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Regional Technology & Innovation Strategies in the United States: Small Steps, High Expectations

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A. Introduction

Technology and innovation policies in the U.S. come in so many different forms and shapes in the United States, which often confounds and frustrates visitors trying to understand the U.S. "system". Technology and innovation policies range from free-standing technology or industry targeted initiatives, such as North Carolina's Biotechnology Center, to regionally targeted, broad-based strategies spanning R&D, technology transfer, and technology diffusion, such as Arkansas' Science and Technology Authority. Further, priorities change, and programs rise and fall with changes in regional economies and/or state governments. This diversity and flexibility are consequences of the fact that responsibility for much of the funding and most of the implemention of technology and innovation policies—as with both education and economic development policies—rests with the fifty states. Although the federal government spends large sums of money on research and innovation, the states, control the purse strings and make the decisions concerning which programs to apply for and, within generally broad guidelines, how and where to use the resources. Because states have different economies, government structures, technological capacities, resources, priorities, and political orientations, they have adopted a variety of arrays of objectives, programs, and organizations.

This is not to understate the importance of the federal government which, by virtue of its funding, influences states to develop technology and innovation programs that would not have been considered in the absence of federal resources. The federal government is a vital catalyst for starting new programs. It is also the major source of funds for basic and pre-competitive R&D. Further, it influences private sector participation through its tax and regulatory policies.

Multi-state and sub-state regions have less discretion and authority but are also actors. Multi-state agencies, which are generally voluntary and non-binding, periodically establish plans and use their collective strength to leverage federal and state resource. Sub-state regions, which exhibit even more diversity in economies, resources, and wealth than states, devise ways to compete for and use the state and federal funds to fit their own circumstances and meet their own special needs.

This chapter briefly traces the recent history of innovation policy to the present and then describes strategies in two contiguous states in the southeastern United States, North Carolina and Virginia, to illustrate innovation policies at the state and sub-state areas and show how they can be influenced by multi-state regional bodies. Each of these states is moving from a historic dependence on agriculture and low-wage non-durable goods manufacturing to highly skilled high-tech industries and services. Each is advantaged by many strong research universities and each now has an urban concentration with an international reputation as a Mecca for high technology. Each state also retains some of the unfortunate legacies of its past within its borders—relatively low levels of education and weak public schools (compared to U.S. averages) and rural areas with low incomes and large disadvantaged minority populations that are slow to embrace technology. The stories also illustrate the weakness of the footing for technology policy is and the tenuousnous of its support. To understand the strategies of North Carolina and Virginia, it is first useful to appreciate the national context and influences under which they evolved.

B. An Expanding View of Technology and Innovation

Large-scale public sector research, technology, development, and innovation strategies began with the first element of those strategies following a pathbreaking report by Vannevar Bush in 1945 that legitimated scientific research as a public responsibility and social good.[1] One result was the formation of the National Science Foundation, the main source of support for basic research in the U.S. To the extent that technology and innovation were accepted as factors in regional development, they were linked to research and development. Regional development was associated with regions' research capabilities which, in turn, were tied to their universities and research labs. Economic outcomes were expected to be eventually derived from the transformation of R&D into new commercial products. In this paradigm, public policy debates and strategic plans were about investments in and quality of R&D, and enrollment patterns in collegiate science and engineering programs. The participants and primary beneficiaries were generally those with vested interests in the outcomes: the universities, large corporations with R&D divisions, banks, and government agencies, and the communities with R&D facilities.

States took a different view of "science policy" and saw it as opportunities to attract federal research and development dollars to their educational and research institutions, which were assumed to be the wellsprings of technology-based growth, usually by attracting new companies. Industry was a customer for research contracts with universities and for communities' plant sites, not a source of innovation. The public benefit was akin to GE's old slogan "progress is our most important product". Although a few farsighted planners foresaw the connection between technology and innovation and economic growth, for the most part states' interest was mainly in the contributions research institutions could make to local employment and to improve the overall attractiveness in marketing a region to industry.

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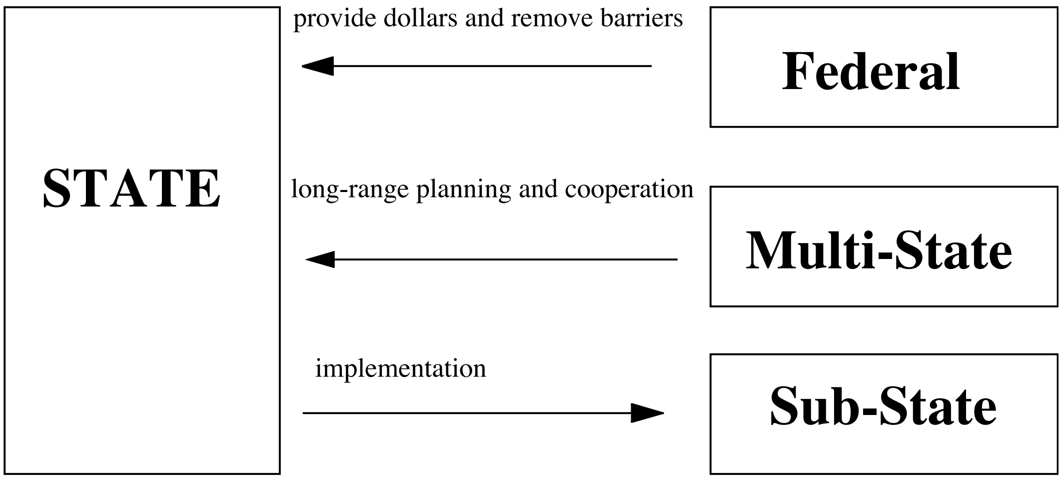
[1] J. Merton England, *A Patron for Pure Science: The National Science Foundation's Formative Years, 1945-57* (Washington, DC: National Science Foundation, 1982)

Figure 1

Structure of Technology and Innovation Policy in the United States



1. Rising Interest in High Tech Industries

In the early 1980s, as emerging economies became more cost-competitive for traditional industry sites, states turned to technology and high-tech industries, where they still had an advantage, for economic growth. This led to a whole host of state technology-based strategies likely to produce jobs, generally assumed to be tied to what was loosely designated "high-tech" industry.[2] A study by the U.S. Congress' Office of Technology Assessment (OTA) in 1983 found 153 state technology programs that were intended to stimulate the growth of existing technology-dependent businesses and new businesses with investments in applied research and development, seed and venture capital, technology transfer agents, science parks, and business incubators.[3] Projects that attracted dollars was "Center of Excellence", a term used by research centers across the nation to promise (but not always produce) high quality and commercial results.

In 1983 a National Governors' Association (NGA) survey produced 27 states that had appointed special bodies to report on state capabilities and recommend policies to promote technology and innovation during the previous three years.[4] States' strategies took on a more regional and economic development focus than did federal efforts because state legislative bodies insisted that the benefits of the appropriations be

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[2] Amy Glasmeier, P. Hall, and Ann Markusen, "Defining high-technology industries," Working Paper 407 (Berkeley, CA: Institute of Urban and Regional Development, University of California, 1983).

[3] Office of Technology Assessment, *Technology, Innovation, and Regional Develpoment*. (Washington, DC: Government Printing Office, 1984).

[4] Task Force on Technological Innovation, Technology & Growth: *State Initiatives in Technological Innovation*, (Washington, DC: National Governors' Association, 1983).

captured locally. No state wanted to support programs that created jobs or wealth outside of their borders unless it was reciprocated.

That desire to have the "best" resources in so many common technology areas led to considerable duplication of effort, and states competed intensely for what they considered to be emerging, high-growth, high-tech industries. In 1987, for example, the NGA found state funding for 38 research centers for microelectronics, which came to symbolize high technology, in 20 states.[5] This emphasis was in large part a response to the competition in 1980 for of the Microelectronics Technology and Computer Consortium (MTCC), an alliance of large corporations' R&D operations that acted and was treated like a branch plant in its site selection process—eventually to settle in Austin, Texas. Many states that unsuccessfully wooed the MTCC with large portfolios of incentives and subsidies subsequently established their own microelectronics centers hoping both to compete with Texas and capture a share of the anticipated spin offs.

The benefits of this multitude of programs accrued mainly to the already advantaged regions and companies, not the less advantaged regions. First, targeted high-tech industries were classified as by their products and tended to be in places where levels of education were high. Second, these programs were supply driven by the R&D labs and often ended up where the capital and intellect were most highly concentrated. Large corporations and areas with strong economies, bolstered by the necessary resources to exploit technological advances, gained the most from technology and innovation programs. Rural areas and inner cities where low skill levels were low and technological infrastructures weak, did not. In fact these areas lost jobs, as their local employers, unable to either modernize or compete on the basis of costs, either closed or moved to lower labor cost regions.

2. Establishing Technology as State Policy

In 1983, the NGA—after reviewing states' programs—concluded that "no State has yet devised a fully integrated, comprehensive policy" for promoting high technology development.[6] By the late 1980s nearly every state created some organization or office with responsibility for technology and innovation efforts but still few were truly "comprehensive". Some states heavily endowed with science and technology such as New York and Michigan increased their efforts to turn them into economic advantage, and other rural and agricultural states, such as Montana and Maine, began to look to technology and innovation to transform themselves into modern industrial economies. The state governance structures of these organizations range from independent, non-profit, quasi-governmental agencies with independent boards and programmatic responsibilities to state commissions or councils with authority limited to planning and oversight and with no programs to operate.

3. The Feds Crack Open Doors

[5] John Rees and Tim Lewington, "An assesment of state technology programs," in Jurgen Schmandt and Robert Wilson (Eds.) *Growth Policy in the Age of High Technology: The Roles of Regions and States*, (London: Unwin Hyman, 1990), p. 203.
[6] Task Force on Technological Innovation, Technology & Growth: *State Initiatives in Technological Innovation*, p. 8.

The federal government supported states' efforts with the Stevenson-Wydler Act of 1980 requiring all federal laboratories to make greater efforts to transfer their technologies to commercial arenas; the Small Business Innovation Act of 1982 setting aside at least 1.25 percent of all federal research dollars for SMEs; the National Cooperative Research Act of 1984 protecting companies in joint research agreements from anti-trust litigation; and the Federal Technology Transfer Act of 1986 authorizing and supporting cooperative agreements between federal labs and businesses or states. The federal government also provided funds, mainly through the National Science Foundation (e.g., basic research, science and technology centers, university-industry partnerships), the Department of Defense (military R&D), and the National Aeronautics and Space Administration. To help the states with the weakest economies and least wealth—which nearly always also had fewest technological resources measured by rankings of per capita in R&D and scientists and engineers—the government established the Experimental Program to Stimulate Competitive Research (EPSCoR). It provided qualifying states with R&D funds, which had to be matched, to build its capacity for research and technology development. The federal government also began to try to pinpoint the technologies critical to its national security or economy and target R&D funds to their development.

At this point in time, each state still viewed technology and innovation as an outgrowth of R&D and dependent largely on the strength of and tied to its research universities. In 1986, a report carried out with an agency of the National Governors' Association identified six innovation policy options for states: R&D tax credits, direct support for R&D, joint university-corporate R&D, science parks, small business incubators, and technology extension programs.[7] Only the last option was aimed at existing small and mid-sized enterprises (SMEs), but it too was generally described as university based and primarily technology transfer. Further, many of the states supported these initiatives not for what they would produce but for what they would attract, i.e., federal R&D dollars and new technology dependent businesses. Industrial recruitment remained the strongest argument for state technology and innovation policy.

4. New Interest in Technology Diffusion

By the end of the 1980s, technology and innovation policies were beginning to shift away from the most advanced technologies to more practical, down-to-earth applications. America's competitive edge in manufacturing was seen as slipping, and critics placed some of the blame on the nation's low investments in process development and applications of advanced technologies.[8] Simultaneously, the downsizing of industry placed more importance on the nation's 360,000 small and mid-sized suppliers and niche producers, which had been bypassed in all previous innovation strategies. This resulted in the current paradigm in which the technology and innovation strategies gain legitimacy and command more attention as public strategies. New technology-based initiatives include process research and development, adopting more technologically advanced production processes, but they also recognized the multi-dimensional needs of SMEs in order to adopt new

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[7] David R. Jones (Ed.) *Building the New Economy: States in the Lead*. (Washington, DC: Corporation for Enterprise Development, 1986).

[8] Michael L. Dertouzos, Richard K. Lester, and Robert M. Solow, *Made in America: Regaining the Competitive Edge* (Cambridge, MA: MIT Press, 1989).

technologies, which include management, organization, marketing, financing, and training. The primary national goal of the new—and more pragmatic—strategies for technology and innovation is improving the competitive advantage of industry.

The U.S. Congress, in the Omnibus Trade & Competitiveness Act in 1988, authorized a new set of initiatives to facilitate the technological modernization of SMEs. The Act provided the financial incentives and national leadership to energize states and regions enough to start or scale up technology support programs for industry. At the outset, the federal legislation was designed as a traditional R&D-driven program, a means to transfer technologies and know-how from university and federal research labs to SMEs more effectively. But before long the administering agency realized that cutting edge technologies were not what most SMEs needed most, and to serve them the program had to be much more customer-driven and decentralized. As the Office of Technology Assessment noted, "What small manufacturers need more than the newest technologies fresh out of the laboratory is off-the-shelf hardware and software and individual help in choosing and managing them."[9]

Collectively, the set of programs they sparked eventually became known as the National Manufacturing Extension Partnership (MEP) and the title that attracted federal dollars was the "manufacturing technology center". In the early stage of implementation, the architects of the strategies decided that states ought to be full partners, and that federal funds ought to require state endorsements as well as matching funds. Thus, the resulting MEP became an alliance between the federal government and the states to establish—and fund for a limited time (until they achieved self-sufficiency)—manufacturing technology centers and field based technology extension services. A few of these existed before the federal initiative but they were small, university based and were having little impact on SMEs or regional economies. Compared to earlier, more traditional research-oriented strategies that aim to advance the state of the *technology*, these technology-based strategies aim to advance the state of the *firm*, to allow firms to catch up with the technological advances already made. By 1992, 37 states had created programs of technology-focused assistance to manufacturers.[10] This was significantly up from only 13 programs in nine states found in a similar survey in 1988-89.[11]

The ways states initially chose to organize these services also hold certain attributes in common but with important distinctions. One such attribute was a clearly defined organizational setting but with substantial differences in the degree of institutional autonomy. Some programs were tightly controlled by universities or state agencies, such as New York, South Carolina, and Wisconsin, while others were set up under autonomous non-profit organizations, such as Minnesota Technology, Inc. and Kansas' Mid-America Manufacturing Technology Center. Some states assigned responsibility to the same agency that manages other technology and innovation programs, such as Arkansas, Delaware, and Minnesota, while others, like Virginia and Massachusetts, separated responsibilities for technology diffusion from those for R&D and technology

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[9] Office of Technology Assessment, *Making Things Better: Competing in Manufacturing* (Washington, DC: Govermment Printing Office, 1990), p. 178.

[10] Paul Phelps and Paul Brockman, "Science and Technology Programs in the States," Unpublished Paper for the National Governors' Association, February 1992.

[11] Office of Technology Assessment, *Making Things Better:*, p. 177.

development. The current trend across the nation, however, is toward independent, non-profit entities unfettered by bureaucracy.

A second attribute is the source of industry expertise. Some states, like North Carolina and Georgia, rely on resident experts while others, like Minnesota, refer SMEs to consultants for technology solutions. Another attribute is the way an area of activity is defined and circumscribed; some states have developed special expertise around specific business clusters, such as Indiana with plastics or Michigan with the auto industry, while others address a geographic region.

Finally, all programs charge some fees for services. But just how much is still a subject of controversy. States are expected—and often directed—by the national support programs to recover all of their costs. For example, the National Institute for Standards and Technology (NIST) expects programs it starts to eventually become financially independent, not only from federal funds but from state funds. Yet many states view technology and innovation as a form of economic development and are quite willing to share costs of services that benefit their economies. This tension between self-sufficiency, which turns programs into erstwhile consultancies, and public good has created conflicts in states farsighted enough to embrace technology and innovation as an on-going economic development strategy.

5. Thinking About and Acting On Clusters

The latest shift in states' views of technology and innovation policy is to address businesses as production systems rather than as independent atomistic employers and develop cluster-targeted strategies. This newest of the technology and innovation paradigms is based on the facts that like and businesses tend to cluster regionally, and where they do they utilize specialized technology services, learn from each other, attract other related firms, and produce synergy. Therefore, technology and innovation strategies will be more effective if directed toward the needs of clusters that are dominant or prominent because of their present or potential contribution to the regional economy.

This observation that technology based businesses and resources tend to cluster is not new. The 1984 OTA report on technology and innovation noted the tendency of high tech businesses toward agglomeration, or "proximity to complementary and competitive enterprises as well as distributors and customers".[12] Concentration, the OTA wrote, "enhances productivity by creating *external economies of scale*, in both production and marketing, similar to the internal economies created by the size and vertical integration of much larger corporations".[13] Yet at that time state and federal governments were reluctant to make choices that appeared to be industrial policies. Instead they focused on accelerating the development of "critical technologies," which loosely related to specific industries but were theoretically available to help all U.S. businesses.

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[12] Office of Technology Assessment, *Technology, Innovation, and Regional Development*, p. 34.
[13] Ibid. Pg. 35.

In the 1990s, states began to accept industry-specific policies, in part because the most prestigious business schools were promoting the value of clusters and in part because states were defining "clusters" broadly enough to include a large proportion of the state's jobs. The report by McGraw-Hill called *America's Clusters*, for example, claims its 380 clusters include 57 percent of all jobs in the U.S. A growing number of states—including North Carolina and Virginia—took steps to encourage and support business clusters. The ostensible goal of these strategies is to increase regional synergy by developing the conditions that enable geographically clustered businesses to more easily interact with one another. Cluster strategies in place in Arizona, Oregon, Illinois, and New York and emerging in a number of other states as small-scale experimental cut across both technology and innovation and economic development organizations.

6. International Influences

Technology policy, and particularly technology diffusion and cluster approaches—especially when targeted to SMEs—have been heavily influenced by European and Japanese models. The U.S., which had little experience and less success in assisting SMEs in traditional industries, looked to Europe for their models. Every region of the U.S. sent delegations of policy makers to Europe between in 1987 and 1996. This author, for example, led delegations of state legislators, government officials, and business and technology program executives from the Southern Technology Council and the states of Delaware, Kentucky, North Carolina, and Oklahoma. Most visited the most highly regarded technology diffusion programs such as the Danish Technology Institute, the Netherlands' TNO, and Germany's Steinbeis Foundation and Fraunhofer Institutes. Federal agencies such as the National Institute of Standards and Technology and the U.S. Department of Commerce's Economic Development Agency commissioned studies of these and other European programs. The operating principals of the most successful European technology diffusion programs ultimately were adopted by many new state and federal programs. For example, the concepts of inter-firm collaboration and industry clusters, now included in some fashion in most state technology policies, were based directly on European experiences, and the increasingly popular concept of the teaching factory was a European import.

C. Regional (Multi-State) Strategies: Using the Power of Persuasion

The competition for federal dollars led groups of states to formal regional alliances in order to strengthen their comparative positions, and a few multi-state efforts to attract federal dollars and accelerate technology adoption and innovation developed. The first was the Midwest, where the governors formed a short-lived technology alliance that died because it lacked a sound basis for cooperation and tried to quickly to name the "winners", the sites within the region that would become hubs of R&D and innovation. Perhaps the most prominent success was in the U.S. South. Due largely to its strong cultural identity and common economic problems, technological disadvantages, and more unified political environment, it had in place an established regional organization that enabled it to respond regionally to technology and innovation.

That organization is the Southern Growth Policies Board (SGPB), a 14-state organization created in 1971 by a group of progressive southern leaders from business and government to plan for orderly growth in the region. Its by-laws direct it to establish a *Commission on the Future* every six years and set priorities for the region. The 1986 Commission, led by the SGPB Chairman Arkansas Governor Bill Clinton, was the first to explicitly address technology and innovation. Southern states were just beginning to recognize both the importance of technology to emerging industries and weakness of their technological infrastructure and resources. Eighteen months earlier, a summit meeting of the directors of the region's fledgling or potential state science and technology organizations produced a plan to use the collective strength of the region to increase its science and technology capacities.[14] It set out some of the guiding principles for the Commission.

The 1986 Commission produced a plan called *Halfway Home and a Long Way to Go*, which lent legitimacy and credibility to a newly formed arm of SGPB dedicated specifically to technology policy called the Southern Technology Council (STC). In 1988, the STC began a process to develop the nation's first multi-state plan for science and technology, in a region that on average considers itself disadvantaged in this arena but that also has pockets of emerging strength. The region includes, for example, the states of Florida and North Carolina, rich in research capacities and high-tech companies, but also the states of Mississippi, Louisiana, Kentucky, and Arkansas, among the nation's weakest states in science and technology. The plan had to balance the needs of all 14 southern states, which meant finding a broad set of objectives and flexibility in implementation strategies.

The STC's plan, *Turning to Technology* created a framework that projected a new structure for technology development. It added technology diffusion to the conventional technology transfer, and it addressed the needs of poor and rural areas and populations likely to be left behind in technology-based strategies.[15] Some of the recommendations were new to the region, such as increasing "cooperation among firms to achieve economies of scale and scope" to meet the goal stated of widespread deployment of technology and "enlarge multi-institutional collaboration and international exchange" to meet the desired goal of improvement and expansion of research and technology development. The plan also included a strategy for implementation that assigned responsibilities to various levels of government, business, labor, trade associations, and non-profit organizations, but since regional organizations have no legislative authority—only the power of persuasion—each state was responsible for setting its own priorities.

The STC was successful in presenting a united regional front to both federal government and industry. It sponsored the first regional studies noting the need for modernization among the region's many rural SMEs, which led to a host of state programs around industrial modernization. Most important, the STC provides a forum for heads of state technology and innovation programs to get to know each, exchange information, and even share resources and has led to a number of multi-state initiatives

[14] Organized by this author in 1984 and held in Austin Texas in December.
[15] Southern Technology Council, *Turning to Technology A Strategic Plan for the Nineties*, (Research Triangle Park, North Carolina: Southern Growth Policies Board December 1989).

around technology and innovation. Yet this body is mainly a network for raising visibility, learning, and forging alliances among operating bodies. Resources require action by individual member states.

D. In the States, Where the Action Is: North Carolina and Virginia

North Carolina and Virginia[16] are two states now noted for their successes in using technology and innovation to promote regional development. This is particularly significant given their histories. Both were sleepy southern states through the 1950s, steeped in southern customs and culture. They were racially segregated and their economies were highly dependent on agriculture and on traditional manufacturing industries recruited to the South with the promise of subsidies, lower wages, and freedom from unions. The last was important because average wages did not rise as quickly as did the economies. As late as the 1970s, some area's were turning away companies that paid above average wages or were likely to be unionized.[17] In later years, however, both were fortunate to have progressive governors that sought to modernize their economies, improve education, and increase the standards of living.

Today, North Carolina is the nation's tenth largest state with about 7 million people and growing, and the nation's most industrialized state, with the highest proportion of its work force in manufacturing. Virginia is a state of about 5 million with the nation's capital on its northeastern border and it benefits from the overflow of federal agencies such as the Pentagon and National Science Foundation to inside its borders, the highly educated technical work force living in its suburban communities, and from the resulting business spin offs. Both states however still have substantial pockets of poverty in their Appalachian regions to the west and the coastal regions in the east, which technology is slow to reach.

1. The Story of North Carolina: A Round Up of High Tech Plants

In North Carolina, the hub of technology based development is the Research Triangle Park (RTP), widely acknowledged as one of America's two most successful planned research parks (the other being at Stanford University). The RTP was conceived in 1955, when Governor Luther Hodges formed a committee of business leaders and university officials to investigate the strengths of the three top—though not yet first-class nationally—universities (Duke, North Carolina State University, and the University of North Carolina) for economic development. At that time, the state ranked 49th among the 50 states in per capita income and a large part of its employment was in textiles, tobacco, and furniture. Their report suggested that these universities had sufficient strength in science and technology to attract a cluster of high tech companies.[18] In 1956, a group of citizens and corporations bought the 6,700 acres in the middle of the triangle

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[16] Virginia is actually a "commonwealth" rather than a state but we will use the term "state," the more common U.S. term, throughout this chapter to avoid confusion.

[17] Paul Luebke, *Tarheel Politcs: Myths and Realities*, (Chapel Hill, NC: University of North Carolina Press, 1990)

[18] Michael I. Luger and Harvey A. Goldstein, *Technology in the Garden; Research Parks & Regional Development*. (Chapel Hill, NC: University of North Carolina Press, 1991)

formed by the three universities. With a half million dollar grant from the state and 157 acres, the foundation established the Research Triangle Institute as a non-profit contract research company —with interlocking boards drawn from the universities. Thus, the park became more than just a real estate operation. But even with the early state support for the research institute and the formation of a state Board of Science and Technology in 1963 to make small research grants, RTP remained largely empty for eight years until 1966 when IBM and then the U.S. Environmental Health Sciences located large facilities there. With those two tenants as anchors to inspire other companies, RTP eventually reached its current size of 34,000 employees.

The RTP stands as North Carolina's most visible technology and innovation policy for two decades. While the RTP prospered, much of the rest of the state's economy remained mired in the past and dependent on traditional industries and branch plants using low skilled labor. The next phase of technology and innovation began 1980 when the young, newly elected Governor Jim Hunt assembled a "blue-ribbon panel" of state leaders to see whether the state could replicate California's success in microelectronics and attract a cluster of electronics companies. It recommended the formation of an independent non-profit R&D center in RTP to attract industry. The governor said that "the microelectronics industry is our chance—perhaps the only chance that will come in our lifetime—to make a dramatic breakthrough in elevating wages and per capita income of the people of the state."[19] General Electric quickly announced plans to build an electronics plant there citing the new Microelectronics Center of North Carolina (MCNC) as a major factor in its decision.

But North Carolina did not stop with this major investment. Between 1980 and 1982 the state legislature established the North Carolina Biotechnology Center to support the growing high-tech industry, the Technological Development Authority to help new high tech business start-ups through incubators and risk capital, the North Carolina School of Science and Mathematics to produce a cadre of young scientists and raise the state's image in public education, and, with federal support, a North Carolina Small Business Technology and Development Center. The state already had various research centers in its universities, a small industrial extension service operating out of its state university, and a nationally renowned system of 58 vocationally oriented community and technical colleges. With the plethora of high tech programs to back up its recruitment efforts, high tech employment in the state nearly doubled, from 132,209 in 1977 to 262,863 in 1994 (see Table 1).

North Carolina was still considered surprisingly weak in coordination and planning. The state now had more than 30 independently administered, publicly supported, and sometimes competing public and private organizations addressing specific research and technology-based needs of the state's economy, and the customer-companies were confused and with little connection to the state's Department of Commerce. A survey of companies found that even among electronics companies, only one in seven was aware of MCNC, and fewer than half were aware of any public support service, including the state's industrial extension service, community colleges and small

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[19] Dale Whittington (Ed.) *High Hopes fot High Tech: Microelectronics Policy in North Carolina*. (Chapel Hill, NC: University of North Carolina Press, 1985)

buisness centers.[20] There was little coordination among agencies and no state body responsible for coordinating, rationalizing, and supporting technology and innovation policies.

Table 1
Employment in High Tech Industries in North Carolina, 1977 - 1994

Type of industry	Employment 1977	Employment 1987	Employment 1994
All Manufacturing	790,360	868,337	880,544
Very High Tech	31,357	56,837	60,365
Moderately High Tech	65,052	81,283	109,256
Somewhat High Tech	35,800	61,056	93,242
Total	132,209	199,176	262,863

Note: The industry classifications were established by the U.S. Department of Commerce.
Very High Tech is comprised of 6 three-digit Standard Industry Classifications (SICs), e.g., computer and office equipment and aircraft and parts.
Moderately High Tech is 21 SICs, e.g., industrial inorganic chemicals and engoines and turbines.
Somewhat High Tech is 10 SICs, e.g., metalworking machinery and household appliances.

Many receive substantial investments from the state but were also expected to produce measurable results and eventually become self-supporting through memberships and fees generated by services. The various programs fiercely competed with each other for state funds from a legislature that has little understanding or appreciation of technology and innovation policy other than for attracting new industry to the state. On-going operating funds from the state are quite small and getting smaller, not larger, as the political climate grows more conservative. It was in this climate that the governor decided to act.

a. Forming a State Coordinating Body: The North Carolina Alliance for Competitive Technologies (NC ACTs)

Frustrated by the lack of coordination and cooperation among technology and innovation agencies and their failure to reach SMEs, Governor Jim Hunt, who established many of the state's leading programs and who was reelected after an eight year absence, created a new agency. It purpose was to better organize the existing set of technology and innovation programs and make them more rationale and user-friendly for industry. The state was now considered rich in technology and innovation resources; its universities had established themselves in R&D, and centers, and the much-publicized Research Triangle Park which anchored a large number of high-tech companies had become an international success story.

In 1995, the governor, through an executive order, established the North Carolina Alliance for Competitive Technologies (NC ACTs) as a partnership to coordinate, plan, and rationalize the state's technology programs. He appointed a 20-member Board of

[20] North Carolina State University, *The North Carolina Manufacturing Competitiveness Survey, Final Report*. (Research Triangle Park: NC ACTs, June 1996).

Directors composed of leaders from industry, government, and education, and hired Walt Plosila, a highly respected technology policy expert and former architect and director of Pennsylvania's Ben Franklin Technology Program, as its first director.

NC ACTs' three overriding objectives were to develop a comprehensive strategy and vision to guide the use of state public resources devoted to technology development and deployment, organize public and private entities involved in technology to ensure a rationale customer-driven delivery system that measures and rewards results, and match state investments with other public and private investments. A state-wide plan was its first order of business, and toward this end NC ACTs created an advisory board which it divided into working committees around manufacturing modernization; human resources; R&D technology infrastructure; technology transfer and commercialization; technological innovation and entrepreneurship; and structure, organization, and financing. Staff gathered most of the relevant information, including a detailed inventory and assessment of all technology and innovation programs and a survey of businesses' needs and views.

The various committees studied the data and information, applied their own experiences, and wrote committee reports with recommendations. These findings were compiled into a plan for the state called *Making Manufacturing & Technology Work for North Carolina*.[21] Many of the recommendations included the words "partnerships", "relationships", "alliances", and "linkages", emphasizing the desire for collaboration. But cooperation proved difficult to achieve, in part because of past organizational autonomy and independence and in part because of past competition for funding—competition that was even more fierce in the face of diminishing state resources. But, it was accomplished. The plan included a set of ten "principles of implementation", such as "be client-driven, accessible, and responsive to industry needs", "invest in performance-based incentives, not grants", and "there should be an industry sector or regional geographic focus to the effort". Implementing the plan, however, required not just consensus and cooperation among the players, but legislative support.

Some agencies found ways to cooperate to strengthen their positions, while others continued to follow old patterns undermining the state's efforts to harmonize programs. Today, 24 of the state's 35 technology organizations meet bi-monthly with NC ACTs and are using the plan to program their resources (a single holdout does not wish to be "coordinated"). North Carolina State University's Technology Extension Service has formed an alliance with the state's community college system and located its agents at the colleges to work with continuing education staff.

And, perhaps most important, the state is coordinating its agencies and resources around cluster-based strategies beginning with efforts to support the formulation of industry "roadmaps". Industries are selected by the state based on seven criteria—critical mass, economic growth impact and potential, retention and expansion of current employment base, dominance by SMEs, market changes, dependence on technology, and industry interest and support. Although most of these are based on quantitative

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[21] *Making Manufacturing & Technology Work in North Carolina: Strategies for a Competitive Future*, A Report of the North Carolina Alliance for Competitive Technologies, Research Triangle Park, North Carolina, December 1995.

analyses, the last is considered vital, and industry leaders must support the effort. Industry clusters submit proposals to NC ACTs, which the Board of Directors weighs against its criteria.

The first cluster to be funded was somewhat of a surprise because historically it had few connections to the state's universities, did little research, and was not considered either technology based or a particularly good prospect for growth. That is the hosiery industry. Despite the fact that North Carolina produced 60 percent of the hosiery made in the entire United States, the cluster was given little attention by the state. Traditional industries like textiles, apparel, and, to a lesser extent, even furniture, were considered its dinosaurs—millstones that dragged down wages and were more likely to lose jobs than to grow. In 1995 the Catawba Valley Hosiery Association (recently renamed the Carolina Hosiery Association), with help from NC ACTs, led its members through a process that produced this industry's first strategic plan.[22] As a result, members reached consensus on a need to expand markets and agreed that their success depended on cooperation in both vertical production networks and marketing alliances. The cluster's ability to develop a clear plan, reach consensus, and present a collective vision has helped it win continued support from the state legislature and from the state's technology programs. Today, the industry appears poised to modernize to compete in world markets. Other sectors that followed suit were manufactured housing, environmental technologies, and plastics.

Despite the apparent success of NC ACTs in establishing a plan, in building support within the private sector through its industry initiatives and in creating coordinating body, the traditional independence and autonomy of the state's many programs and the absence of a strong and influential champions in the legislature (or Governor), now place the entire program at risk. The initial 1997 legislative budget has zero funding for NC ACTs. Although it was subsequently reinstated in one of the two legislative Houses, the new allocation was only a fraction of the previous year's budget and too low to carry out the organizations intended functions effectively. In the summer of 1997, the future of NC ACTs and the attempt to rationalize the disparate technology programs in North Carolina is at risk. The building blocks of the state's policy, which have been most successful in documenting their results—e.g., the biotechnology center and technology development authority—seem to be on solid ground. Those that have been able to continue by attracting federal dollars, such as MCNC, the Small Business Technology and Development Center, and the manufacturing extension program—remain viable but only to the extent that the flow of federal dollars continues. Perhaps the most impressive success has been the last. NC ACTs was instrumental in turning a 40-year old university-based industrial extension program into a decentralized (every SME is now within 80 miles of a field agent), consortial (partnering with community colleges and business alliances), SME-focuse— and thus more effective—Manufacturing Extension Partnership.

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[22] *Preserving Hosiery Manufacturing in North Carolina: Strategies for Modernization Through Technologies*, (Hickory, NC: Carolina Hosiery Association, August 1995).

2. The Story of Virginia: Building a High Tech Image, Achieving a High Tech Presence

Virginia's Innovation Policy began in earnest and at significant scale in 1983, when Governor Chuck Robb formed a Task Force on Science and Technology. Based on a single—albeit an important one—recommendation, the Virginia legislature established the Innovative Technology Authority. Its quickly formed a private, non-profit operating arm was named the Center for Innovative Technology (CIT), chartered and incorporated in 1984 and supported by state appropriations. CIT's four-fold mission was technology transfer. i.e., to enhance the ability of the state's universities to develop, transfer technology to industry, and license intellectual property; to expand knowledge pertaining to scientific and technological research; to encourage and provide specialized graduate education in science and technology; and to promote industrial and economic development. Therefore, it was highly research driven and largely controlled by the state's research universities. Toward this end, it was expected to aggressively pursue federal R&D contracts and grants for its universities and industries. The CIT was expected to be entrepreneurial and aggressive, acting like a company, not a government agency. It's first president was selected from industry.

The state government appropriated $89 million between 1985 and 1993 in programs. CIT's state budget averaged about $10 million per year between 1990 and 1996. In addition to its own staff, CIT operated through four research institutes (biotechnology, computer-aided engineering, information technology, and materials sciences); four technology development centers (fiber-optics, bioprocess, power electronics, and semi-custom integrated systems); and seven university-based innovation centers, three of which housed new business incubators.

Being a mostly rural state, rural factions of the legislature also had to be satisfied, and the CIT quickly established outreach arms in its community colleges to bridge the inevitable gap between the remote and less technology advanced businesses and the research universities. In 1987, CIT formed the Economic and Technology Development Project within the state's community colleges. It initially placed its personnel at offices at nine of the state's 23 community colleges, working with college business and industry training staff, to assist industry in finding solutions to technical problems. After one year, the program claimed starting 201 projects and completing 86 saving businesses from $10,000 to $1.5 million each.[23]

In one of the state's more controversial acts, the state later appropriated another $21 million for the construction of a new building. It was controversial because a growing number of state legislators were already beginning to question the economic results of their investments and saw this as a symbol of anticipated expansion and rather than improved outcomes. CIT's inability to adequately document positive results fueled critics of public expenditures on R&D, and its influence on university research created tensions among competing universities and research centers. To address legislative concerns, following a succession of three presidents, the first and third business

[23] Higher Education Economic and Technology Development Pilot Program, *Building Virginia's Economic Base Through Technology Transfer: Year One Report*. (Herndon, VA: Center for Innovative Technology, 1988).

executives and the second (interim) president a university administrator, CIT selected its fourth new President not from industry but from politics—the former popular former Republican Governor Linwood Holton. By restructuring and retrenching, he was able satisfy legislative concerns and create a solid niche for CIT.

In 1992, the legislature, still not fully convinced of that CIT was meeting the needs of industry, created a review committee to assess the "Performance and Potential of the Center for Innovative Technology. The committee found that although CIT was trying to be more responsive to the needs of industry by solving short-term problems and helping to commercialize technologies, the scale and scope of programs serving high-tech industries and the state's industrial base were insufficient.[24] The state government, however, also took much of the blame by not giving CIT a large enough role in its economic development strategies. The Secretary of Economic Development was charged with developing a plan with CIT that took advantage of the state's technology resources.

About the same time the state's department of planning and budget was also reviewing the state's technology policies for technology diffusion and their ability to serve SMEs. This report was also critical of the states' efforts, charging that "it had not "developed a unified approach for industrial modernization, and found that "overlap and duplication has made priority setting and resources allocation difficult" and "there is no agency with clear responsibility for guiding the system".[25] Clearly, the state did not consider modernization part of the CIT's domain. In fact in 1993 the state submitted a proposal to the NIST for support of the Virginia Alliance for Competitive Manufacturing (VACM), which was intended to provide the leadership and coordination. The proposal was successful but in the short period of time between NIST's decision to fund the VACM and the final contract a change in governors and political parties interrupted the process. The new political regime viewed VACM as the a policy of the previous administration and therefore postponed accepting the federal funds.

In 1994, CIT president Governor Holton was replaced by a popular and prominent community college president Dr. Robert Templin, indicating CIT's willingness to move closer to the needs of the SMEs. The continuing restructuring under new leadership paralleled the changes in state technology policy. from technology transfer to technology diffusion, from large-scale R&D to modernization of SMEs, and from targeting technologies to targeting industry clusters. CIT now focuses on five key industry clusters: aerospace and transportation, where the potential is believed to exist for the state to become an international leader and develop Spaceport Virginia; biotechnology and medical applications, a small but rapidly growing cluster; energy and environmental technologies with an estimated $400 billion global market; and information technologies and telecommunications, where it already claimed 4,000 companies. CIT is also a partner, along with advanced manufacturing technology centers associated with community colleges in southern and western Virginia, in the new Virginia Alliance for Competitive Manufacturing, finally created two years after the federal grant was authorized.

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24 Report of the Review Committee, *The Performance and Potential of the Center for Innovative Technology: Senate Document No. 16*. (Richmond: Commonwealth of Virginia, 1993).

25 Virginia Department of Planning and Budget, *Industrial Modernization in Virginia*, (Richmond: State Government, 1993), p. vi.

For the years 1995 and 1996, the CIT announced (based on a study collected by George Mason University based on an instrument designed by the Battelle Memorial Institute) that it had created or retained 5,571 jobs and 130 companies and created $161 million in "increased competitiveness" for Virginia.[26] This assessment was a response to earlier criticism of CIT's failure to set precise economic goals and document achievement. A new strategic plan formulated in 1994 set out goals for 1995-97 of 6,000 jobs and 150 companies, and $100 million in competitiveness. Thus, CIT had already exceeded two of its goals and was near the third with a year to go.

For example, the state now has in total 11 technology development centers most of which are supported in part by CIT, a NASA funded technology transfer center, a number of high-tech industry councils. and a small business innovation research/ technology transfer support program. Most of the programs receive a commitment for five years of funding after which they are expected to become self-sufficient based on industry sponsors.[27]

As Virginia takes to technology and innovation, most of its programs are still predicated on traditional recruitment goals. The investments are expected to pay off in the long term, but elected state officials look first at their success in bringing in immediate jobs. The recruitment of a large Motorola plant in 1995, for example, was credited to the state's technology resources and viewed as a seed for a Virginia version of Silicon Valley.[28] Economic development remains a matter of incentives but technology and innovation resources are an increasing part of that package. Still, the number of high tech jobs in the Commonwealth has been declining, along with total manufacturing jobs.[29] Applying the same definitions to sectors as North Carolina (see Table 1), Virginia lost high-tech jobs between 1989 and 1994 (see Table 2), with especially high losses in plastics and aeronautical and nautical guidance systems and instrumentation.

Table 2
Estimated Employment in High Tech Industries in Virginia, 1989 - 1994

Type of industry	Employment 1989	Employment 1994	Change 1989 - 1994
All Manufacturing	437,300	397,241	(40,059)
Very High Tech	24,398	20,986	(3,412)
Moderately High Tech	57,945	44,358	(13,587)
Somewhat High Tech	22,391	22,563	172
Total	104,734	87,907	(16,827)

[26] "CIT Continues Progress Toward Three-Year Goals", *Virginia's Center for Innovative Technology Innovations*, October 1996.
[27] Christopher Coburn (Ed.), *Partnerships: A Compendium of State and Federal Cooperative Technology Programs* (Columbus, OH: Battelle Press, 1995).
[28] Elizabeth Corcoran, "Planinting a Seed of Silicon: Experts See High Tech Nurturing Role for Virginia," *The Washington Post*, April 13, 1995, p. B.5.
[29] *Technology Plan for Virginia:, High Performance Manufacturing* , Materials distributed at conference in June 1997. (Herndon, VA: Center for Innovative Technology, June 1997).

Note: The industry classifications were established by the U.S. Department of Commerce. For some sectors, ranges of employment was used to avoind disclosing confidential data. The midpoint of cells in those sectors was assumed.
Very High Tech is comprised of 6 three-digit Standard Industry Classifications (SICs), e.g., computer and office equipment and aircraft and parts.
Moderately High Tech is 21 SICs, e.g., industrial inorganic chemicals and engoines and turbines.
Somewhat High Tech is 10 SICs, e.g., metalworking machinery and household appliances.

a. Regional Visions and Virginia's Region 2000

A more recent technology strategy of the Commonwealth and the CIT target specific sub-state regions, examines their particular technology-based industries and resources, and fit programs to their special circumstances. Thus far, the CIT has identified six such technology regions: Hampton Roads Region (the southeastern shore); Northern Shenandoah and Northern Virginia Region (northern-most counties); the Greater Charlotteville region (home of the University of Virginia), the Greater Richmond Region (state capital and population center); Virginia's Region 2000 (four-county area in center of state with heavy manufacturing base); and the New Century Region (western counties, home to Virginia Tech).

One such region is a four-county, three-city, 2,000 square mile area in central Virginia that formed a regional planning body called Region 2000. Anchored by the city of Lynchburg, this highly industrialized region of 210,000 inhabitants lacks any technological support infrastructure. It has no research university within its borders and few advanced technical education programs. Both the University of Virginia and Virginia Polytechnic are within a two-hour drive, but in different technology regions and a bit too far to use or attend classes regularly.

In 1995, Region 2000 began a process of planning its long-term future. Since the area is near (125 miles) Research Triangle Park (RTP), local officials became intrigued by RTP's success. The stimulus for a technology plan was Region 2000's desire to explore the possibility of replicating RTP. Already the home of a number of high tech businesses (e.g., Ericcson and B&W nuclear), Region 2000 considered policies that would enable it to attract enough additional high-tech businesses to become Virginia's own RTP. It would, of course, have to compete for this title with the state's three leading high tech areas, the Washington DC suburbs, the state's capital, Richmond, and Hampton Roads, home of a major shipbuilding industry on the state's eastern shore. It was that environment which led Region 2000 to contact CIT, request and receive a grant to develop a technology plan[30].

Once the region assessed its strengths and weaknesses it became apparent that traditional manufacturing, not high-tech industry, was its bread and butter. But future success would hinge on its ability to move its companies toward higher value added manufacturing. This, in turn, would depend on their rates of innovation and improvement in technology and techniques. Although the region prided itself on the diversity of its economy, an industry location and employment analysis revealed concentrations and interdependencies, particularly in industrial machinery, electronics, and wood products.

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30 Carried out by Regional Technology Strategies, Inc. between september 1996 and January 1997.

Though lacking R&D, the region had the state's only community college able to carry out certifiable ISO 9000 training, an effective new business incubator, and a plethora of professional, trade, social, and civic organizations that provided social conduits for learning and building trust. Yet the region did not fully appreciate either its industrial strengths or its interdependencies. Its schools strongly encouraged youth away from industry and toward liberal arts courses and four-year colleges. The businesses overwhelmingly rated skill shortages and out migration of youth as their major problem. This led a group of machining firms to form their own training center. And despite the large number employed in manufacturing, the region did not have any state industrial or technology extension service, or CIT outpost to provide technical assistance. All were located outside of the region.

To improve the region's ability to create, commercialize, and use technology, the plan recommended the formation under Region 2000 of a Technology Committee and a Manufacturers' Support Service. The plan was submitted to and approved by a 90-person commission that represented most of the region's leading education institutions, agencies, business sectors, and professional associations. Its ability to implement then plan will depend on the strength of its business leadership, and will of its political leaders.

E. Principles of Effective U.S. Technology & Innovation Strategies

The histories of technology and innovation policies and structures in North Carolina and Virginia illustrate the skepticism and lack of commitment within state governments. Although the importance of technology and innovation to economic growth is well established in the U.S., their place in public policy is not, and the institutions created to support technology and innovation are only as secure as their most recent documented records of jobs created or equivalent accomplishments and the legislative strength of their champions. The legitimacy of government subsidies or incentives to accelerate technology and innovation in the private sector (except for those used to attract high tech companies) is still regularly questioned, particularly when budgets are tight and pressures to reduce taxes high.

The experiences of U.S. states, demonstrated in part by the two southern states incorporate a number of important lessons about the success and failure of regional technology and innovation policies.

1. Integrate technology and innovation into regional economic development agendas

In the United States, economic development is funded and carried out by states and their designated development agencies have the most stable funding streams and most extensive networks of practitioners. Technology and innovation strategies are most likely to achieve legitimacy among state elected officials if they can be woven into the "conventional practice" of economic development agencies. But technology and innovation also can be accepted as economic development for the wrong reasons. Because states have relied so long on recruitment, research, technology, and innovation are often coveted as and converted into incentives rather than their direct value.

Preoccupation with recruitment tactics turns technology and innovation into strategies for making places more competitive with other places instead of making businesses more competitive with other businesses, and the economic developers, not the industries, become the customers. Virginia seems to be taking greater steps to integrate the two than North Carolina, where the Department of Commerce remains at arms length from technology and innovation.

2. Design programs to be demand driven

The best technology and innovation strategies are governed by industry, including SMEs, and driven by needs of businesses and workers rather than interests or expertise of service providers. This does not mean government takes a passive role. Good strategies use knowledge, information, and leadership effectively to stimulate demand for technology among SMEs. However, it is often difficult to arrive at customer-driven solutions and solicit private sector participation from SMEs. Small and mid-sized firms tend to be only marginally involved in strategic planning and governance and to undervalue technology because (a) their owners and managers have too little time and resources to commit to public processes; (b) many do not trust the public sector; and (c) there are few regional or national associations that can represent their technical needs and interests. Unfortunately, labor, in most parts of the U.S., is too weak, and relationships with business management too confrontational, to permit constructive dialogue. Consequently, labor has nominal, if any, input. Demands are driven by business managers' needs.

3. Treat regions as systems of interdependent firms

Strategies that address the collective and inter-related needs of a region have had greater impact than those that address individual firms or problems. The best attempts improve the operation of the systems rather than the individual parts, and the more innovative are beginning to frame the system in terms of production, not the delivery of services. In a regional production system, the set of related firms is the central element, services are designed to address the needs of that system and firms are recruited that fill gaps in the system. The system can revolve around a set of related products, a core technology, a research capability, a set of unique skills, or a natural resource. Technology and innovation strategies that address systems are more apt to optimize the use of a region's technical resources and produce the most synergy. Those that take this route often lead to a second stage of planning, empowering and helping the dominant or strategic clusters to develop their own specialized strategies. This strategy places a high value on social infrastructure and building trust and may support industry technology associations and councils. North Carolina's targeting of key industries and cluster hubs at some of its community colleges represent such an approach. Both North Carolina and Virginia also have invested in social infrastructure, North Carolina though its industry initiatives and support of industry associations and Virginia through its support of high tech councils and—albeit weaker—of business networks.

4. Obtain high level endorsement, scale, and sufficient time

When a well-respected or very high authority actively and enthusiastically endorses a strategy and promises a high level of support, things happen. Without this support, plans often fail to reach the implementation phase. Even when they do receive support, sometimes the authority to develop the plans is not accompanied by sufficient funds for implementation at any scale that can possibly make a difference in a region's economy, leading to underfunded pilot efforts that are unable to keep their promises and to frustration and competition among participants. Programs are also given far too little time to show results. The U.S. is better at devising innovative technology-based strategies than it is a building consensus and support, implementing at scale, and transcending political elections. Another important condition for success is an organization that can in the state. But continuity (at least until outcomes can be assessed) is very difficult to achieve. Both MCNC in North Carolina and CIT in Virginia were chastised by their respective legislatures for (1) not proving economic impacts and (2) not achieving self-sufficiency quickly enough.

5. Be inclusive, involving all relevant and impacted segments of the population

This is an argument for raising the priority of consensus building. The more expansive and inclusive the base of support, the better the chance that the strategy will address the community's needs and priorities. This is difficult when addressing technology and innovation because active participants are overrepresented by the best-educated segments of the population and most well-off regions. It is made more difficult because the U.S. never developed the European concept of "social partners" to regularly participate in strategic planning or policy making. Membership in organized labor is low and, in most states, excluded from policy processes. To be more inclusive, some states create large commissions and working committees or take the issues into the field to engage a large set of actors. The U.S. has a large, significant, and perhaps unique non-profit sector composed of organizations that are often involved in and assist with planning and implementation. Many of these non-profit organizations—which often receive government funding—take on functions generally assumed in Europe by the public sector.

6. Measure Impacts

The strongest programs in the U.S. have developed procedures for measuring and documenting their impacts—on the competitiveness of businesses, economies of regions, and quality of life of individuals. The first of these currently receives the most attention. The MEP is developing a standard design for collecting information and evaluating impacts on businesses for two purposes in order to demonstrate the impacts of public investments on the global competitiveness of SMEs. Technology diffusion programs prior to this national program limited evaluations the most part to scale of efforts such as numbers of companies visited, types of interactions, and income earned, and did not measure results such as cost-benefits and impacts on sales, profits, and employment. Some successful programs also measure impacts on workers by looking for changes in earnings, promotions, or quality of work. But such outcome measures are much rarer in the states because most technology and innovation programs effects on workers are derivative, not primary goals. Impacts on specific places, such as depressed or very rural areas are measured only when programs are funded by agencies that target these areas.

F. Final comments

The vast majority of technology and innovations policies in the U.S. are partnerships among federal, state, and local governments and regional organizations, with federal agencies serving as catalysts and sources of funds, regional consortia acting as coordinators, local governments taking advantage of opportunities—but with the states securely sitting in the drivers' seats. Technology and innovation policy is constantly evolving and expanding in the U.S. as new strategies emerge. It is also constantly defending its investments before skeptical legislatures and the Congress, which expect quicker and clearer results and high levels of corporate fees than technology and innovation are generally able to produce or believe that free markets will be able to produce results more effectively than government interventions. North Carolina and Virginia are both states that want very much to be known for the advanced states of their science and technology establishments and industries yet have not fully accepted and indeed embraced the programs that have done much to contribute to this image and reality.