McKinsey Quarterly: Five routes to more innovative problem solving

Tricky problems must be shaped before they can be solved. To start that process, and stimulate novel thinking, leaders should look through multiple lenses.

APRIL 2013 • Olivier Leclerc and Mihnea Moldoveanu

Source: Strategy Practice

Rob McEwen had a problem. The chairman and chief executive officer of Canadian mining group Goldcorp knew that its Red Lake site could be a money-spinner—a mine nearby was thriving—but no one could figure out where to find high-grade ore. The terrain was inaccessible, operating costs were high, and the unionized staff had already gone on strike. In short, McEwen was lumbered with a gold mine that wasn't a *gold mine*.

Then inspiration struck. Attending a conference about recent developments in IT, McEwen was smitten with the open-source revolution. Bucking fierce internal resistance, he created the Goldcorp Challenge: the company put Red Lake's closely guarded topographic data online and offered $575,000 in prize money to anyone who could identify rich drill sites. To the astonishment of players in the mining sector, upward of 1,400 technical experts based in 50-plus countries took up the problem. The result? Two Australian teams, working together, found locations that have made Red Lake one of the world's richest gold mines. "From a remote site, the winners were able to analyze a database and generate targets without ever visiting the property," McEwen said. "It's clear that this is part of the future."[1]

McEwen intuitively understood the value of taking a number of different approaches simultaneously to solving difficult problems. A decade later, we find that this mind-set is ever more critical: business leaders are operating in an era when forces such as technological change and the historic rebalancing of global economic activity from developed to emerging markets have made the problems increasingly complex, the tempo faster, the markets more volatile, and the stakes higher. The number of variables at play can be enormous, and free-flowing information encourages competition, placing an ever-greater premium on developing innovative, unique solutions.

This article presents an approach for doing just that. How? By using what we call flexible objects for generating novel solutions, or *flexons*, which provide a way of shaping difficult problems to reveal innovative solutions that would otherwise remain hidden. This approach can be useful in a wide range of situations and at any level of analysis, from individuals to groups to organizations to industries. To be sure, this is not a silver bullet for solving any problem whatever. But it is a fresh mechanism for representing ambiguous, complex problems in a structured way to generate better and more innovative solutions.

The flexons approach

Finding innovative solutions is hard. Precedent and experience push us toward familiar ways of seeing things, which can be inadequate for the truly tough challenges that confront senior leaders. After all, if a problem can be solved before it escalates to the C-suite, it typically is. Yet we know that teams of smart people from different backgrounds are more likely to come up with fresh ideas more quickly than individuals or like-minded groups do.[2] When a diverse range of experts—game theorists to economists to psychologists—interact, their approach to problems is different from those that individuals use. The solution space becomes broader, increasing the chance that a more innovative answer will be found.

Obviously, people do not always have think tanks of PhDs trained in various approaches at their disposal. Fortunately, generating diverse solutions to a problem does not require a diverse group of problem solvers. This is where flexons come into play. While traditional problem-solving frameworks address particular problems under particular conditions—creating a compensation system, for instance, or undertaking a value-chain analysis for a vertically integrated business—they have limited applicability. They are, if you like, specialized lenses. Flexons offer languages for shaping problems, and these languages can be adapted to a much broader array of challenges. In essence, flexons substitute for the wisdom and experience of a group of diverse, highly educated experts.

To accommodate the world of business problems, we have identified five flexons, or problem-solving languages. Derived from the social and natural sciences, they help users understand the behavior of individuals, teams, groups, firms, markets, institutions, and whole societies. We arrived at these five through a lengthy process of synthesizing both formal literatures and the private knowledge systems of experts, and trial and error on real problems informed our efforts. We don’t suggest that these five flexons are exhaustive—only that we have found them sufficient, in concert, to tackle very difficult problems. While serious mental work is required to tailor the flexons to a given situation, and each retains blind spots arising from its assumptions, multiple flexons can be applied to the same problem to generate richer insights and more innovative solutions.

Networks flexon

Imagine a map of all of the people you know, ranked by their influence over you. It would show close friends and vague acquaintances, colleagues at work and college roommates, people who could affect your career dramatically and people who have no bearing on it. All of them would be connected by relationships of trust, friendship, influence, and the probabilities that they will meet. Such a map is a network that can represent anything from groups of people to interacting product parts to traffic patterns within a city—and therefore can shape a whole range of business problems.

For example, certain physicians are opinion leaders who can influence colleagues about which drugs to prescribe. To reveal relationships among physicians and help identify those best able to influence drug usage, a pharmaceutical company launching a product could create a network map of doctors who have coauthored scientific articles. By targeting clusters of physicians who share the same ideas and (one presumes) have tight interactions, the company may improve its return on investments compared with what traditional mass-marketing approaches would achieve. The network flexon helps decompose a situation into a series of linked problems of prediction (how will ties evolve?) and optimization (how can we maximize the relational advantage of a given agent?) by presenting relationships among entities. These problems are not simple, to be sure.[3] But they are well-defined and structured—a fundamental requirement of problem solving.

Evolutionary flexon

Evolutionary algorithms have won games of chess and solved huge optimization problems that overwhelm most computational resources. Their success rests on the power of generating diversity by introducing randomness and parallelization into the search procedure and quickly filtering out suboptimal solutions. Representing entities as populations of parents and offspring subject to variation, selection, and retention is useful in situations where businesses have limited control over a large number of important variables and only a limited ability to calculate the effects of changing them, whether they're groups of people, products, project ideas, or technologies. Sometimes, you must make educated guesses, test, and learn. But even as you embrace randomness, you can harness it to produce better solutions to complex problems.

That's because not all "guessing strategies" are created equal. We have crucial choices to make: generating more guesses (prototypes, ideas, or business models) or spending more time developing each guess or deciding which guesses will survive. Consider a consumer-packaged-goods company trying to determine if a new brand of toothpaste will be a hit or an expensive failure. Myriad variables—everything from consumer habits and behavior to income, geography, and the availability of clean water—interact in multiple ways. The evolutionary flexon may suggest a series of low-cost, small-scale experiments involving product variants pitched to a few well-chosen market segments (for instance, a handful of representative customers high in influence and skeptical about new ideas). With every turn of the evolutionary-selection crank, the company's predictions will improve.

Decision-agent flexon

To the economic theorist, social behavior is the outcome of interactions among individuals, each of whom tries to select the best possible means of achieving his or her ends. The decision-agent flexon takes this basic logic to its limit by providing a way of representing teams, firms, and industries as a series of competitive and cooperative interactions among agents. The basic approach is to determine the right level of analysis—firms, say. Then you ascribe to them beliefs and motives consistent with what you know (and think they know), consider how their payoffs change through the actions of others, determine the combinations of strategies they might collectively use, and seek an equilibrium where no agent can unilaterally deviate from the strategy without becoming worse off.

Game theory is the classic example, but it's worth noting that a decision-agent flexon can also incorporate systematic departures from rationality: impulsiveness, cognitive shortcuts such as stereotypes, and systematic biases. Taken as a whole, this flexon can describe all kinds of behavior, rational and otherwise, in one self-contained problem-solving language whose most basic variables comprise agents (individuals, groups, organizations) and their beliefs, payoffs, and strategies.

For instance, financial models to optimize the manufacturing footprint of a large industrial company would typically focus on relatively easily quantifiable variables such as plant capacity and input costs. To take a decision-agent approach, you assess the payoffs and likely strategies of multiple stakeholders—including customers, unions, and governments—in the event of plant closures. Adding the incentives, beliefs, and strategies of all stakeholders to the analysis allows the company to balance the trade-offs inherent in a difficult decision more effectively.

System-dynamics flexon

Assessing a decision's cascading effects on complex businesses is often a challenge. Making the relations between variables of a system, along with the causes and effects of decisions, more explicit allows you to understand their likely impact over time. A system-dynamics lens shows the world in terms of flows and accumulations of money, matter (for example, raw materials and products), energy (electrical current, heat, radio-frequency waves, and so forth), or information. It sheds light on a complex system by helping you develop a map of the causal relationships among key variables, whether they are internal or external to a team, a company, or an industry; subjectively or objectively measurable; or instantaneous or delayed in their effects.

Consider the case of a deep-sea oil spill, for example. A source (the well) emits a large volume of crude oil through a sequence of pipes (which throttle the flow and can be represented as inductors) and intermediate-containment vessels (which accumulate the flow and can be modeled as capacitors). Eventually, the oil flows into a sink (which, in this case, is unfortunately the ocean). A pressure gradient drives the flow rate of oil from the well into the ocean. Even an approximate model immediately identifies ways to mitigate the spill's effects short of capping the well. These efforts could include reducing the pressure gradient driving the flow of crude, decreasing the loss of oil along the pipe, increasing the capacity of the containment vessels, or increasing or decreasing the inductance of the flow lines. In this case, a loosely defined phenomenon such as an oil spill becomes a set of precisely posed problems addressable sequentially, with cumulative results.

Information-processing flexon

When someone performs long division in her head, a CEO makes a strategic decision by aggregating imperfect information from an executive team, or Google servers crunch Web-site data, information is being transformed intelligently. This final flexon provides a lens for viewing various parts of a business as information-processing tasks, similar to the way such tasks are parceled out among different computers. It focuses attention on what information is used, the cost of computation, and how efficiently the computational device solves certain kinds of problems. In an organization, that device is a collection of people, whose processes for deliberating and deciding are the most important explanatory variable of decision-making's effectiveness.[4]

Consider the case of a private-equity firm seeking to manage risk. A retrospective analysis of decisions by its investment committee shows that past bets have been much riskier than its principals assumed. To understand why, the firm examines what information was transmitted to the committee and how decisions by individuals would probably have differed from those of the committee, given its standard operating procedures. Interviews and analysis show that the company has a bias toward riskier investments and that it stems from a near-unanimity rule applied by the committee: two dissenting members are enough to prevent an investment. The insistence on near-unanimity is counterproductive because it stifles debate: the committee's members (only two of whom could kill any deal) are reluctant to speak first and be perceived as an "enemy" by the deal sponsor. And the more senior the sponsor, the more likely it is that risky deals will be approved. Raising the number of votes required to kill deals, while clearly counterintuitive, would stimulate a richer dialogue.

Putting flexons to work

We routinely use these five problem-solving lenses in workshops with executive teams and colleagues to analyze particularly ambiguous and complex challenges. Participants need only a basic familiarity with the different approaches to reframe problems and generate more innovative solutions. Here are two quite different examples of the kinds of insights that emerge from the use of several flexons, whose real power emerges in combination.

Reorganizing for innovation

A large biofuel manufacturer that wants to improve the productivity of its researchers can use flexons to illuminate the problem from very different angles.

Networks. It's possible to view the problem as a need to design a better innovation network by mapping the researchers' ties to one another through co-citation indices, counting the number of e-mails sent between researchers, and using a network survey to reveal the strength and density of interactions and collaborative ties. If coordinating different knowledge domains is important to a company's innovation productivity, and the current network isn't doing so effectively, the company may want to create an internal knowledge market in which financial and status rewards accrue to researchers who communicate their ideas to co-researchers. Or the company could encourage cross-pollination by setting up cross-discipline gatherings, information clearinghouses, or wiki-style problem-solving sites featuring rewards for solutions.

Evolution. By describing each lab as a self-contained population of ideas and techniques, a company can explore how frequently new ideas are generated and filtered and how stringent the selection process is. With this information, it can design interventions to generate more varied ideas and to change the selection mechanism. For instance, if a lot of research activity never seems to lead anywhere, the company might take steps to ensure that new ideas are presented more frequently to the business-development team, which can provide early feedback on their applicability.

Decision agents. We can examine in detail how well the interests of individual researchers and the organization are aligned. What financial and nonfinancial benefits accrue to individuals who initiate or terminate a search or continue a search that is already under way? What are the net benefits to the organization of starting, stopping, or continuing to search along a given trajectory? Search traps or failures may be either Type I (pursuing a development path unlikely to reach a profitable solution) or Type II (not pursuing a path likely to reach a profitable solution). To better understand the economics at play, it may be possible to use industry and internal data to multiply the probabilities of these errors by their costs. That economic understanding, in turn, permits a company to tailor incentives for individuals to minimize Type I errors (by motivating employees to reject apparent losers more quickly) or Type II errors (by motivating them to persist along paths of uncertain value slightly longer than they normally would).

Predicting the future

Now consider the case of a multinational telecommunications service provider that operates several major broadband, wireless, fixed, and mobile networks around the world, using a mix of technologies (such as 2G and 3G). It wants to develop a strategic outlook that takes into consideration shifting demographics, shifting technologies for connecting users with one another and with its core network (4G), and shifting alliances—to say nothing of rapidly evolving players from Apple to Qualcomm. This problem is complicated, with a range of variables and forces at work, and so broad that crafting a strategy with big blind spots is easy. Flexons can help.

Each view of the world described below provides valuable food for thought, including potential strategic scenarios, technology road maps, and possibilities for killer apps. More hard work is needed to synthesize the findings into a coherent worldview, but the different perspectives provided by flexons illuminate potential solutions that might otherwise be missed.

Decision agents. Viewing the problem in this way emphasizes the incentives for different industry players to embrace new technologies and service levels. By enumerating a range of plausible scenarios from the perspective of customers and competitors, the network service provider can establish baseline assessments of future pricing, volume levels, and investment returns.

Networks. This lens allows a company or its managers to look at the industry as a pattern of exchange relationships between paying customers and providers of services, equipment, chips, operating systems, and applications, and then to examine the properties of each exchange network. The analysis may reveal that not all innovations and new end-user technologies are equal: some provide an opportunity for differentiation at critical nodes in the network; others do not.

System dynamics. This flexon focuses attention on data-flow bottlenecks in applications ranging from e-mail and voice calls to video downloads, games, and social-networking interactions.[5] The company can build a network-optimization map to predict and optimize capital expenditures for network equipment as a function of expected demand, information usage, and existing constraints. Because cost structures matter deeply to annuity businesses (such as those of service providers) facing demand fluctuations, the resulting analysis may radically affect which services a company believes it can and cannot offer in years to come.

Flexons help turn chaos into order by representing ambiguous situations and predicaments as well-defined, analyzable problems of prediction and optimization. They allow us to move up and down between different levels of detail to consider situations in all their complexity. And, perhaps most important, flexons allow us to bring diversity *inside* the head of the problem solver, offering more opportunities to discover counterintuitive insights, innovative options, and unexpected sources of competitive advantage.

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Notes

[1] See Linda Tischler, "He struck gold on the Net (really)," fastcompany.com, May 31, 2002.

[2] Lu Hong and Scott Page, "Groups of diverse problem solvers can outperform groups of high-ability problem solvers," *Proceedings of the National Academy of Sciences of the United States of America*, 2004, Volume 101, pp. 16385–89. For more on the benefits of open innovation, see John Seely Brown and John Hagel III, "Creation nets: Getting the most from open innovation," mckinseyquarterly.com, May 2006.

[3] For more on network analysis, see Robert L. Cross, Roger D. Martin, and Leigh M. Weiss, "Mapping the value of employee collaboration," mckinseyquarterly.com, August 2006. For more on the role of brokers in filling organizational gaps, see Ronald S. Burt, *Structural Holes: The Social Structure of Competition*, first edition, Cambridge, MA: Harvard University Press, 1992.

[4] See Dan Lovallo and Olivier Sibony, "The case for behavioral strategy," mckinseyquarterly.com, March 2010.

[5] The information-processing flexon, which focuses attention on the computational tasks required to give users access to assured data streams, is also relevant for evaluating bottlenecks and facilitating predictions about how networks and operators will fare in the future.