stick firmly?" Eventually, other problem definitions followed: "How can we get this new glue to stick to one surface but not another (e.g., to notepaper but not normal paper)?" "How can we replace staples, thumbtacks, and paper clips in the workplace?" "How can we manufacture and package a product that uses nonadhesive glue?" "How can we get anyone to pay $1.00 a pad for scratch paper?" And so on.

Shifting definitions is not easy, of course, because it is not natural. It requires individuals to deflect their tendency toward constancy. Later, we will discuss some hints and tools that can help overcome the constancy block while avoiding the negative consequences of inconsistency.

A Single Thinking Language A second manifestation of the constancy block is the use of only one **thinking language**. Most people think in words—that is, they think about a problem and its solution in terms of verbal language. **Analytical problem solving** reinforces this approach. Some writers, in fact, have argued that thinking cannot even occur without words (Feldman, 1999; Vygotsky, 1962). Other thought languages are available, however, such as nonverbal or symbolic languages (e.g., mathematics), sensory imagery (e.g., smelling or tactile sensation), feelings and emotions (e.g., happiness, fear, or anger), and visual imagery (e.g., mental pictures). The more languages available to problem solvers, the better and more creative will be their solutions. As Koestler (1964, p. 177) puts it, "[Verbal] language can become a screen which stands between the thinker and reality. This is the reason that true creativity often starts where [verbal] language ends."

Percy Spencer at Raytheon is a prime example of a visual thinker:

> *One day, while Spencer was lunching with Dr. Ivan Getting and several other Raytheon scientists, a mathematical question arose. Several men, in a familiar reflex, pulled out their slide rules, but before any could complete the equation, Spencer gave the answer. Dr. Getting was astonished. "How did you do that?" he asked. "The root," said Spencer shortly. "I learned cube roots and squares by using blocks as a boy. Since then, all I have to do is visualize them placed together." (Scott, 1974, p. 287)*

The microwave oven depended on Spencer's command of multiple thinking languages. Furthermore, the new oven would never have gotten off the ground without a critical incident that illustrates the power of visual thinking. By 1965, Raytheon was just about to give up on any consumer application of the magnetron when a meeting was held with George Foerstner, president of the recently acquired Amana Refrigeration Company. In the meeting, costs, applications, manufacturing obstacles, and production issues were discussed. Foerstner galvanized the entire microwave oven effort with the following statement, as reported by a Raytheon vice president.

> *George says, "It's no problem. It's about the same size as an air conditioner. It weighs about the same. It should sell for the same. So we'll price it at $499." Now you think that's silly, but you stop and think about it. Here's a man who really didn't understand the technologies. But there is about the same amount of copper involved, the same amount of steel as an air conditioner. And these are basic raw*

materials. It didn't make a lot of difference how you fit them together to make them work. They're both boxes; they're both made out of sheet metal; and they both require some sort of trim. (Nayak & Ketteringham, 1986, p. 181)

In several short sentences, Foerstner had taken one of the most complicated military secrets of World War II and translated it into something no more complex than a room air conditioner. He had painted a picture of an application that no one else had been able to capture by describing a magnetron visually, as a familiar object, not as a set of calculations, formulas, or blueprints.

A similar occurrence in the Post-It Note chronology also led to a breakthrough. Spence Silver had been trying for years to get someone in 3M to adopt his unsticky glue. Art Fry, another scientist with 3M, had heard Silver's presentations before. One day while singing in North Presbyterian Church in St. Paul, Minnesota, Fry was fumbling around with the slips of paper that marked the various hymns in his book. Suddenly, a visual image popped into his mind.

I thought, "Gee, if I had a little adhesive on these bookmarks, that would be just the ticket." So I decided to check into that idea the next week at work. What I had in mind was Silver's adhesive. . . . I knew I had a much bigger discovery than that. I also now realized that the primary application for Silver's adhesive was not to put it on a fixed surface like bulletin boards. That was a secondary application. The primary application concerned paper to paper. I realized that immediately." (Nayak & Ketteringham, 1986, pp. 63–64)

Years of verbal descriptions had not led to any applications for Silver's glue. Tactile thinking (handling the glue) also had not produced many ideas. However, thinking about the product in visual terms, as applied to what Fry initially called "a better bookmark," led to the breakthrough that was needed.

This emphasis on using alternative thinking languages, especially visual thinking, has become a new frontier in scientific research (McKim, 1997). With the advent of the digital revolution, scientists are more and more working with pictures and simulated images rather than with numerical data. "Scientists who are using the new computer graphics say that by viewing images instead of numbers, a fundamental change in the way researchers think and work is occurring. People have a lot easier time getting an intuition from pictures than they do from numbers and tables or formulas. In most physics experiments, the answer used to be a number or a string of numbers. In the last few years the answer has increasingly become a picture" (Markoff, 1988, p. D3).

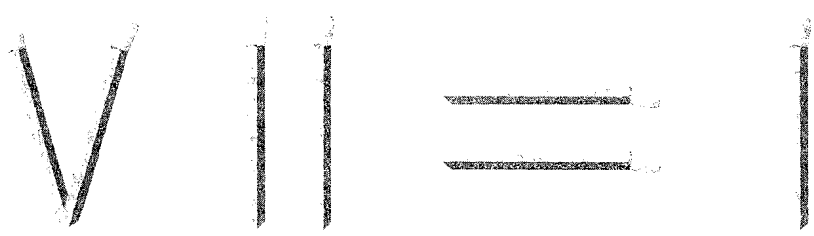
To illustrate the differences among thinking languages, consider the following simple problem:

Figure 3.4 shows seven matchsticks. By moving only one matchstick, make the figure into a true equality (i.e., the value on one side equals the value on the other side). Before looking up the answers in the section at the end of the chapter with scoring keys and comparison data, try defining the problem by using different thinking languages. What thinking language is most effective?

Commitment

Commitment can also serve as a conceptual block to creative problem solving. Once individuals become committed to a particular point of view, definition, or solution, it is likely that they will follow through on that commitment. Cialdini (2001) reported a study, for example, in which investigators asked Californians to put a large, poorly lettered sign on their front lawns saying DRIVE CAREFULLY. Only 17 percent agreed to do so. However,

Figure 3.4 The Matchstick Configuration



after signing a petition favoring "keep California beautiful," the people were again asked to put the DRIVE CAREFULLY sign on their lawns, and 76 percent agreed to do so. Once they had committed to being active and involved citizens (i.e., to keeping California beautiful), it was consistent for these people to agree to the large unsightly sign as visible evidence of their commitment. Most people have the same inclination toward being consistent and maintaining commitments.

Two forms of commitment that produce conceptual blocks are stereotyping based on past experiences and ignoring commonalities.

Stereotyping Based on Past Experiences March (1999) pointed out that a major obstacle to innovative problem solving is that individuals tend to define present problems in terms of problems they have faced in the past. Current problems are usually seen as variations on some past situation, so the alternatives proposed to solve the current problem are ones that have proven successful in the past. Both problem definitions and proposed solutions are therefore restricted by past experience. This restriction is referred to as **perceptual stereotyping** (Adams, 2001). That is, certain preconceptions formed on the basis of past experience determine how an individual defines a situation.

When individuals receive an initial cue regarding the definition of a problem, all subsequent problems are frequently framed in terms of the initial cue. Of course, this is not all bad, because perceptual stereotyping helps organize problems on the basis of a limited amount of data, and the need to consciously analyze every problem encountered is eliminated. On the other hand, perceptual stereotyping prevents individuals from viewing a problem in novel ways.

The creation of microwave ovens and of Post-It Notes provide examples of overcoming stereotyping based on past experiences. Scott (1974) described the first meeting of John D. Cockcroft, technical leader of the British radar system that invented magnetrons, and Percy Spencer of Raytheon.

> *Cockcroft liked Spencer at once. He showed him the magnetron, and the American regarded it thoughtfully. He asked questions—very intelligent ones—about how it was produced, and the Britisher answered at length. Later Spencer wrote, "The technique of making these tubes, as described to us, was awkward and impractical." Awkward and impractical! Nobody else dared draw such a judgment about a product of undoubted scientific brilliance, produced and displayed by the leaders of British science.*

Despite his admiration for Cockcroft and the magnificent magnetron, Spencer refused to abandon his curious and inquisitive stance. Rather than adopting the position of other scientists and assuming that since the British invented it and were using it, they surely knew how to produce a magnetron, Spencer broke out of the stereotypes and pushed for improvements.

Similarly, Spence Silver at 3M described his invention in terms of breaking stereotypes based on past experience.

> *The key to the Post-It adhesive was doing the experiment. If I had sat down and factored it out beforehand, and thought about it, I wouldn't have done the experiment. If I had really seriously cracked the books and gone through the literature, I would have stopped. The literature was full of examples that said you can't do this. (Nayak & Ketteringham, 1986, p. 57)*

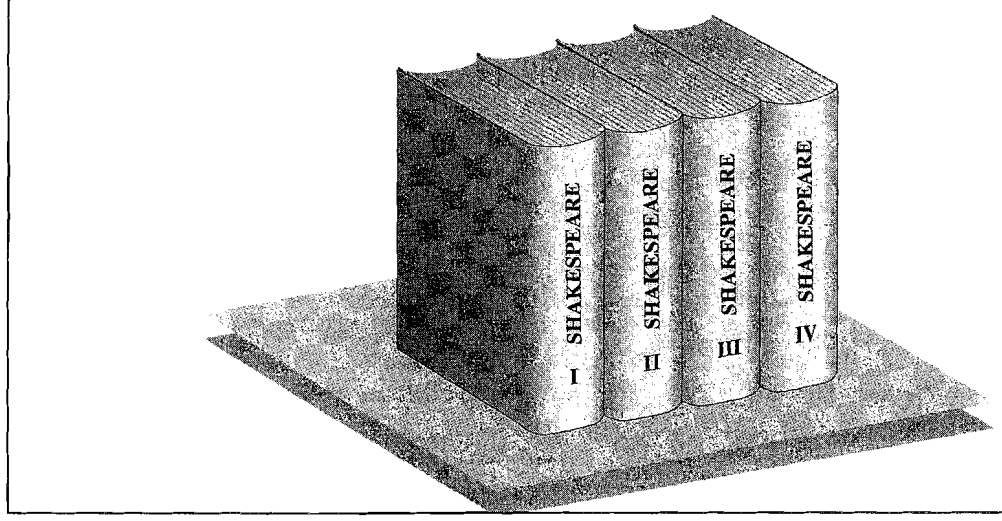
This is not to say that one should avoid learning from past experience or that failing to learn the mistakes of history does not doom us to repeat them. Rather, it is to say that commitment to a course of action based on past experience can sometimes inhibit viewing problems in new ways, and can even prevent us from solving some problems at all. Consider the following problem as an example.

Assume that there are four volumes of Shakespeare on the shelf (see Figure 3.5). Assume that the pages of each volume are exactly two inches thick, and that the covers of each volume are each one-sixth of an inch thick. Assume that a bookworm began eating at page 1 of Volume 1, and it ate straight through to the last page of Volume IV. What distance did the worm cover? Solving this problem is relatively simple, but it requires that you overcome a stereotyping block to get the correct answer. (See the end of the chapter for the correct answer.)

Ignoring Commonalities A second manifestation of the commitment block is failure to identify similarities among seemingly disparate pieces of data. This is among the most commonly identified blocks to creativity. It means that a person becomes committed to a particular point of view, to the fact that elements are different, and, consequently, becomes unable to make connections, identify themes, or perceive commonalities.

The ability to find one definition or solution for two seemingly dissimilar problems is a characteristic of creative individuals (see Sternberg, 1999). The inability to do this can overload a problem solver by requiring

Figure 3.5 Shakespeare Riddle



Source: *"Shakespeare Riddle" from CREATIVE GROWTH GAMES by Eugene Raudsepp and George P. Haugh, Copyright © 1977 by Eugene Raudsepp & George P. Haugh, Jr. Used with permission of Berkley Publishing Group, a division of Penguin Group (USA) Inc.*

that every problem encountered be solved individually. The discovery of penicillin by Sir Alexander Fleming resulted from his seeing a common theme among seemingly unrelated events. Fleming was working with some cultures of staphylococci that had accidentally become contaminated. The contamination, a growth of fungi, and isolated clusters of dead staphylococci led Fleming to see a relationship no one else had ever seen previously and thus to discover a wonder drug. The famous chemist Friedrich Kekule saw a relationship between his dream of a snake swallowing its own tail and the chemical structure of organic compounds. This creative insight led him to the discovery that organic compounds such as benzene have closed rings rather than open structures (Koestler, 1964).

For Percy Spencer at Raytheon, seeing a connection between the heat of a neon tube and the heat required to cook food was the creative connection that led to his breakthrough in the microwave industry. One of Spencer's colleagues recalled: "In the process of testing a bulb [with a magnetron], your hands got hot. I don't know when Percy really came up with the thought of microwave ovens, but he knew at that time—and that was 1942. He [remarked] frequently that this would be a good device for cooking food." Another colleague described Spencer this way: "The way Percy Spencer's mind worked is an interesting thing. He had a mind that allowed him to hold an extraordinary array of associations on phenomena and relate them to one another" (Nayak & Ketteringham, 1986, pp. 184, 205). Similarly, the connection Art Fry made between a glue that wouldn't stick tightly and marking hymns in a choir book was the final breakthrough that led to the development of the revolutionary Post-It Note business.

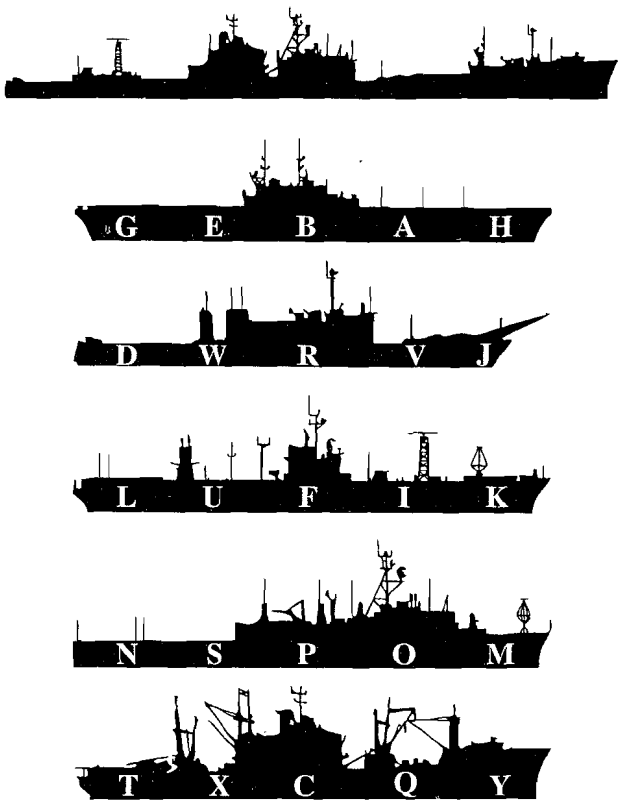
To test your own ability to see commonalities, answer the following two questions: (1) What are some common terms that apply to both the substance water and the field of finance? (For example, "financial float.") (2) In Figure 3.6, using the code letters for the smaller ships as a guide, what is the name of the larger ship? (Some of the answers are at the end of the chapter.)

Compression

Conceptual blocks also occur as a result of **compression** of ideas. Looking too narrowly at a problem, screening out too much relevant data, and making assumptions that inhibit problem solution are common examples. Two especially cogent examples of compression are artificially constraining problems and not distinguishing figure from ground.

Artificial Constraints Sometimes people place boundaries around problems, or constrain their approach to them, in such a way that the problems become impossible to solve. Such constraints arise from hidden assumptions people make about problems they encounter. People assume that some problem definitions or alternative solutions are off limits, so

Figure 3.6 Name That Ship!



Source: *Ship Shapes; Bodycombe, D.J. (1997). Appears by permission of the publisher Constable & Robinson Ltd., London.*

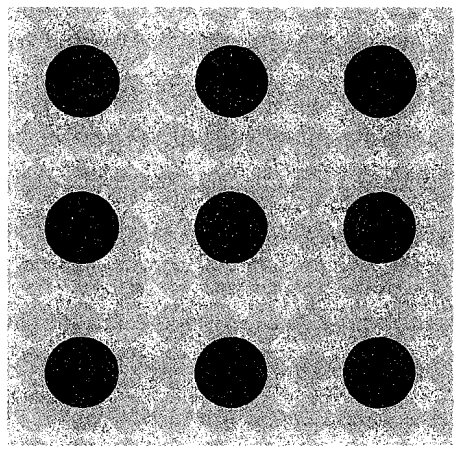
they ignore them. For an illustration of this conceptual block, look at Figure 3.7. This is a problem you have probably seen before. Without lifting your pencil from the paper, draw four straight lines that pass through all nine dots. Complete the task before reading further.

By thinking of the figure as more constrained than it actually is, the problem becomes impossible to solve. It is easy if you break out of your own limiting assumptions on the problem. Now that you have been cued, can you do the same task with only three lines? What limiting constraints are you placing on yourself?

If you are successful, now try to do the task with only one line. Can you determine how to put a single straight line through all nine dots without lifting your pencil from the paper? Both the three-line solution and some one-line solutions are provided at the end of the chapter.

Artificially constraining problems means that the problem definition and the possible alternatives are limited more than the problem requires. Creative problem solving requires that individuals become adept at recognizing their hidden assumptions and expanding the alternatives they consider—whether they imagine, improve, invest, or incubate.

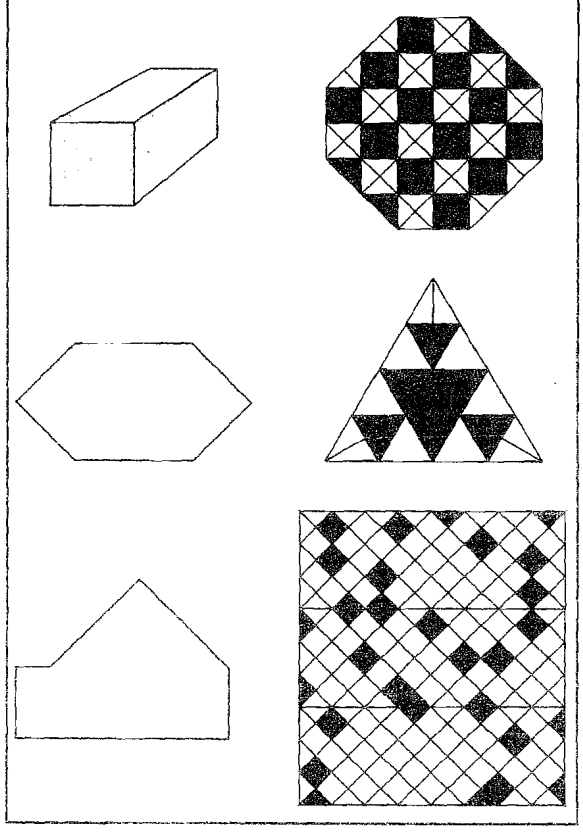
Figure 3.7 The Nine-Dot Problem



Separating Figure from Ground Another illustration of the compression block is the reverse of artificial constraints. It is the inability to constrain problems sufficiently so that they can be solved. Problems almost never come clearly specified, so problem solvers must determine what the real problem is. They must filter out inaccurate, misleading, or irrelevant information in order to define the problem correctly and generate appropriate alternative solutions. The inability to separate the important from the unimportant, and to compress problems appropriately, serves as a conceptual block because it exaggerates the complexity of a problem and inhibits a simple definition.

How well do you filter out irrelevant information and focus on the truly important part of a problem? Can you ask questions that get to the heart of the matter? Consider Figure 3.8. For each pair, find the pattern on the left that is embedded in the more complex pattern on the right. On the complex pattern, outline the embedded pattern. Now try to find at least two figures in each pattern. (See the end of the chapter for some solutions.)

Figure 3.8 Embedded Pattern



Overcoming this compression block—separating figure from ground and artificially constraining problems—was an important explanation for the microwave oven and Post-It Note breakthroughs. George Foerstner's contribution to the development and manufacture of the microwave oven was to compress the problem, that is, to separate out all the irrelevant complexity that constrained others. Whereas the magnetron was a device so complicated that few people understood it, Foerstner focused on its basic raw materials, its size, and its functionality. By comparing it to an air conditioner, he eliminated much of the complexity and mystery, and, as described by two analysts, "He had seen what all the researchers had failed to see, and they knew he was right" (Nayak & Ketteringham, 1986, p. 181).

On the other hand, Spence Silver had to add complexity, to overcome compression, in order to find an application for his product. Because the glue had failed every traditional 3M test for adhesives, it was categorized as a useless configuration of chemicals. The potential for the product was artificially constrained by traditional assumptions about adhesives—more stickiness, stronger bonding is best—until Art Fry visualized some unconventional applications—a better bookmark, a bulletin board, scratch paper, and, paradoxically, a replacement for 3M's main product, tape.

Complacency

Some conceptual blocks occur not because of poor thinking habits or inappropriate assumptions but because of fear, ignorance, insecurity, or just plain mental laziness. Two especially prevalent examples of the **complacency** block are a lack of questioning and a bias against thinking.

Noninquisitiveness Sometimes the inability to solve problems results from an unwillingness to ask questions, obtain information, or search for data. Individuals may think they will appear naive or ignorant if they question something or attempt to redefine a problem. Asking questions puts them at risk of exposing their ignorance. It also may be threatening to others because it implies that what they accept may not be correct. This may create resistance, conflict, or even ridicule by others.

Creative problem solving is inherently risky because it potentially involves interpersonal conflict. It is risky also because it is fraught with mistakes. As Linus Pauling, the Nobel laureate, said, "If you want to have a good idea, have a lot of them, because most of them will be bad ones." Years of nonsupportive socialization, however, block the adventuresome and

inquisitive stance in most people. Most of us are not rewarded for bad ideas. To illustrate, answer the following questions for yourself:

1. When would it be easier to learn a new language, when you were five years old or now? Why?
2. How many times in the last month have you tried something for which the probability of success was less than 50 percent?
3. When was the last time you asked three "why" questions in a row?

To illustrate the extent of our lack of inquisitiveness, how many of the following commonly experienced questions can you answer?

- ❑ Why are people immune to their own body odor?
- ❑ What happens to the tread that wears off tires?
- ❑ Why doesn't sugar spoil or get moldy?
- ❑ Why doesn't a two-by-four measure two inches by four inches?
- ❑ Why is a telephone keypad arranged differently from that of a calculator?
- ❑ Why do hot dogs come 10 in a package while buns come 8 in a package?
- ❑ How do military cadets find their caps after throwing them in the air at football games and graduation?
- ❑ Why is Jack the nickname for John?

Most of us adopt a habit of being a bit complacent in asking such questions, let alone finding out the answers. We often stop being inquisitive as we get older because we learn that it is good to be intelligent, and being intelligent is interpreted as already knowing the answers, instead of asking good questions. Consequently, we learn less well at 25 than at 5, take fewer risks, avoid asking why, and function in the world without really trying to understand it. Creative problem solvers, on the other hand, are frequently engaged in inquisitive and experimental behavior. Spence Silver at 3M described his attitude about the complacency block this way:

> *People like myself get excited about looking for new properties in materials. I find that very satisfying, to perturb the structure slightly and just see what happens. I have a hard time talking people into doing that—people who are more highly trained. It's been my experience that people are reluctant just to try, to experiment—just to see what will happen. (Nayak & Ketteringham, 1986, p. 58)*

Bias Against Thinking A second manifestation of the complacency block is in an inclination to avoid doing mental work. This block, like most of the others, is partly a cultural bias as well as a personal one. For example, assume that you passed by your roommate's or colleague's office one day and noticed him leaning back in his chair, staring out the window. A half-hour later, as you passed by again, he had his feet up on the desk, still staring out the window. And 20 minutes later, you noticed that his demeanor hadn't changed much. What would be your conclusion? Most of us would assume that the fellow was not doing any work. We would assume that unless we saw action, he wasn't being productive.

When was the last time you heard someone say, "I'm sorry. I can't go to the ball game (or concert, dance, party, or movie) because I have to think?" Or, "I'll do the dishes tonight. I know you need to catch up on your thinking"? That these statements sound silly illustrates the bias most people develop toward action rather than thought, or against putting their feet up, rocking back in their chair, looking off into space, and engaging in solitary cognitive activity. This does not mean daydreaming or fantasizing, just thinking.

A particular conceptual block exists in Western cultures against the kind of thinking that uses the right hemisphere of the brain. **Left-hemisphere thinking,** for most people, is concerned with logical, analytical, linear, or sequential tasks. Thinking using the left hemisphere is apt to be organized, planned, and precise. Language and mathematics are left-hemisphere activities. **Right-hemisphere thinking,** on the other hand, is concerned with intuition, synthesis, playfulness, and qualitative judgment. It tends to be more spontaneous, imaginative, and emotional than left-hemisphere thinking. The emphasis in most formal education is toward left-hemisphere thought development even more in Eastern cultures than in Western cultures. Problem solving on the basis of reason, logic, and utility is generally rewarded, while problem solving based on sentiment, intuition, or pleasure is frequently considered tenuous and inferior.

A number of researchers have found that the most creative problem solvers are **ambidextrous** in their thinking. That is, they use both left- and right-hemisphere thinking and easily switch from one to the other (Hermann, 1981; Hudspith, 1985; Martindale, 1999). Creative ideas arise most frequently in the right

Table 3.4 Exercise to Test Ambidextrous Thinking

List 1	List 2
sunset	decline
perfume	very
brick	ambiguous
monkey	resources
castle	term
guitar	conceptual
pencil	about
computer	appendix
umbrella	determine
radar	forget
blister	quantity
chessboard	survey

hemisphere but must be processed and interpreted by the left, so creative problem solvers use both hemispheres equally well.

Try the exercise in Table 3.4. It illustrates this ambidextrous principle. There are two lists of words. Take about two minutes to memorize the first list. Then, on a piece of paper, write down as many words as you can remember. Now take about two minutes and memorize the words in the second list. Repeat the process of writing down as many words as you can remember.

Most people remember more words from the first list than from the second. This is because the first list contains words that relate to visual perceptions. They connect with right-brain activity as well as left-brain activity. People can draw mental pictures or fantasize about them. The same is true for creative ideas. The more both sides of the brain are used, the more creative the ideas.

REVIEW OF CONCEPTUAL BLOCKS

So far, we have suggested that certain conceptual blocks prevent individuals from solving problems creatively and from engaging in the four different types of creativity. These blocks narrow the scope of problem definition, limit the consideration of alternative solutions, and constrain the selection of an optimal solution. Unfortunately, many of these conceptual blocks are unconscious, and it is only by being confronted with problems that are unsolvable because of conceptual blocks that individuals become aware that they exist. We have attempted to make you aware of your own conceptual blocks by asking you to solve some simple problems that require you to overcome these mental barriers. These conceptual blocks are not all bad, of course; not all problems should be addressed by creative problem solving. But research has shown that individuals who have developed creative problem-solving skills are far more effective with complex problems that require a search for alternative solutions than others who are conceptually blocked (Basadur, 1979; Collins & Amabile, 1999; Sternberg, 1999; Williams & Yang, 1999).

In the next section, we provide some techniques and tools that help overcome these blocks and improve creative problem-solving skills.

Conceptual Blockbusting

Conceptual blocks cannot be overcome all at once because most blocks are a product of years of habit-forming thought processes. Overcoming them requires practice in thinking in different ways over a long period of time. You will not become a skilled creative problem solver just by reading this chapter. On the other hand, by becoming aware of your conceptual blocks and practicing the following techniques, research has demonstrated that you can enhance your **creative problem-solving** skills.

STAGES IN CREATIVE THOUGHT

A first step in overcoming conceptual blocks is recognizing that creative problem solving is a skill that can be developed. Being a creative problem solver is not an inherent ability that some people naturally have and others do not have. Jacob Rainbow, an employee of the U.S. Patent Office who has more than 200 patents by himself, described the creative process as follows:

So you need three things to be an original thinker. First, you have to have a tremendous amount of information—a big data base if you like to be fancy. Then you have to be willing to pull the ideas, because you're interested. Now, some people could do it, but they don't bother. They're interested in doing something else. It's fun to come up with an idea, and if nobody wants it, I don't give a damn. It's just fun to come up with something strange and different. And then you must have the ability to get rid of the trash which you think of. You cannot only

think of good ideas. And by the way, if you're not well-trained, but you've got good ideas, and you don't know if they're good or bad, then you send them to the Bureau of Standards, National Institute of Standards, where I work, and we evaluate them. And we throw them out. (Csikszentmihalyi, 1996, p. 48)

In other words, gather a lot of information, use it to generate a lot of ideas, and sift through your ideas and get rid of the bad ones. Researchers generally agree that creative problem solving involves four stages: *preparation, incubation, illumination,* and *verification* (see Albert & Runco, 1999; Nickerson, 1999; Poincare, 1921; Ribot, 1906; Wallas, 1926). The **preparation stage** includes gathering data, defining the problem, generating alternatives, and consciously examining all available information. The primary difference between skillful creative problem solving and analytical problem solving is in how this first step is approached. Creative problem solvers are more flexible and fluent in data gathering, problem definition, alternative generation, and examination of options. In fact, it is in this stage that training in creative problem solving can significantly improve effectiveness because the other three steps are not amenable to conscious mental work (Adams, 2001; Ward, Smith, & Finke, 1999). The following discussion, therefore, is limited primarily to improving functioning in this first stage. The **incubation stage** involves mostly unconscious mental activity in which the mind combines unrelated thoughts in pursuit of a solution. Conscious effort is not involved. **Illumination**, the third stage, occurs when an insight is recognized and a creative solution is articulated. **Verification** is the final stage, which involves evaluating the creative solution relative to some standard of acceptability.

In the preparation stage, two types of techniques are available for improving creative problem-solving abilities. One technique helps individuals think about and *define problems more creatively;* the other helps individuals gather information and *generate more alternative solutions* to problems.

One major difference between effective, creative problem solvers and other people is that creative problem solvers are less constrained. They allow themselves to be more flexible in the definitions they impose on problems and the number of solutions they identify. They develop a large repertoire of approaches to problem solving. In short, they engage in what Csikszentmihalyi (1996) described as "playfulness and childishness." They try more things and worry less about their false starts or failures. As Interaction Associates (1971, p. 15) explained:

Flexibility in thinking is critical to good problem solving. A problem solver should be able to conceptually dance around the problem like a good boxer, jabbing and poking, without getting caught in one place or "fixated." At any given moment, a good problem solver should be able to apply a large number of strategies [for generating alternative definitions and solutions]. Moreover, a good problem solver is a person who has developed, through his understanding of strategies and experiences in problem solving, a sense of appropriateness of what is likely to be the most useful strategy at any particular time.

As a perusal through any bookstore will show, the number of books suggesting ways to enhance creative problem solving is enormous. We now present a few tools and hints that we have found to be especially effective and relatively simple for business executives and students to apply. Although some of them may seem game-like or playful, a sober pedagogical rationale underlies all of them. Our purpose is to address your own personal skills as a creative problem solver, not to discuss how creativity can be fostered in an organizational setting. These tools, therefore, will help to unfreeze you from your normal skeptical, analytical approach to problems and increase your playfulness. They relate to (1) defining problems and (2) generating alternative solutions.

METHODS FOR IMPROVING PROBLEM DEFINITION

Problem definition is probably the most critical step in creative problem solving. Once a problem is defined, solving it is often relatively simple. However, as explained in Table 3.2, individuals tend to define problems in terms with which they are familiar. Even well-trained scientists suffer from this problem: "Good scientists study the most important problems they think they can solve" (Medawar, 1967). When a problem is faced that is new or complex or does not appear to have an easily identified solution, the problem either remains undefined or is redefined in terms of something familiar. Unfortunately, new problems may not be the same as old problems, so relying on past definitions may impede the process of solving current problems, or lead to solving the wrong problem. Applying techniques for creative

problem definition can help individuals see problems in alternative ways so their definitions are less narrowly constrained. Three such techniques for improving and expanding the definition process are discussed below.

Make the Strange Familiar and the Familiar Strange

One well-known, well-tested technique for improving creative problem solving is called **synectics** (Gordon, 1961; Roukes, 1988). The goal of synectics is to help you put something you don't know in terms of something you do know, then reverse the process back again. The point is, by analyzing what you know and applying it to what you don't know, you can develop new insights and perspectives. The process of synectics relies on the use of analogies and metaphors, and it works this way.

First you form a definition of a problem (make the strange familiar). Then you try to transform that definition so it is made similar to something completely different that you know more about (make the familiar strange). That is, you use analogies and metaphors (synectics) to create this distortion. Postpone the original definition of the problem while you examine the analogy or the metaphor. Then impose this same analysis on the original problem to see what new insights you can uncover.

For example, suppose you have defined a problem as low morale among members of your team. You may form an analogy or metaphor by answering questions such as the following about the problem:

- What does this remind me of?
- What does this make me feel like?
- What is this similar to?
- What is this opposite of?

Your answers, for example, might be: This problem reminds me of trying to get warm on a cold day (I need more activity). It makes me feel like I do when visiting a hospital ward (I need to smile and go out of my way to empathize with people). It is similar to the loser's locker room after an athletic contest (I need to find an alternative purpose or goal). This isn't like a well-tuned automobile (I need to do a careful diagnosis). And so on. Metaphors and analogies should connect what you are less sure about (the original problem) to what you are more sure about (the metaphor). By analyzing the metaphor or analogy, you may identify attributes of the problem that were not evident before. New insights can occur and new ideas can come to mind.

Many creative solutions have been generated by such a technique. For example, William Harvey was the first to apply the "pump" analogy to the heart, which led to the discovery of the body's circulatory system. Niels Bohr compared the atom to the solar system and supplanted Rutherford's prevailing "raisin pudding" model of matter's building blocks. Consultant Roger von Oech (1986) helped turn around a struggling computer company by applying a restaurant analogy to the company's operations. The real problems emerged when the restaurant, rather than the company, was analyzed. Major contributions in the field of organizational behavior have occurred by applying analogies to other types of organization, such as machines, cybernetic or open systems, force fields, clans, and so on. Probably the most effective analogies (called parables) were used by Jesus to teach principles that otherwise were difficult for individuals to grasp (for example, the prodigal son, the good Samaritan, a shepherd and his flock).

Some hints to keep in mind when constructing analogies include:

- Include action or motion in the analogy (e.g., driving a car, cooking a meal, attending a funeral).
- Include things that can be visualized or pictured in the analogy (e.g., circuses, football games, crowded shopping malls).
- Pick familiar events or situations (e.g., families, kissing, bedtime).
- Try to relate things that are not obviously similar (e.g., saying an organization is like a big group is not nearly as rich a simile as saying that an organization is like, say, a psychic prison or a poker game).

Four types of analogies are recommended as part of synectics: ***personal analogies***, in which individuals try to identify themselves as the problem ("If I were the problem, how would I feel, what would I like, what could satisfy me?"); ***direct analogies***, in which individuals apply facts, technology, and common experience to the problem (e.g., Brunel solved the problem of underwater construction by watching a shipworm tunneling into a tube); ***symbolic analogies***, in which symbols or images are imposed on the problem (e.g., modeling the problem mathematically or diagramming the process flow); and ***fantasy analogies***, in which individuals ask the question "In my wildest dreams, how would I wish the problem to be resolved?" (e.g., "I wish all employees would work with no supervision.").