

Defining High Tech

ACCRA Research Methods: Defining High Technology

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The Importance of High Technology

Historically, the Eastern and Midwestern states relied heavily upon manufacturing industries for economic growth. Many of these states experienced economic downturns beginning in the late 1960s. During the late 1970s and early 1980s the United States suffered a recession and saw substantial increases in energy prices and real interest rates. These events hurt the manufacturing industries, which relied heavily on energy and capital investment to produce goods. The appreciation of the dollar in foreign markets and improvements in transportation enabled other countries to compete with these older, established manufacturing companies. When traditional manufacturing industries experienced downsizing and began locating to the Southern and Western states in order to reduce production costs, areas with high technology industries weathered the economic downturns much better. As a result, some areas that needed to restructure their economies looked to high technology industries for help.

Research into the high technology industries indicated that they created a substantial number of jobs. In addition, the jobs were relatively well-paid and stable, which helped to offset the losses in the manufacturing sectors. The high technology firms were also quite innovative and competitive. In 1982, the Joint Economic Committee stated that the high technology sectors were at the core of technological change in the United States. They reported further that the "importance of technical change and industrial innovation to the productivity and growth of the national economy makes high technology companies an important national resource." In 1991, fearing that other countries were outpacing the Nation's technological advances, the United States Senate stated that "unless the Nation acts today to promote the development of generic industrial technology, its technological position will erode further, with disastrous consequences for American jobs, economic growth, and national security." During the 1990s, businesses began investing in technological improvements, and the majority of economic developers recognized the importance of high technology industries in their regions.

High Technology Definitions

A number of researchers and organizations have developed subjective and objective definitions of high technology. With subjective definitions, the researcher develops a definition based on personal criteria. The benefit of the subjective approach is that it is personalized for a region's specialized industries, but it may lose credibility because it is not widely used. Objective definitions can be used for multiple regions and as more use the definition, it gains credibility. Ann Markusen, Peter Hall, and Amy Glasmeier in their book, *High Tech America*, generated a definition of high technology industries that was used extensively during the 1980s. Their definition focused on manufacturing industries because service activities had not yet developed their current prominence. Markusen, Hall, and Glasmeier relied on occupational data and identified 29 three-digit SIC high technology industries that had concentrations of engineers, engineering technicians, computer scientists, life scientists, and mathematicians greater than the average for all manufacturing industries. As a result, these industries would have the technical capacity to develop new products.

Some are bothered at these definitions of high technology, because the industries included seem to utilize old technologies. For example, SIC 284, Soap, was classified as a high technology industry. However, it is important to note that SIC classifications describe the products that are produced. When Markusen, Hall, and Glasmeier relied on occupational data to define high technology, they focused on the processes used to produce the goods. Many chemists and chemical engineers are needed to research and develop soap products, so soap is considered a high technology industry. Processes define high technology--not the product. Therefore, the use of SIC codes is not a perfect indicator of high technology.

Modifications have been made to the original definition to include services including computer software. The definitions of Saxenian (1994) and DeVol (1999) incorporate these newer industries into their definitions and discard some of the more traditional manufacturing industries. Stough (2000) includes the original definition and the newer industries. It also is possible to disaggregate the definition and look at sub-divisions of the high technology industry. The Center for Innovative Technology in Virginia developed a definition of high technology and further divided it into the following sub-sectors according to SIC codes: information technology, advanced materials, aerospace, biotechnology, energy and environment, electronics, transportation, management services, and technology industrial manufacturing.

Daniel Hecker, an Economist at the Bureau of Labor Statistics, has dedicated a substantial amount of time to defining high technology industries. He also proposed the notion of embeddedness--that technology is an increasingly integral part of many industries. It can be difficult to distinguish between industries that use high technology unless a comprehensive analysis is used. Hecker's methodology and list of industries is found in "High-Technology Employment: A Broader View," *Monthly Labor Review*, June 1999, pgs. 18-28, and can be downloaded at the Bureau of Labor Statistics web site (www.bls.gov).

Which definition of high technology is the most useful? There is no clear-cut answer. No definition is perfect because of embeddedness and because SIC data focuses on products, not processes. However, the objective definitions summarized above have merit, especially the newer definitions that include the services sector.

Describing the High Technology Sector in an Area

Indicators such as establishments and employment are measures of the size of the high technology sector. Government sources, such as the Bureau of Economic Analysis and the Bureau of Labor Statistics, provide some of this information. Private and commercial sources may also provide employment or output forecasts for a region. Using Input/Output Analysis models, one can estimate the indirect effects, such as jobs and income, above and beyond the direct number of jobs produced. Surveys of local businesses can also provide information on the current state of high technology in an area.

Using High Technology Analyses to Assist Economic Development Goals

Sommers and Carlson, in their book, *Ten Steps to a High Tech Future: The New Economy in Metropolitan Seattle* (The Brookings Institution, 2000), develop steps that economic development officials can take in order to enhance a technology economy.

1. Understand high tech firms in your region and your region's competitive advantages. Integrating related high technology industries into the established economy will encourage positive results. For example, the traditional industries in Northeast Ohio have been iron, steel, automobiles, durable goods, and chemicals. High technology industries such as machinery, chemicals, and electronics have been attracted to the region recently because of the established business linkages.

2. Invest in human capital.
Higher education is important because the workforce involved with high technology generally need bachelor's degrees or beyond. However, it is also important to focus on K-12 education to develop the future workforce and the families of the current workers.
3. Create a research and development (R&D) presence.
R&D is crucial for innovations and business spin-offs. This can be developed in cooperation with universities and/or businesses.
4. Invest in physical capital.
Infrastructure is also crucial to attract businesses. Highways need to be in top condition, buildings can be built or renovated, and fiber optic cable is increasingly important. A good public transportation system is also a requirement.
5. Invest in quality of life.
An area must also attract a workforce for the new and expanding businesses. Nearby cities that support cultural and entertainment activities will attract workers. It is also important to determine the types of households that comprise the current population. For example, if there are a number of young families in the area, then it is beneficial to host events that appeal to this group. On the other hand, nightlife will attract a younger group. These examples illustrate the types of information and activities that economic developers may be interested in analyzing. In addition to having vibrant cities, the surrounding suburban areas need to have adequate housing and activities as well.
6. Streamline permitting, planning, and other public services.
Reducing governmental red tape helps in attracting businesses, especially small start-ups. Making licensing and permitting easier to obtain is also a positive step.
7. Adapt other local laws (such as special tax policies and administrative procedures).
Publicly-sponsored incubators have had success in some areas. It is also important to note that most high technology firms employ a smaller number of workers than an average company; so governmental officials should keep this in mind when setting policies.
8. Provide venture capital and seed capital.
The amount of venture capital invested reached record highs in 2000, but it is unlikely that this will continue in 2001. However, Business Angels Networks have seen success in some areas, and should be encouraged.
9. Create support programs for entrepreneurs.
One way to do this is to set up an entrepreneurial network directory or web site. This way, entrepreneurs would know others in the area, and they could discuss common issues together.
10. Apply information technology in the public sector.
Governmental web sites can be enhanced by streamlining web pages, providing forms for permits and licenses, and giving general information.

Most of these steps can be performed at the local level; some require a larger forum such as the state level. Nevertheless, progress in any of these steps would benefit the high technology sector of local economies.