Economic Development Planning, Summary 8

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Title: Arizona’s Technology Workforce: Issues, Opportunities and Competitive Pressures

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Summary: In response to persistent reports that Arizona companies are being constrained by a low supply of science and engineering workers in the state, a 15-month-long study was undertaken to explore the issues, opportunities and competitive pressures that Arizona’s technology employers and employees face. The study, primarily based on a survey of and follow-up interviews with technology employers, put to rest a number of myths regarding the “technology talent gap” in Arizona.

In general, the demand for computer scientists, engineers and scientists by Arizona employers does not outweigh the state’s supply of these employees. While they may prefer to hire locally, companies report they are also able to attract workers with the experience and skills they want from other states. That is not to say that it is always easy for these companies to do so. There are challenges, including obstacles in hiring foreign workers.
**Sector:** High technology, aerospace, defense, semiconductor

**Geographic impact:** Arizona

**Key actors:** Arizona Technology Council, Arizona Commerce Authority, Arizona Department of Economic Security, Governor’s Council on Workforce Policy, U.S. Department of Labor, Arizona State University, University of Arizona, Northern Arizona University, Maricopa Community Colleges, Salt River Project.

**Major challenges:** Shortage of technology workers with right skill sets and/or very specific kinds of experience; lack of workers with requisite soft skills; an unwillingness or inability among companies to pay to train recent college graduates; lack of concentrated technology industry; shortage of native-born scientists and engineers; immigration policies limiting H-1B visa; suppliers of talent (universities, community colleges and workforce development and training agencies) and employers are not connecting, and potential scientists and engineers turn to other fields of study in college (medicine, law, finance and business) because of higher salaries in those careers.

**Progress to date:** The Workforce Development and Education Committee of the Arizona Technology Council is studying ways to use the report as a blueprint to ensure an adequate supply of technology talent to meet the needs of employers.

**Major implications:** Arizona and United States face major challenges from China, India and other countries that are rapidly developing their science and engineering capabilities. Arizona needs to be able to tap into the worldwide pool of talent, while strengthening its own citizens’ capabilities in science and engineering.

**Opportunities for alignment:** Arizona colleges and universities work more closely with technology companies to ascertain their needs. These schools should consider offering more hands-on training in science and engineering, and further promote internship programs. Science and engineering departments could better align faculty and curricula with the state’s key technology sectors. State workforce training and development programs coordinating more closely with technology companies to supply needed workers.

**Background:** In late 2009, Steve Zlstra, president and CEO of the Arizona Technology Council, Arizona’s largest technology organization with more than 600 members, contacted the Seidman Research Institute at ASU about conducting a study on the work force needs of high-technology companies in Arizona. The aim was to better understand whether reports about high technology companies in Arizona having problems in recruiting scientists and engineers were isolated, part of a broader “urban legend,” or were a major problem for many companies. The study was approved and funded by the Governor’s Council on Workforce Policy through the American Recovery and Reinvestment Act.
Science and engineering workers account for 5.42 percent of total Arizona employment, which is slightly higher than the national percentage of 5.24. Science and engineering are particularly important because they are integral to the process of innovation and production of commercially useful knowledge. A state that exports products and ideas is on a very good economic development foundation.

Among the 50 states and District of Columbia, Arizona ranks 20th in share of employment by science and engineering workers. Among the Western states, Washington, Colorado, California, New Mexico, Utah and Oregon all have higher shares of science and engineering employment than does Arizona.

Aerospace and parts are highly represented among Arizona’s high-tech industries, representing a 5.76 percent share of national employment. Other well-represented sectors are semiconductors and other electronic components (3.81 percent); navigational and control instruments (3.02 percent), data processing (2.87 percent); and optical instrument manufacturing (2.10 percent). Each of these industries exceeds Arizona’s 1.93 percent share of U.S. total private-sector employment.

Does local training create a larger local workforce? Nationwide, 38 percent of students graduating with a bachelor’s degree in science or engineering leave the state shortly after graduation. For newly trained doctoral graduates, the figure is even higher – 64 percent. It is a given that high-tech employers will have to look out of state to fill their needs for science and engineering workers with advanced and specialized training. That is the case even with Massachusetts, which imports more than half of the new doctoral graduates it needs.

Arizona is clearly more attractive to science and engineering graduates of its three public colleges than critics suggest. The stay rate is higher among all students who received a degree in science or engineering in Arizona between 2000 and 2010 than the national average. The percentage of such graduates who currently live in Arizona breaks down this way: 72 percent for Arizona State University, 66 percent for University of Arizona, and 64 percent for Northern Arizona University.

Still, Arizona produces relatively few science and engineering graduates when compared with the size of its population. The state accounts for 1.83 percent of the U.S. population but only 1.41 percent of the nation’s science and engineering degrees, and 1.5 percent of the graduate degrees. Colorado graduates a relatively large number of science and engineering students.

Arizona State University

Of the 6,800 ASU students who received an undergraduate degree in science or engineering, 72 percent call Arizona home. In line with the national rate, the more advanced the degree, the more likely that an ASU graduate will leave the state.

Among the 4,148 ASU graduates with a master’s degree or Ph.D. in science or engineering, the stay rate is 47.2 percent. ASU graduates the largest number of
advanced science and engineering degrees in electrical engineering and computer. The stay rates for advanced degrees in those fields are 43 percent and 39 percent, respectively.

The highest stay rates for ASU undergraduates in the science and engineering fields are: electrical engineering (77 percent), computer science (74 percent) and biochemistry (72 percent). The lowest stay rates are for those graduating with degrees in physics (63 percent), microbiology (65 percent), industrial engineering (65 percent), and aerospace engineering (66 percent).

ASU graduates with advanced degrees in science or engineering who leave the state tend to reside in the West. The largest number – 755 – live in California, about 35 percent. Other states with ASU graduates with advanced degrees in science or engineering include Texas (195), Washington (174) Oregon (112), and Illinois (74).

By comparison, Arizona has 1,959 ASU graduates with an advanced degree in engineering or science degree.

**University of Arizona**

The stay rates for graduates in science and engineering at the University of Arizona are uniformly lower than they are for ASU. Possible reasons include Tucson having a smaller economy than Greater Phoenix. It’s also often the case that students who choose not to stay in the same city as their university often end up leaving the state altogether. Of the 7,139 UA students who received an undergraduate degree in science or engineering, 65.6 percent continue to live in Arizona. Only 24.4 percent of the 1,998 UA graduates with an advanced degree in science or engineering call Arizona home.

Stay rates are highest for UA undergraduates with degrees in microbiology (75 percent), reflecting a strong science base in Tucson, and electrical engineering (74 percent). Similar to ASU, stay rates are lowest in the fields of physics (45 percent) and aerospace engineering (55 percent).

UA’s 24 percent stay rate for advanced degrees is half that of the comparable group for ASU. The four fields with the largest number of advanced degrees and their associated stay rates are: electrical engineering (29 percent), optics (31 percent), chemistry (27 percent), and computer science (16 percent).

As is the case with ASU, California is home to the most UA graduates with an advanced degree in science or engineering who leave the state. Some 287 such graduates live in California, or 24 percent of the total. Other states with the most UA graduates with advanced degrees in science or engineering are Texas (78), Washington (68), New York (63), Pennsylvania (43), and Massachusetts (42). By comparison, UA graduates with advanced degrees in science or engineering number 488 in Arizona.
Northern Arizona University
Northern Arizona University provides very few advanced degrees in science and engineering. Of the 1,699 undergraduates receiving a degree in science or engineering, 64.3 percent remain in Arizona. This is considerably lower than the ASU stay rate, and only slightly lower than the UA rate. Of the 191 alumni with a graduate degree in science or engineering, 58.5 percent remain in state. For the most popular science or engineering undergraduate majors at NAU, the stay rates are: computer information systems (68 percent), mechanical engineering (61 percent) and environmental science (60 percent). The lowest stay rates are: physics (47.8 percent), chemistry (56.2 percent) and computer science and engineering (57.4 percent).

Science and engineering employment in Arizona: Arizona is relatively intensive when it comes to science and engineering. In all, 128,280 Arizonans work in these sectors. This represents 1.93 percent of U.S. employment in science and engineering, which is slightly higher than Arizona’s 1.86 percent share of overall employment. Engineering occupations are well represented in Arizona, accounting for 2.18 percent of U.S. workers in architecture and engineering.

Arizona firms employ a relatively large number of database administrators and systems software developers, but relatively few work in applications software development. The life and physical sciences, represented by biochemists, microbiologists and chemists, are not very important to the Arizona economy.

By share of employment, Arizona ranks 17th in computer and mathematical occupations; 13th in architecture and engineering; and 27th in life, physical and social science occupations.

Conclusions: Contrary to some perceptions, it’s not true that Arizona technology companies are constrained because they can’t find good talent. Nor is it true that a huge gap exists between the demand for scientists and engineers and the state’s supply of such workers. While Arizona is a relatively low producer of science and engineering graduates, a greater percentage of these graduates stay in the state than the national average.

Employers also report that they are able to recruit talent from out of state without a great deal of stress. Arizona is hardly alone among western states that must recruit scientists and engineers from out of state. California, Colorado and Washington, states with heavy science and engineering employment, must import an even greater percentage of such workers and new graduates. It’s clear that a state does not need to rely exclusively or even primarily on its own colleges and universities to meet its science and engineering workforce needs.

A review of wages in Arizona suggests that any shortage of scientists and engineers in the state has been limited to computer scientists and engineers. Among those
surveyed about how difficult it was to attract qualified workers were 134 establishments that employ more than 6,000 computer scientists, about 10 percent of total Arizona employment in computer-related occupations. One-quarter of these firms said that it was very difficult to attract qualified computer scientists; one-half said that it was somewhat difficult; and one-quarter said that it was not difficult at all. This distribution of responses made it difficult to draw any strong conclusions.

Among the firms employing engineers, only 15 percent said it was very difficult to find qualified engineers to hire. More than twice that percentage, 33 percent, said that it was not difficult at all to find engineers.

Technology firms expressed satisfaction with the quantity and quality of new graduates of Arizona’s educational institutions. Only 12 percent of the 134 firms surveyed about computer scientists said that Arizona graduates lacked the necessary job skills. Of the 110 employers of engineers, only 15 percent expressed dissatisfaction.

In recruiting out of state, very few of those interviewed said they encountered reluctance on the part of prospects to move to Arizona. Those voicing concerns usually cited low industry concentrations or the poor reputation of Arizona’s school systems, which interviewees were able to counter by providing information about the availability of high quality districts and schools.

**Policy options:** The growing strength of foreign countries, especially China and India, in science and engineering pose the greatest threat to the viability of Arizona's high-technology firms. If the H-1B visa could be further liberalized, that would make it possible for companies to hire more skilled foreign scientists and engineers. Otherwise, these workers will take their skills to other parts of the world.

For those Arizona companies heavily involved in government and defense-related work, it would also help if it were easier for talented foreign workers to gain U.S. citizenship.

While proposals to strength U.S. capabilities in science and engineering could be productive, it seems unlikely that a significant number of native-born students will forego careers in medicine, law, business or finance to pursue jobs in science and engineering, unless financial rewards change.

At the state and local level, there are policies that could conceivably make it easier for firms to find science and engineering workers. They are:

- To address concerns among out-of-state prospects about Arizona’s low industry concentrations, economic development policies could be pursued that would strengthen or encourage the formation of high-technology clusters. However, it’s noted that economists are generally skeptical of how effective local industrial policies can be.
• To encourage more students to seek degrees in science and engineering, the universities could alter program fees and admissions standards. Many interviewees mentioned the value of science and engineering departments offering more hands-on training and promoting internship programs.

• Companies are changing their policies to make it easier to find labor. Among the changes is to focus more on hiring recent graduates, rather than experienced workers, so that they can train and promote from within. Some also mentioned they are considering changing their job requirements to be more realistic about the skill sets needed.