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How Science Can Create Millions of New Jobs

Reigniting basic research can repair the broken U.S. business model and put Americans back to work

By Adrian Slywotzky

Name an industry that can produce 1 million new, high-paying jobs over the next three years. You can't, because there isn't one. And that's the problem.

America needs good jobs, soon. We need 6.7 million just to replace losses from the current recession, then an additional 10 million to keep up with population growth and to spark demand over the next decade. In the 1990s the U.S. economy created a net 22 million jobs, or 2.2 million a year. But from 2000 to the end of 2007, the rate plunged to 900,000 a year. The pipeline is dry because the U.S. business model is broken. Our growth engine has run out of a key fuel—basic research.

The U.S. infrastructure for scientific innovation has historically consisted of a loose public-private partnership. It included legendary institutions such as Bell Labs, RCA Labs, Xerox (XRX) PARC, and the research operations of IBM (IBM), along with NASA, the Defense Advanced Research Projects Agency (DARPA), and others. In each of these organizations, programs with clear commercial potential were supported alongside pure research. There was ample corporate and venture capital funding for commercialization, so the labs were able to make enormous contributions to science, technology, and the economy—including the creation of millions of high-paying jobs.

Consider a few milestones from Bell Labs: Fax transmission, long-distance television transmission, photovoltaic solar cells, the transistor, the UNIX operating system, and cellular telephony. Each of these innovations laid the groundwork for vibrant new industries. The transistor alone is the building block for computers, consumer electronics, telecom systems, high-tech medical devices, and much more. Likewise, DARPA's creation of the Internet (as ARPAnet) in 1969 and Xerox PARC's development of Ethernet and the graphical user interface (GUI) set the stage for the PC revolution. These basic research breakthroughs unleashed cycles of applied innovation that created entirely new sectors of our economy.

But since the 1990s, funding for basic research has slowly declined. Bell Labs had 30,000 employees as recently as 2001; today (under current owner Alcatel-Lucent (ALU)) it has 1,000. That's symbolic and symptomatic of the broken link in the U.S. business model. With upstream invention and discovery drying up, innovations capable of generating an industry have thinned to a trickle.

It's tempting to ascribe current job losses in the U.S. to the deep recession or to outsourcing, but the root of the problem is the absence of high-value job creation. We have been through three recessions since 1981, not including the current economic meltdown. Throughout those years, U.S. companies have engaged in aggressive outsourcing, yet the economy bounced back from each downturn with a new blockbuster industry or two. Eventually we will emerge from the current recession, but don't expect to see the same kind of job-creating vigor this time around.

In the past, when the U.S. exported high-paying jobs to low-wage countries, we replaced them with even greater numbers of high-paying jobs in industries whose inception could be traced back to science done decades earlier. The PC, Internet, and cellular industries, born in the 1980s and 1990s, more than offset the loss of high-paying jobs in consumer electronics, steel, and other sectors. But in recent years, outsourced software and manufacturing jobs have largely been replaced by millions of low-wage service jobs in fast-food, retail, and the like.

Compounding the effects of outsourcing and extended recession, the ongoing destruction of old business models (think print journalism, the music business, and landline telephones) will slash a large number of high-value jobs in the coming decade. The result? A broken demand structure. Of the roughly 130 million jobs in the U.S., only 20%, or 26 million, pay more than $60,000 a year. The other 80% pay an average of $33,000. That ratio is not a good foundation for a strong middle class and a prosperous society. It's time to identify—and fix—the root of the problem.

The good news is that restarting the science engine is quite doable and doesn't require massive investment relative to other spending. Venture capitalists are sitting on plenty of cash and are good at bringing startups to the market. We just have to rebuild the upstream labs that focus on basic research—the headwaters for the whole innovation ecosystem.

TOLERANCE FOR RISK—AND FAILURE

The difficulty is that science is a crapshoot. It depends on the efforts of hundreds of people with high IQs, PhDs, deep curiosity, and a strong work ethic—not to mention serendipity. It also takes a certain critical mass, not just in people, but also in infrastructure, which means lab support, equipment, and instrumentation. It takes open communication among peers and other subtle but critical cultural factors. Success requires a tolerance for risk—and failure; a willingness to think and apply innovation laterally (many of the big breakthroughs were originally aimed at other targets); and a culture that attracts and rewards the best minds.

The innovation path itself is unpredictable. Who in 1975 could have seen how the PC would evolve, how it would engender networking giants such as Cisco (CSCO), or how that shift would lead to an online revolution and blockbuster businesses such as Amazon (AMZN), eBay (EBAY), and Google (GOOG)? Who in 1980 could envision that the work at Bell Labs in novel cellular communications technology would lead to the global mobile revolution?

Many of the classic scientific research labs, such as Bell and RCA, were funded by companies with virtual monopolies and strong, predictable cash flow. But such companies hardly exist today. With the increasing focus on shareholder value that started in the 1990s, top companies could no longer justify open-ended research that might not have a near-term impact on their bottom lines.

Of all the recent developments, the diminution of Bell Labs may be the most jarring. Founded in 1925 to devise new equipment for the Bell System phone companies, its scientists amassed no fewer than six Nobel prizes. However, starting in 2001, budget cuts forced drastic reductions in laboratory funding and staffing. In 2008 parent Alcatel-Lucent pulled the plug on the last remaining areas of basic science—material physics and semiconductor research—to focus on projects with quicker payoffs.

A similar fate befell RCA Labs. In the 1950s and '60s it produced breakthroughs in color TV, tape recording, transistors, lasers, solar cells, and infrared imaging. At its peak in the 1970s, RCA was generating more patents than rival Bell Labs. By the time GE purchased RCA in 1986, the Labs had already started their long-term decline.

Xerox's Palo Alto Research Center (PARC) and DARPA also played transforming roles. PARC, for example, improved on DARPA's invention of the computer mouse and made point-and-click computing possible. It also incubated Ethernet technology, laser printing, and other ideas that sustained dozens of major Silicon Valley companies. DARPA, set up in 1958 as a response to the Soviet launch of Sputnik, is responsible for the Internet and numerous technologies with applications beyond the military. Its breakthroughs range from computer graphics, microprocessors, and advanced semiconductor design to parallel computing and local-area networks, and among its direct technological progeny are dozens of major companies—especially those that thrive on the Net. The agency continues to seed new research in the area of renewable power and energy efficiency, but its mission has largely shifted from science to tactical projects with short-term military applications.

For any institution, cutting back on basic research may make great sense in the short term. For a time you can free-ride off the investments of others. But then you have the "tragedy of the commons" writ large. What's good for the company ("cut the science") is a disaster for the system—no new industries.

While the timeline for translating scientific research efforts into tangible results is typically 15 years or longer, that cycle can be accelerated. We've done it at least twice: The Manhattan Project created the atomic bomb in six years; the Apollo Program landed a man on the moon just eight years after President John F. Kennedy set his famous goal for our space effort. Apollo not only had a big short-term impact on jobs, but also sped up development of key computer and communications technology and unleashed a host of innovations in fuel cells, water purification, freeze-drying of food, and digital image processing used in CAT scans and MRIs.

Today's challenges in the areas of energy, health care, transportation, water supply, climate change, and more will require Washington to unleash a series of focused projects, supported by research investments in a dozen or more leading companies. Only such direction and support could reproduce, on some scale, the cumulative impact of Bell Labs, RCA Labs, Xerox PARC, and the rest. In essence, the U.S. must recreate a broad network of industrial and national labs, perhaps catalyzing the process with one or two major national initiatives.

It won't be easy to replace Bell Labs' scale of 30,000 workers or instill the urgency of a Manhattan Project. Given that the U.S. economy is so much bigger than it was 40 years ago and so much less competitive internationally, several equivalent corporate research labs may be needed. But there is no shortage of plausible participants—top research corporations such as IBM, Hewlett-Packard (HPQ), Cisco, Google, ExxonMobil (XOM), DuPont (DD), and Microsoft (MSFT). These companies already employ hundreds of PhD researchers and scientists, and while their labs mostly focus on shorter-term development goals, they still retain the spirit of scientific pursuit. (For a video on Hewlett-Packard's research effort, click here)

Funding is always an issue, but consider that Bell Labs' budget peaked at $1.6 billion in 1982—about $3.6 billion in 2009 dollars. Today, $20 billion a year could fund three large labs and five smaller ones. Split between public and private sources, $20 billion is not so much. If leading companies committed a small percentage of their R&D budgets to pure research in exchange for a tax credit or a government match, a new innovation ecosystem would quickly begin to take shape. It would also be much easier to attract top minds today than during the dot-com boom of the 1990s or the financial innovation boom of this decade.

The choice facing the country is to do nothing and risk the decline of innovation or act boldly by reasserting our faith in scientific inquiry and discovery. We can't do this as a series of half steps that are expensive but ineffectual, that don't reach critical mass or a critical rate of change. This middle-road approach might well describe NASA over the past 30 years—not necessarily a good model.

The better model is the one we have put aside: a dynamic public-private ecosystem of large-scale labs and a venture capital industry waiting downstream to commercialize ideas and turn them into large public companies that create lucrative and satisfying jobs. What's needed to get that model back on track? First, clear national goals in two or three key areas, such as carbon-free energy and preventive medicine. Second, a commitment of $10 billion a year, above and beyond spending for national agencies, to jump-start new industrial research labs. Third, government tax credits for corporations that promise to spend, say, 5% to 10% of R&D on basic research.

In 1943, Elmer W. Engstrom was put in charge of RCA Labs in Princeton, N.J. After the war, as he reflected on the task before him, he called attention to "the depletion of basic knowledge" that resulted from shifting resources from basic science to war-related applications. He said universities were great institutions, but "you couldn't count on them alone" to close that knowledge gap.

Engstrom believed that it was a duty of the great industrial labs to "rebuild the war-depleted inventory of basic scientific knowledge." He also believed that "by doing work in fundamental research of a quality which will command the respect of scientific investigators in universities, we will stimulate work there which will, in effect, enlarge the scope of the work done within RCA Laboratories and thus bring about more rapid progress."

Although the causes of our concerns are different, Engstrom could be providing a precise description and prescription for our situation today. He could be calling out from the 1940s to our leaders today, articulating a challenge and a solution. If only a dozen major companies respond to that challenge, they can, in collaboration with the government, solve our jobs problem within a decade.

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