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INNOVATION

## How to Back the Right Technology

*When trying to decide where to place their bets, companies often make three fundamental mistakes*

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How will the car of the future be powered -- by a hydrogen fuel cell, a lithium-ion battery, ethanol, liquefied natural gas? Or by something else entirely?

Billions of dollars have been invested in the competing technologies, and billions more will be spent. But the winner in this race won't be decided for years. So how do executives in the auto industry decide what technology to back? The right choice can turn a newcomer into a powerhouse. The wrong choice can hobble even an established industry giant.

This is the challenge facing executives in all technology-driven markets: how to choose the right technologies to invest in, with the company's future at stake. To help companies make the right choices, we studied the evolution of competing technologies in various markets.

What we found was that technologies, and the competition among them, evolve in more-complex ways than conventional wisdom suggests. To make the right decisions, executives need to understand some important patterns of technological evolution.

In trying to figure out which technology to back, companies often make some fundamental mistakes. In particular:

- They fail to distinguish among different levels of technology, with the result

that they focus too much on one level and get tripped up by changes in another level.

- They assume technological performance follows a standard path -- from innovation to obsolescence. It often doesn't.
- They fail to recognize that technological innovations shape consumers' tastes, not mere whims.

In the end, it turns out, companies are often better off betting on more than one horse.

Here's a closer look at the three crucial mistakes companies often make, and how managers can arrive at more-informed decisions.

### *Recognizing Levels*

Executives first need to distinguish among three different levels of technological innovation: platform, design and component.

A platform is an underlying technology that relies on a unique scientific principle. For example, in displays for television sets, there are four different platform technologies: cathode-ray tube, or CRT; liquid-crystal display, or LCD; organic light-emitting diode, or OLED; and plasma. Each uses a different scientific principle to form an image on a screen.

Any platform can support a number of design innovations. LCDs, for instance, come in a variety of sizes. Moreover, a variety of component innovations can be used in any design. LCDs can be made of glass or plastic, for example.

Innovation occurs almost constantly at the level of design and components, absorbing companies' attention as they look for ways to best their competitors. Platform innovations are less frequent. But when they do occur, they have the potential to transform markets, not just give an edge to one competitor.

One great danger to companies is to be so immersed in design and component innovation that they miss out on a platform innovation. For example, while Sony Corp. focused in the 1990s on improving its CRT television sets, a market it dominated, rival Samsung Electronics Co. invested heavily in flat-screen LCD TVs. As the market for LCD TVs grew, Sony fell behind its rivals and ended up entering into a joint venture with Samsung to build liquid-crystal displays.

### *Innovation's Messy Paths*

Another mistake to avoid is to assume that all technologies follow a standard progression.

The conventional wisdom is that the performance of any technology is initially low, then improves rapidly after some breakthrough, and ultimately levels out in maturity. A new technology's performance supposedly starts below that of the established technology, surpasses it after the breakthrough is achieved, and then remains superior until the next big thing comes along. Literature on the subject has encouraged managers to embrace a new technology once it begins to show rapid improvement, and to abandon the old technology because it is destined to become obsolete.

However, our analysis of several markets shows that technological evolution is much messier than this simple pattern. For instance, new technologies sometimes enter the market with better performance than the existing technology, only to fall behind at some point before later regaining the lead. That's the case in the market for external lighting. When gas-discharge lighting, which is used in fluorescent tubes, was introduced around 1930, it was brighter per watt than the existing arc-discharge lighting, which is used in many street lamps, and it maintained that superiority for some 40 years, until improvements in arc-discharge lighting made it the brightest per watt again. Then, in 1980, gas discharge made its biggest jump in performance so far, again surpassing arc discharge in brightness per watt. Both technologies have gone through several long periods of stagnation followed by sharp improvements in performance.

When one technology is growing rapidly, it's easy to get caught up in the hype and overinvest in it. However, the unpredictability and impermanence that we found in this and other markets suggests that companies should consider investing in, or at least monitoring, a portfolio of technologies, so they aren't blindsided by a sudden improvement in one or another.

Consider the competition between ink-jet and laser technology in the printer market. When the two technologies were introduced in the mid-1980s, laser was far superior to ink-jet in resolution. Ink-jet quickly caught up, but didn't surpass laser's resolution. Then, in the mid-1990s, laser again took a significant lead. But ink-jet surpassed laser in resolution in 1997 and has maintained that edge. All the while, printer maker Hewlett-Packard Co. continued to sell both ink-jet and laser printers, putting itself in the best position to succeed in a shifting market.

## *Changing Metrics*

Investment decisions are further complicated by shifts in the metrics by which consumers evaluate products. The conventional wisdom is that these changes are random -- the result of consumers' whims. But that's not the case. We found that these shifts are driven by the emergence of new platform technologies.

For example, in displays, in the 1970s and early 1980s, when CRT was the sole platform, consumers judged competing products mostly on resolution -- the sharpness of the image. When LCDs came on the scene in the 1980s, they excited interest in two new features, thinness and lightness. In the 1990s, when plasma technology emerged, it got consumers interested in brightness and screen size. Now, OLED, a technology that allows flexible screens, has introduced convenience as a potential deciding factor for consumers.

The challenge for managers is to see these changes coming. That means, first, watching carefully for any emerging technologies that might apply to their market, and then comparing these new technologies with the existing platforms at regular intervals, with two questions in mind: How do the new technologies measure up in the features that current technologies provide? Progress in performance over time may show a growing threat to the existing technologies. And second, how might the new technologies' strengths in other features change what consumers will look for?

Sometimes that means keeping an eye on other markets. Companies are sometimes taken by surprise because a new technology doesn't compete directly at first with the existing technologies in their market. LCD displays didn't compete directly with CRTs for many years because they didn't offer high enough resolution. The technology was initially used for pocket calculators, digital watches and other small electronic devices. But improvements in resolution eventually allowed it to be used in computer monitors and televisions. Today, the demand for LCD screens outstrips the demand for CRT screens. A manager who monitored LCD technology's progress in small electronics might have anticipated its entry into other markets and the effect that its advantages would have on those markets.

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That brings us back to the car of the future. Lithium-ion batteries are currently the most efficient of several alternatives for powering cars with electricity, but that superiority emerged only in the past couple of

years, and it took many companies in the auto industry by surprise.

Companies might have predicted the emergence of lithium-ion batteries in the auto market by monitoring the technology's performance outside that market. Lithium-ion batteries were initially used in portable electronic products like laptop computers, cellphones and cordless power tools. Their performance in those devices improved drastically in the years just before they soared to the top of the efficiency ratings in car batteries.

Lithium-ion batteries also have other strengths that bolster their competitiveness, including safety, ease of recharging and relatively low cost -- strengths that would be apparent to companies that examine competing technologies on the basis of several performance criteria.

Of course, there is no guarantee that lithium-ion technology will retain its position as the most efficient alternative for car batteries. Other existing technologies might jump ahead, or a new technology might change the market. But managers who understand how technologies evolve and compete with each other will be in a strong position to figure it all out.

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