Letting constraints filter and guide your thinking can often be the best way to reach truly creative solutions BY IAN AYRES AND BARRY NALEBUFF

Principled Problem Solving

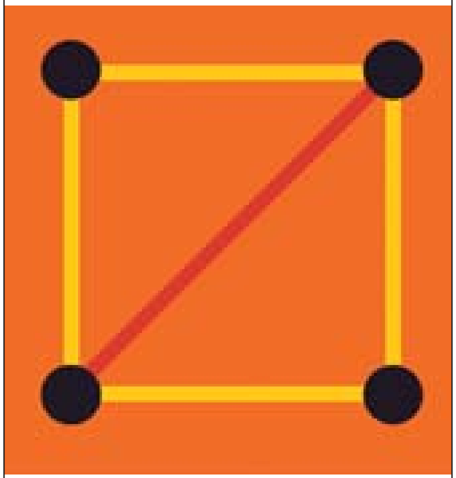
THESE DAYS the popular mantras for stimulating creativity frequently extol the virtues of thinking outside the box: "There are no wrong answers." "Consider all options." "Break the boundaries that prevent you from innovating." But not all boundaries should be broken. Some are real and need to be respected. Sometimes it is best to know how to think creatively *inside* the box.

If you identify constraints that any solution to a specific problem must obey, you can channel your search into more productive directions. Eventually you must always figure out which of your possible solutions are workable and which are not. By imposing constraints on your solution search—in effect, understanding what box they will ultimately have to fit into—you can filter out unworkable ideas before they take shape and see the real solutions more easily.

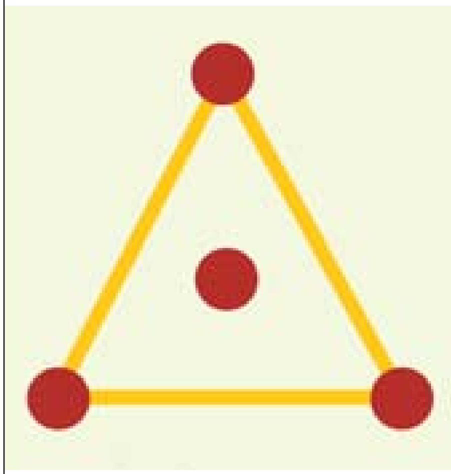
Becoming aware of the relevant constraints can be powerfully liberating. Filtering out your thoughts this way may at first seem as though it would censor potentially good ideas. But, on the contrary, identifying the underlying attributes of real solutions can actually help generate ideas.

When you are faced with a difficult problem, it's all too easy to get caught up in what you don't know. So instead begin by figuring out what you do know about the solution, even if it is incomplete. Identify all the attributes that will be a necessary part of any workable solution. These necessary attributes are the principles (mathematicians call them axioms) that will serve as problem-solving catalysts. A great advantage of this principle-centered approach is that it helps to focus your search by preventing you from having to start from scratch every time you run into a roadblock.

Suppose your task is to plant four seeds so that each is equidistant from the other three. (We learned of this problem from Edward de Bono's book *Lateral Thinking: Creativity Step by Step*.) A common first stab at a solution is to plant them at the corners of a square, but that doesn't work, because the seeds at opposite diagonals are farther apart. So a complete answer is not immediately apparent.



You do know how to solve part of the problem, however—you can plant three seeds equidistantly by putting them at the corners of an equilateral triangle. If all four seeds must be equidistant, then so must three of them. Thus, we know one principle: *Three of the seeds must form an equilateral triangle.*



Where does that fourth seed go? Placing it at the center of the triangle doesn't work. At this point there may be a strong temptation to give up on the triangle—but resist that temptation! The message of principled problem solving is to take what you know to be right and build on it, even if that is not enough to answer the problem.

Given that the first three seeds are relatively fixed in their locations, we can extend our initial principle to say more about where the fourth seed must go. Not only must three of the seeds form an equilateral triangle, but also: *Any three of the seeds must form an equilateral triangle.*

The constraint that isn't really there, but that we often unconsciously impose, is the requirement that all the seeds lie on a single plane. Putting the fourth seed in the middle would have been right if we could have elevated or lowered it to create equilateral triangles with the seeds at the other corners. The answer that comes to mind, then, is to plant the fourth seed either in a mound or a hole at the center.

Going to three dimensions requires a leap of imagination. But by forcing yourself to hold the first three points in the triangle, you were pushed to give up the false constraint of limiting your answer to two dimensions.

Although such abstract puzzles can be fun, a more important question is whether these same cognitive tools work equally well for solving real-world problems.

Let's apply the same principled problem-solving approach to the redesign of a home mortgage. In its most general terms, a mortgage involves a bank (or other financial service provider) lending you some money that you promise to pay back. There are fixed-rate mortgages, floating-rate mortgages and balloon mortgages. All these mortgages have one

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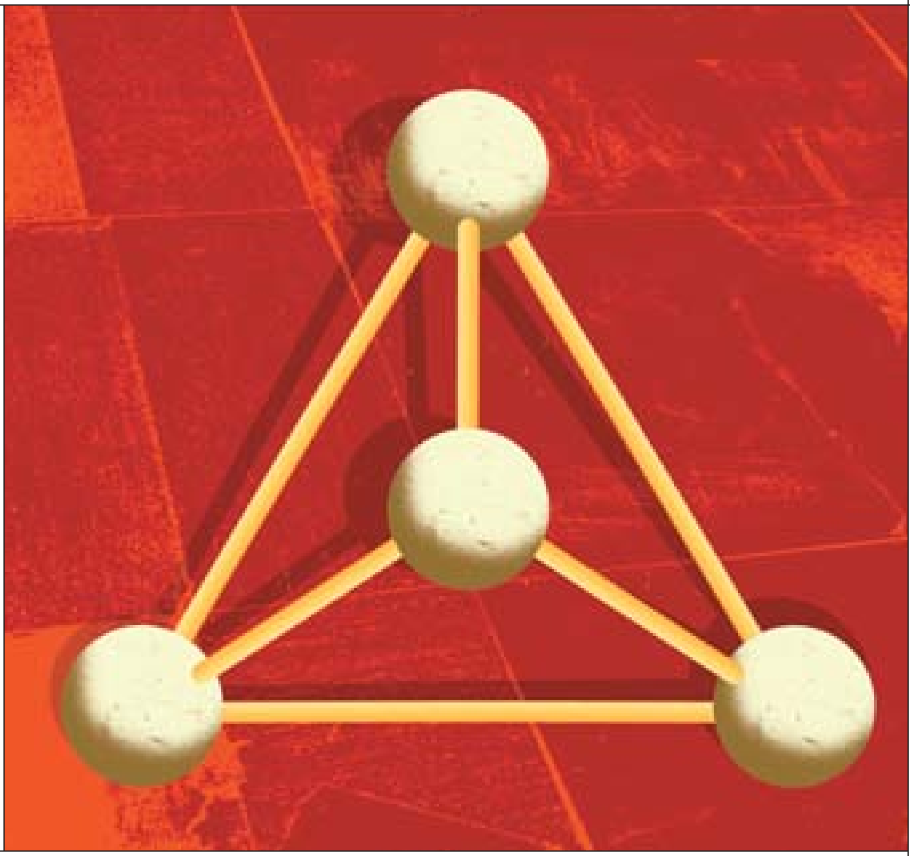
common denominator: *The present discounted value of your payments equals the amount that you've borrowed.*

Take the case of a $100 mortgage and a 10 percent interest rate. You could pay $10 a year forever, or, alternatively, you could pay nothing the first year and then $121 in the second year and pay off the mortgage. The bottom line is that the bank needs to get back an amount of money that (in present-value terms) equals the value of what the bankers lent you. This is the first principle of any mortgage solution.

With this principle in mind, let's look at adjustable-rate mortgages. People with a fixed salary and limited liquidity have a real problem borrowing with an adjustable-rate mortgage. They fear that if rates and their monthly payment rise too much, they may no longer be able to afford the mortgage.

The problem is that because most borrowers rely on their salary to make mortgage payments, they cannot take the risk that their monthly payments will go up. Yet when rates rise, the lenders need to get more money in order to restore the value of the loan. Is there a way to give borrowers the benefits of lower rates on adjustable-rate mortgages without exposing them to fluctuations in their monthly payment?



(**The message of principled problem solving** is to take what you know to be right and build on it.)

The core principle is that the bank must get the present value of its money back. The conflicting prerequisite is that payments can't rise with interest rates. If we treat the objective of nonfluctuating payments as a constraint, we force ourselves to ask whether we can design an adjustable-rate mortgage that satisfies both constraints.

If we want to keep the monthly payment constant when the interest rate rises, then another term of the loan has to give. That is, something else besides the monthly payment will have to adjust with the market interest rate.

Why not adjust the *number* of payments while holding the amount of each payment constant? We're not suggesting that the borrower make more frequent payments. Instead extend the life of the mortgage. A 15-year mortgage, for instance, could adjust to become a 16- or 18-year mortgage as interest rates rose.

There are some real constraints on the "adjustable-term" mortgage. Extending the life of the mortgage runs into diminishing returns. Once the mortgage reaches the point at which it would take forever to pay off, the term cannot be extended any further. This constraint need not be a problem, however. Many adjustable mortgages have caps on the maximum possible interest adjustment. Similarly, the term adjustment might be limited to no more than 30 years.

We now have a solution. Would there be any demand for such a product? In fact, in the U.K., these adjustable-term mortgages already exist and have been very popular.

As we've seen, then, principled problem solving offers a way to filter out solutions that are nonstarters. It can also stimulate creativity by steering us toward answers that might not otherwise have occurred to us.

Of course, principled problem solving can fail if we identify false principles—that is, if we impose artificial constraints on the problem. If a false principle causes us to reject real solutions out of hand, then we may never find an answer. This is why thinking outside the box has such appeal. *Unprincipled* thinking outside the box often fails because it sentences the problem solver to consider any potential solution, no matter how far-fetched.

Thinking outside the box and principled problem solving are, thus, the yin and the yang, the dialectic of efficient innovation. Think of these approaches together as thinking inside the *real* box.

This article is adapted from Why Not? How to Use Everyday Ingenuity to Solve Problems Big and Small, *by Barry Nalebuff and Ian Ayres (Harvard Business School Press, 2003).*