

## Sources of Innovation

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There are, of course, innovations that spring from a flash of genius. Most innovations, however, especially the successful ones, result from a conscious, purposeful search for innovation opportunities, which are found only in a few situations. Four such areas of opportunity exist within an organization or industry: unexpected successes and failures, incongruities, process needs, and industry and market changes. Three additional sources of opportunity exist outside a company in its social and intellectual environment: demographic changes, changes in perception, and new knowledge.

True, these sources overlap, different as they may be in the nature of their risk, difficulty, and complexity, and the potential for innovation may well lie in more than one area at a time. But together, they account for the great majority of all innovation opportunities.

### 1. *The Unexpected Success or Failure*

Consider, first, the easiest and simplest source of innovation opportunity: the unexpected success or failure.

In the 1940s, when everyone believed that computers were designed for advanced scientific work, business unexpectedly showed an interest in a machine that could do payroll. Univac, which had the most advanced machine, spurned business applications. But IBM, realizing it faced a possible unexpected

success, redesigned what was basically Univac's machine for such mundane applications as payroll. And within five years, it became a leader in the computer industry.

The unexpected failure may be an equally important source of innovation opportunity. Everyone knows about the Ford Edsel as the biggest new-car bust in automotive history. What very few people seem to know, however, is that the Edsel's failure was the foundation for much of the company's later success. When the Edsel bombed—despite a considerable amount of planning, market research and design that had gone into it—Ford realized that something was happening in the automobile market that ran counter to the basic assumptions on which GM and everyone else had been designing and marketing cars. No longer was the market segmented primarily by income groups; the new principle of segmentation was what we now call “lifestyles.” Ford's response was the Mustang, a car that gave the company a distinct personality and reestablished it as an industry leader.

Unexpected successes and failures are such productive sources of innovation opportunities because most organizations dismiss them, disregard them, and even resent them. The German scientist who around 1905 synthesized novocaine, the first nonaddictive narcotic, had intended it to be used in major surgical procedures like amputation. Surgeons, however, preferred total anesthesia for such procedures; they still do.

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Instead, novocaine found a ready appeal among dentists. Its inventor spent the remaining years of his life traveling from dental school to dental school making speeches that forbade dentists from “misusing” his noble invention in applications for which he had not intended it. This is a caricature, to be sure, but it illustrates the attitude managers often take to the unexpected: “It should not have happened.”

### 2. *Incongruities*

Incongruities are the next source of innovation opportunity.

Alcon Laboratories was one of the success stories of the 1960s because Bill Conner, the company’s co-founder, exploited an incongruity in medical technology. He knew that the cataract operation was among the world’s most common surgical procedures. That’s partly because doctors had systematized it to the point that the only “old-fashioned” step left was the cutting of a ligament. Eye surgeons had learned to cut the ligament with complete success, but it was so different from the rest of the operation—and so incompatible with it—that they often dreaded it. It was incongruous.

Doctors had known for 50 years about an enzyme that could dissolve the ligament without cutting. All Conner did was to add a preservative to this enzyme that gave it a few months’ shelf life. Eye surgeons immediately accepted the new compound, and Alcon found itself with a worldwide monopoly. Fifteen years later, Nestlé bought the company for a fancy price.

Such an incongruity within the logic or rhythm of a process is only one possibility out of which innovation opportunities may

arise. Another source is incongruity between economic realities. For instance, whenever an industry has a steadily growing market but falling profit margins—as, say, in the steel industries of developed countries between 1950 and 1970—an incongruity exists. The innovative response: steel minimills.

An incongruity between expectations and results can also open up possibilities for innovation. For 50 years after the turn of the century, shipbuilders and shipping companies worked hard both to make ships faster and to lower their fuel consumption. Even so, the more successful they were in boosting speed and trimming their fuel needs, the worse the economics of ocean freighters became. By 1950 or so, the ocean freighter was dying, if not already dead.

All that was wrong, however, was an incongruity between the industry’s assumptions and its realities. The real costs did not come from doing work (that is, being at sea) but from not doing work (that is, sitting idle in port). Once managers understood where costs truly lay, the innovations were obvious: the roll-on and roll-off ship and the container ship. These solutions, which involved old technology, simply applied to the ocean freighter what railroads and truckers had been using for 30 years. A shift in viewpoint, not in technology, totally changed the economics of ocean shipping and turned it into one of the major growth industries of the last 20 to 30 years.

### 3. *Process Need*

The next innovation opportunity is the process need—that is, perfecting an already existing process by replacing a weak link or creating a new link.

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What we now call the media, for example, had its origin in two innovations developed around 1890 in response to process needs. One was Ottmar Mergenthaler's Linotype machine, which made it possible to produce newspapers quickly and in large volume. The other was a social innovation—modern advertising—invented by the first true newspaper publishers: Adolph Ochs of the New York Times, Joseph Pulitzer of the New York World and William Randolph Hearst. Advertising made it possible for them to distribute news practically free of charge, with the profit coming from marketing.

#### *4. Changes in Industry or Market Structure*

Another source of innovation opportunity is industry and market changes. Managers may believe that industry structures are static, but these structures can—and often do—change overnight.

When an industry grows quickly—the critical figure seems to be in the neighborhood of 40% growth in 10 years or less—its structure changes. Yet established organizations, concentrating on defending what they already have, tend not to counterattack when a newcomer challenges them. Indeed, when market or industry structures change, traditional industry leaders again and again neglect the fastest growing market segments. (Think about the way the old record companies responded to the advent of digital music.)

New opportunities rarely fit the way the industry has always approached the market, defined it or organized to serve it. Innovators therefore have a good chance of being left alone for a long time.

#### *5. Demographics*

Of all the innovation opportunities, demographics are among the most reliable. That's because demographic events have known lead times; for instance, every person who will be in the American labor force by the year 2035 has already been born. Yet because policy makers often neglect demographics, those who watch them and exploit them can reap great rewards.

For instance, everyone in the developed world knew around 1970 or so that there was both a baby bust and an education explosion going on; about half or more of the young people were staying in school beyond 12th grade. Consequently, the number of people available for traditional blue-collar work in manufacturing was bound to decrease and become inadequate by 1990. Everyone knew this, but only the Japanese acted on it, and they therefore gained a 10-year lead in robotics.

Managers have known for a long time that demographics matter, but they have always believed that population statistics change slowly. However, they don't. Indeed, the innovation opportunities made possible by changes in the numbers of people—and in their age distribution, education, occupations, and geographic location—are among the most rewarding and least risky of pursuits.

#### *6. Changes in Perception*

“The glass is half full” and “The glass is half empty” are descriptions of the same phenomenon but have vastly different meanings. Changing a manager's perception of a glass from half full to half empty opens up big innovation opportunities.

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All factual evidence indicates, for instance, that in the last 20 years, Americans' health has improved with unprecedented speed—whether measured by mortality rates for the newborn, survival rates for the very old, the incidence of cancers (other than lung cancer), cancer cure rates, or other factors. Even so, collective hypochondria grips the nation. Never before has there been so much concern with or fear about health. Suddenly, everything seems to cause cancer or degenerative heart disease or premature loss of memory. The glass is clearly half empty.

Rather than rejoicing in great improvements in health, Americans seem to be emphasizing how far away they still are from immortality. This view of things has created many opportunities for innovations: markets for new health care magazines, for exercise classes and jogging equipment, and for all kinds of health foods.

A change in perception does not alter facts. It changes their meaning, though—and very quickly. It took less than two years, for instance, for the computer to change from being perceived as a threat and as something only big businesses would use to something one buys for doing income tax. Economics do not necessarily dictate such a change; they may even be irrelevant. What determines whether people see a glass as half full or half empty is mood rather than fact, and a change in mood often defies quantification. But it is not exotic. It can be defined. It can be tested. And it can be exploited for innovation opportunity.

#### *7. New Knowledge*

Among history-making innovations, those that are based on new knowledge—whether scientific, technical or social—rank high.

They are the superstars of entrepreneurship; they get the publicity and the money. They are what people usually mean when they talk of innovation, although not all innovations based on knowledge are important.

Knowledge-based innovations differ from all others, however, in the time they take, in their casualty rates and in their predictability, as well as in the challenges they pose. Like most superstars, they can be temperamental, capricious and hard to direct. And they have the longest lead time of all innovations—often decades.

To become effective, innovation of this sort usually demands not one kind of knowledge but many. The computer, for example, required no fewer than six separate strands of knowledge: binary arithmetic; Charles Babbage's conception of a calculating machine; the punch card; a type of electronic switch called an audion tube; symbolic logic; and concepts of programming and feedback developed by the military during World War I. Although all the necessary knowledge was available by 1918, the first operational digital computer did not appear until 1946.

Long lead times and the need for convergence among different kinds of knowledge explain the peculiar rhythm of knowledge-based innovation, its attractions, and its dangers. During a long gestation period, there is a lot of talk and little action. Then, when all the elements suddenly converge, there is tremendous excitement and activity and an enormous amount of speculation. It may be difficult, but knowledge-based innovation can be managed. Success requires careful analysis of the various kinds of knowledge needed to make an innovation possible.