

## Manufacturing: Up from the Ashes

*Susan Christopherson*

**W**hen we think about innovation, we usually think about a start-up with a big idea, looking for venture capital and anticipating an initial public offering. It is these entrepreneurial companies that attract the attention of politicians, universities, and public R&D centers. And why not? Everybody is hoping for big gains from a small initial investment. They hope the firm will generate the next new thing, build a business, and expand employment in the region that gave them an initial push toward success.

That hope is frequently dashed. Once on their way, innovative companies have a different set of criteria for where to build their business. They look for access to the expertise they need to keep innovating, capital to commercialize and reach export markets, and a labor force with the skills required by their production processes. Innovation is about more than finding and helping talented lone wolves. It is about building industry environments where inventive firms can thrive and grow.

While we have all heard about innovative industries in Silicon Valley and along Route 128, some of the best environments for new advanced technology companies have emerged in unlikely places: our old industrial cities, places like Syracuse and Rochester in New York and Pittsburgh, Pennsylvania. These often-dismissed Rust Belt cities have the assets needed to support process and product innovation, as well as the commercial application of new technologies. If we want to develop a more innovative economy and to translate innovations into products with global markets, we need to find ways to build the nascent industries emerging out of the ashes of our old manufacturing base.

**W**hat I call “phoenix industries” have significant features that set them apart from the vaguely defined clusters that are the bread and butter of economic-development gurus. Phoenix industries have what’s called “initial advantage”: They benefit from pre-existing personal networks, technical skills, and market knowledge that have developed over a long time, the products of investments in R&D and the workforce made during the heyday of American manufacturing, from the 1950s to the 1970s. Fortunately for our old industrial regions, assets like specialized engineering and research programs housed in nearby universities have proved difficult to move. That is why multinational

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firms like United Technologies, General Electric, and Kodak have kept R&D operations in Syracuse, Schenectady, and Rochester respectively, even as they have dramatically reduced their assembly line manufacturing there.

Despite their ties to the past, phoenix industries look very different from the old manufacturing industries that they have gradually replaced. Instead of one dominant employer, the sector is made up of many small and medium-size companies. By contrast with their big-firm predecessors, phoenix companies rarely make products that we see on store shelves. Instead, they produce sophisticated components sold to equipment manufacturers, like the high-quality circuit boards certified for use in medical equipment and the defense industry, or sophisticated sensors to measure changes in heat and light used in all kinds of robotic devices. They also design and produce prototypes for products that

are then manufactured around the world. They are frequently described as “enabling industries” because they research, develop, and produce technologies that are used in many different industries, instead of just one. And because phoenix-industry companies work closely with a variety of customers, they are constantly engaged in

**Some of the best environments for innovation exist in our oft-dismissed Rust Belt cities. They have the assets, but we need to do more to help.**

incremental process as well as product innovation.

The story of the photonics industry in Rochester, New York is instructive. Photonics is about the science and technology of light, and it is the basis for a wide range of industrial applications. Rochester, frequently described as a declining Rust Belt city, is nevertheless ranked by the Society for Optics and Photonics as one of the top centers in the world for optics innovation, and the Rochester metro region produces almost six times as many patents per 1,000 workers as the U.S. average. How?

In their heyday, Rochester’s dominant employers—Eastman Kodak, Xerox, and Bausch & Lomb—invested in optics and engineering programs at local universities and built the region’s strength in optics science and manufacturing skills. As a result of these investments, the region developed major research centers in optics engineering and visual science at the University of Rochester and the Rochester Institute of Technology. In the 1980s, these firms pulled out much of their manufacturing in Rochester. But the R&D and engineering programs, rooted in local universities, stayed. Those programs produced a new generation of engineers who foresaw fewer opportunities with a Kodak or a Xerox but more with the growing array of advanced technology firms in the region, the earliest of which began as outsource suppliers to the Big Three. Rochester was

also home to thousands of highly trained workers, including quality-control technicians and specialized machinists. Those that could stayed in the region and became the expanding photonics industry workforce. Thanks to this skilled labor pool and knowledge base, more than 100 photonics firms have sprouted in the Rochester region since the 1980s.

Pittsburgh is another example. The city may have long ago lost Big Steel, but it has retained a vibrant industry based on steel-making that exports goods and services to steel producers all over the world. As in Rochester, these small- and medium-sized firms are a diverse group. They produce new types of steel-making equipment, provide engineering services, and do the R&D for devices that improve steel-making productivity and quality. According to Carey Treado at the University of Pittsburgh, an expert on the region's steel industry, this innovation-oriented industry now comprises more than 330 firms employing 12,000 workers.

Phoenix industries are renewing not just regional economies but the nation's economy. Small companies account for 98 percent of U.S. exporters and 30 percent of the total value of U.S. exports. And the Commerce Department calculates that exports by small- and medium-sized companies increased 73 percent between 2002 and 2007. Much of this increase comes from producing innovative components for expanding world markets. The value of phoenix industries is showing up even in the current economic recession, as cities like Rochester and Syracuse post lower unemployment figures than the national average.

**H**ow can we use our old regional industrial assets to put our national economy on firmer footing? The most important step we can take is to think about innovation as the first step in a long process, the end goal of which is jobs. This sounds like common sense, but our innovation policy has too often emphasized science-based research and intellectual property and neglected the downstream, where ideas are turned into products and companies that actually employ people. Doing otherwise means working closely with small- and medium-sized companies to improve their productivity and identify how they can transform their operations and move forward with new products and processes. While startups are important, so are the already existing companies in innovative industries like photonics and environmental systems. And we should focus more on the needs of growing companies in innovative industries, and less on the needs of the multi-national firms that are reducing their employment in the United States. Right now, big old companies get all the breaks—in tax abatements, energy subsidies, and support for their research and development. Yet they are not building our industries of the future; that's being done by smaller companies, often located in the same towns and cities as the old-model manufacturers once were.

Nevertheless, the kind of help needed by small manufacturers has dried up since the 1990s (because they aren't a reliable source of campaign contributions). That is a mistake, because, despite the hype about clusters and networks, small firms rarely have the time or inclination to work together or to find ways to free up capacity for process and product innovation. Policy should concentrate on ways to increase their productivity, thus creating room for innovation, and help them achieve collectively what they find difficult or impossible to do as individual companies.

### **TECHNICAL ASSISTANCE**

Susan Helper, an economist at Case Western Reserve University, advocates rebuilding the Manufacturing Extension Partnership (MEP), which enables small companies to improve their productivity and create the capacity to innovate. This program has been measurably successful in increasing small-company productivity, but its funding has decreased from \$138.4 million in 1995 to \$90 million in 2008. My interviews with New York entrepreneurs in the digital simulation and electronic packaging (specialized circuit-board design) industries illustrate the role that MEP has played in fostering innovation. In both these new industries, MEP has enabled companies to build their management systems, supplement their training capacity, and locate new markets for their products and processes. But with its funding on the wane, fewer can access those benefits. Our first step must be to reverse that trend.

### **INDUSTRY PARTNERSHIPS**

Like MEP, industry partnerships build phoenix-industry capacity and fill gaps in their resources, bringing small companies and entrepreneurs together to accomplish as a group what they can't do as individual firms. Often initiated by leaders among the owners of these firms, they can be joined by non-profits, public-sector technical specialists in workforce development or lean manufacturing, or by unions, depending on where the region's leadership lies and what its industry needs. Public investment in these efforts can help phoenix companies learn about technological advances in the industries they serve, foster global marketing efforts, develop the workforce small firms need in a volatile economy, and represent their interests and concerns to economic policy makers.

Maine's North Star Alliance, for example, builds on the state's historic knowledge and skills in boat building and aims to create a new generation of maritime industry. State and federal investment in the alliance has enabled it to develop training programs in boat building design and engineering and to host an international conference on composite materials. The key here is the funding of an

## THE RACE TO INNOVATE

organization that will represent the interests of the boat builders, designers, and suppliers in common and help them find ways to reach new markets, get the workforce they need, and continually innovate. But the funding is through a federal Workforce Innovation in Regional Economic Development (WIRED) grant lasting only three years, and the question of what will happen when it expires still remains.

In Great Britain, there is a coordinated national effort to build new industries on old foundations. Regional agencies such as One Northeast in Newcastle directly support organizations that build the capacity of phoenix industries. One example is the Marine Design Centre, whose goal is to create a new industry from the shipbuilding that has existed in the northeast of England for hundreds of years. As similar design skills and technologies have been applied to oil rigs and other offshore installations, the demand for the region's specialized designers has expanded globally. The Marine Design Centre has established an R&D program with partners, including the University of Newcastle, to conduct seminars for the globetrotting marine designers headquartered in Newcastle; develop skills training programs; and host firms looking for specialized marine design skills. The Centre fills an important marketing role for small firms, giving them the information and visibility they need to compete in global markets.

The Marine Design Centre was started with 1.5 million pounds (\$2.4 million) from One Northeast in 2007, and it has subsequently received funding to carry it through to 2012. The Centre has the potential to become self-supporting by providing a project facility for visiting companies wanting to collaborate with local firms and tap the region's design capacity. America can learn from it: The difference between the UK initiatives and those in the United States is that in Britain, the commitment to building new innovative industries is national and long term. Both design customers such as BAE and designers thinking about re-locating to Newcastle know that the Marine Design Centre is going to be around to help them stay at the cutting edge.

### REGIONAL INDUSTRY-UNIVERSITY CENTERS

We can spur growth in our phoenix industries by encouraging our universities and colleges to participate actively in their creation. Universities in the nineteenth century—particularly the “land grant” institutions initiated by the Morrill Act—connected their own welfare to that of their states and regions, and served that connection through industrial extension services. Over time, that connection has been bent or even broken, as universities focused on tech transfer and developing revenue streams from products that have little or no relation to the regional economy. In some cases, like MIT or the University of Rochester, technology transfer does result in the establishment of new companies that enhance

the regional economy, because the region has other assets that companies need. In most cases, however, the benefit of university-originated inventions does not accrue to the region in which they originate. If universities refocus attention on the quality of their regional economy, that economy can become a stickier place for university inventions to take hold. Like MEP, this idea is not new, but it's one that lost support during the 1990s, when job creation was not perceived as a critical national objective.

There are some modest ongoing programs that could reestablish the role universities have played in fostering local innovative industries. For example, the University Center Economic Development program funds efforts at universities in over 40 states to connect with their local and regional economies. Expanding this now-\$7.2 million program to encourage the augmentation and rebuilding of industrial extension services could provide the on-the-ground assistance needed by businesses and communities. In some land-grant institutions such as Iowa State University, this kind of work is already happening. But in many states, including New York, the university industrial extension primarily serves agricultural production. A modest expansion of university centers could begin to move university technical outreach into areas required to build the next generation of manufacturing companies.

**P**hoenix manufacturing companies may never replace the large plants that employed hundreds of thousands of workers in the 1950s. But they can employ thousands of people in jobs that pay good wages, support the local tax base, and contribute to the diversification of our national economy. While these industries employ a significant number of people with advanced degrees in science and engineering, they also employ middle-skill craft workers, such as welders and solderers, and entry-level production workers, too. Even as unemployment rates soar during the current recession, these firms often face chronic labor shortages. That alone should tell us that they offer the possibility for long-term employment growth, as well as building a more diversified economy in which manufacturing plays a different but still vitally important role.

During the 1990s, we had the luxury of thinking about innovation as something that took place in universities and science labs. We didn't worry too much about whether public investments in innovation translated into products or processes that fed industry growth and created jobs. We don't have that luxury anymore. We need to move beyond the romance of start-ups, target the next generation of industries appropriate to each region's strengths, and create policy and programmatic environments in which those start-ups generate thriving businesses that will stick around, endure, and create sustained employment. **▀**