THE NATIONAL COMPETITIVENESS ACT: GAUGING THE FEDERAL GOVERNMENT'S ROLE IN PROMOTING TECHNOLOGY POLICY TO ENHANCE U.S. ECONOMIC GROWTH

*Helene Miale**

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I. Introduction

A consensus is forming among leaders in government and business that a broad array of both public and private efforts must be undertaken to restore America's economic and technological competitiveness, and that implementation of such initiatives must

* B.A., Journalism & Economics, University of Connecticut, honors scholar; M.A., Communication, Stanford University; J.D., Seton Hall University School of Law, June 1994. Ms. Miale has worked as a print journalist and in marketing communications management within the high technology industry for more than a decade.

become a national priority.[1] The origins of America's competitiveness problem are highly complex and long-standing, involving issues such as the budget and trade deficits, productivity growth, worker skills and technical innovation.[2] The resulting reduction in the rate of productivity growth, and the continuing erosion of the nation's technological lead, have led to a decline in real family income for most Americans.[3] Addressing the nation's technology priorities is one element among several in a broader federal governmental plan to sustain economic growth.[4] Much of America's phenomenal economic growth since World War II has been attributable to major technological advancements, which not only have created many new industries, but also have served as the impetus toward the creation of record numbers of high-paying jobs.[5]

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1 COUNCIL ON COMPETITIVENESS, GAINING NEW GROUND: TECHNOLOGY PRIORITIES FOR AMERICA'S FUTURE 44 (Mar. 1991) [hereinafter GAINING NEW GROUND]. The Council on Competitiveness, founded in 1986, is a non-profit nonpartisan Washington, D.C.-based organization comprised of approximately 150 executives from business, academia and labor. *See also* H.R. REP. No. 102-685, 102d Cong., 2d Sess. 35 (1992).

2 For purposes of this legislation, competitiveness is defined as the ability of U.S.-based companies to manufacture products and provide services that are more attractive to consumers in terms of price, quality and performance than alternatives offered by foreign competition. A competitive economy is one that supports technology development across a range of industries and allows for the subsequent creation of products as a result of that investment. H.R. REP. No. 77, 103d Cong., 1st Sess. 38 (1993) [hereinafter H.R. REP. No. 77].

3 *See* 138 CONG. REC. H9149 (daily ed. Sept. 23, 1992). Median family incomes have declined five percent from 1973 to 1985, while the percentage of families with incomes below $20,000 has increased from 30.6% to 34%. *See also Tyson Presses the Technology Button*, NEW TECH. WK. (King Communications Group, Inc., Wash., D.C.), Mar. 29, 1993, at 6. Laura D'Andrea Tyson, chair of the President's Council of Economic Advisors, pointed toward the need for a fundamental reorientation of government spending—in particular, the need to invest to stimulate economic growth in the $6 trillion U.S. economy, which is currently four percent below capacity. *Id.*

4 *The Administration's Technology Policy and Small Business: Hearing before the House Comm. on Small Business*, 103d Cong., 1st Sess. 2 (1993) (testimony of John H. Gibbons, Director of the Office of Science and Technology Policy, Executive Office of the President) [hereinafter *1993 House Small Business Hearings*].

5 *Id.* at 3. Historically, byproducts from government research and development (R&D) have had a significant impact on industrial technology in the United States. For example, the computer, integrated circuit and jet engine are the result of defense-oriented R&D. THE NATN'L SCIENCE BOARD, COMM. ON INDUS. SUPPORT FOR R&D, THE COMPETITIVE STRENGTH OF U.S. INDUSTRIAL SCIENCE AND TECHNOLOGY: STRATEGIC ISSUES 20 (Aug. 1992) [hereinafter STRATEGIC ISSUES]. *See also* PRESIDENT WILLIAM J. CLINTON & VICE PRESIDENT ALBERT GORE, JR., TECHNOLOGY FOR AMERICA'S ECONOMIC GROWTH, A NEW DIRECTION TO BUILD ECONOMIC STRENGTH 7 (Feb. 22, 1993). For the Clinton Administration, the engine of economic growth is technology.

The federal government has taken an increasingly active role in reformulating science and technology policy for the 1990s and beyond.[6] The realization that the United States has been losing its ability to rapidly commercialize technological inventions has caused consternation among government officials and business executives alike.[7] Critical to the debate on how to invigorate the economy is the extent to which the federal government should direct public policies to promote technology and competitiveness.[8] There is growing support for the notion that government and the private sector should join together in a cooperative effort to regain America's leading role in the development and commercialization of technology.[9]

As support for its theory, the new administration looks to relatively recent technological breakthroughs such as the transistor, recombinant DNA, synthetic fibers and computers, all of which have created new industries in the United States. *Id.*

6 WILLIAM J. CLINTON, TECHNOLOGY: THE ENGINE OF ECONOMIC GROWTH, A NATIONAL TECHNOLOGY POLICY FOR AMERICA 5 (Sept. 21, 1992). The Clinton Administration contends that one of the critical reasons why America is losing ground in technology is the country's failure to adopt a technology policy that encourages the transfer of new research ideas into successful commercial applications. *Id.*

7 GAINING NEW GROUND, *supra* note 1, at 1. The view of America's comparative advantage in technology is now being widely challenged. American electronics and factory automation industries have been almost eliminated by international competition, and the U.S. semiconductor industry now places a distant second in the world market. In addition, other prominent industries, such as computers, chemicals and aerospace, have suffered from global competition, according to George M.C. Fischer, a Motorola executive and chairman of the executive committee of the Council of Competitiveness. *Id.* Ronald H. Brown, Secretary of Commerce, has stated that government has the obligation to create an environment such that industry can bring new technology to market and compete effectively. Where private mechanisms falter, Brown stated, the government should work to remedy market deficiencies to provide American companies with a fair chance to succeed in a global economy. H.R. REP. NO. 77, *supra* note 2, at 41.

8 *Whatever You Call It, Industrial Policy is on the Way*, BUS. WK., Dec. 28, 1992, at 34. According to Laura D'Andrea Tyson, head of the Presidential Council of Economic Advisors, the U.S. "must not be hoodwinked by the soothing notion that the fate of America's high-technology industries will be determined by market forces. Instead, they will be manipulated by trade, regulatory and industrial policies of our trading partners." *Id.*

9 GAINING NEW GROUND, *supra* note 1, at 3. *See also* Richard McCormack, *The Dreary Halls of the Commerce Dept. Show Signs of Life*, NEW TECH. WK. (King Communications Group, Inc., Wash. D.C.), Mar. 8, 1993, at 1, 14. George E. Brown (D-Cal.), chair of the House Committee on Science, Space and Technology, stated the following as to whether the National Competitiveness Act of 1993 is a move toward industrial policy: "I know national industry policy brought fear to the hearts and minds of my predecessors. I don't use those words. But I certainly do use terms like national economic strategy." *Id.*

The end of the Cold War has forced the federal government to rethink and revamp its strategy in support of science and technology programs.[10] In many respects, the U.S. has promoted a de facto industrial policy throughout the last few decades in the form of massive research and development (R&D) programs administered by the defense agencies within the federal government.[11] The transition from a military-based R&D program to a civilian-based R&D effort is a painful one, producing a major impact on many scientists, engineers and military personnel.[12] Whether the American public will enthusiastically support and invest in a broad civilian R&D policy is not at all clear.[13] Nonetheless, Congress and the Clinton Administration[14] are taking steps to create legislation that will, in essence, form the basis of such a policy for the future.[15]

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10 Steven Greenhouse, *The Calls for an Industrial Policy Grow Louder*, N.Y. TIMES, July 19, 1992, at 5.

11 David P. Hamilton, *Clinton's Technology Agenda*, 258 SCI. 1168, 1168 (Nov. 13, 1992). *See also* SEYMOUR MELMAN, THE PERMANENT WAR ECONOMY 16 (1985). Following World War II, the American public viewed military spending as economically desirable in terms of jobs and prosperity, and thus consented to the federal government's huge control over a war economy. *Id.* However, several unforeseen effects developed which had debilitating long-term consequences for the U.S., including the deterioration of the production competence of many industries. *Id.* at 19.

12 Philip H. Abelson, *Policies for Science and Technology*, 260 SCI. 735, 735 (May 7, 1993). While John Gibbons, director of the Office of Science and Technology Policy, emphasizes the need to foster and promote technology, the enthusiasm for greater science and technology initiatives is expressed with cautious optimism by Rep. Brown. He asserts that global technological leadership, by itself, has not translated into solutions addressing societal needs. *Id.* Government and business experts agree that benefits have been derived from defense-related R&D, but that they are likely to decline in the coming years, largely because the Defense Department's role as a technology leader is diminishing in numerous industries and its focus on industrial needs is minimal. S. REP. NO. 113, 103d Cong., 1st Sess. 10 (1993) [hereinafter S. REP. NO. 113].

13 Abelson, *supra* note 12.

14 CLINTON, *supra* note 6, at 8. Civilian industry, rather than the military, is now the driving force behind technology. By strengthening the role of civilian technology in our society, the issue of economic competitiveness, with its implications for national security, can be addressed. *Id.*

15 *Id. See, e.g.*, GAINING NEW GROUND, *supra* note 1, at 19. The Department of Defense has identified 16 out of 22 critical technologies that overlap with those of the Department of Commerce. This overlap strongly suggests that the health of U.S. industrial technology plays a key role in America's national security. Although some in Congress are wary of too much government interference in a market economy, Congress does have the authority to act in areas of competitiveness. *See* Fry v. United States, 421 U.S. 542 (1975) (Congress enacted the Economic Stabilization Act to counter severe inflation that threatened the national economy). Even activity purely intrastate in nature can be regulated by Congress, where the activity affects commerce among states or with foreign nations. *Id.* at 547. *See also* Heart of Atlanta Motel, Inc.

Among leading industrial nations, the United States alone has failed to articulate the goal of making industrial competitiveness a national R&D priority.[16] Federal funding of R&D for industrial development—using technology to bring new products to market—is practically nonexistent.[17] Nations surpassing others in key technological areas and capturing new commercial markets will gain enormous economic strength, leaving behind those that fail to do so.[18] Whether the United States will join other major economic leaders in promoting industrial policy, regardless of its exact form or organizational structure, is yet to be seen.

This note will examine the legislation passed by both Houses of Congress entitled The National Competitiveness Act, also known as H.R. 820, whose companion bill in the Senate is S. 4.[19] The note

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v. United States, 379 U.S. 241 (1964) (Congressional power under the Commerce Clause is very broad and may extend to purely intrastate activities if such activities affect interstate commerce).

16 GAINING NEW GROUND, *supra* note 1, at 13. Japan, for instance, has a Ministry of International Trade and Industry (MITI) to support its industrial policy, and Germany has an equivalent Ministry of Research and Technology, the Bundesministerium fuer Forshung und Technologie (BMFT). *Id.* at 36. Seymour Melman, professor of industrial engineering at Columbia University, notes the following about the United States' lack of R&D efforts in civilian technology, and its overriding emphasis on military R&D:

> In every industrial country it is well appreciated that the scale and quality of technological research and development has a major effect on the productivity of the industrial system as a whole. . . . Economically useful goods enhance the productive competence of the whole society by improving the level of living, or by raising the productivity of labor and capital. None of this can be said for research that improves the firepower of weapons or speeds up their production. Therefore, the amount of money that a county spends on research is not a sufficient indicator of its technological competence. That depends on the degree to which the research effort is applied to productive economic growth.

SEYMOUR MELMAN, THE PERMANENT WAR ECONOMY: AMERICAN CAPITALISM IN DECLINE 78-80 (1985).

17 GAINING NEW GROUND, *supra* note 1, at 13. During the late 1980s, the U.S. devoted .2% of its total R&D budget to industrial development, in contrast with 4.8% in Japan and 14.5% in West Germany. These figures continue to reflect current investment levels for R&D well into the 1990s. *Id.*

18 S. REP. NO. 113, *supra* note 12, at 8 (1993).

19 139 CONG. REC. H2287-97 (daily ed. May 5, 1993). Congress noted the unprecedented challenge the U.S. has faced during the last decade vis-a-vis foreign-based companies offering high-quality, low-priced goods that have contributed to America's drop in real wages and standard of living. The ensuing debate on H.R. 820 has concerned the extent of government participation appropriate in helping to stimulate investment in technology-oriented industries to bring about improved growth in the

will trace the legislation from its earliest form, beginning with the Stevenson-Wydler Technology Innovation Act of 1980,[20] through the development of the Omnibus Trade and Competitiveness Act of 1988.[21] Special emphasis will be placed on H.R. 5231 and S. 1330, both of which originated in 1991,[22] and serve as the basis for the current legislation. Presidential strategies regarding government's proper role in advancing research and technology policies will be explored. Finally, the burgeoning importance of the Department of Commerce and one of its agencies, the National Institute for Standards and Technology (NIST), will be discussed, as well as the impact on research activities at the National Science Foundation (NSF) and National Institutes of Health (NIH).

II. Legislative History

The National Competitiveness Act builds upon Congressional legislation that combines government, industry and university cooperation in science and technology endeavors to improve national economic performance.[23] The National Science and Technology Policy, Organization and Priorities Act of 1976, a bill that reestablished the Office of Science and Technology Policy as a science advisory function, was an early statute that enhanced technological competitiveness.[24] The Act enabled the federal government to maintain central policy organizations within the executive branch to mobilize scientific and technological resources for national programs that Congress considered to be essential for sus-

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economy. *Id.* Both bills are now scheduled for conference committee and final vote before the President can sign the Act.

20 Stevenson-Wydler Technology Innovation Act of 1980, 15 U.S.C. §§ 3701-3712 (1988).

21 19 U.S.C. §§ 2901-2906 (1988). The Omnibus Trade and Competitiveness Act spawned the Advanced Technology Program, a small-scale initiative that is assuming growing proportions under the U.S. Department of Commerce. 15 U.S.C. § 278n (1988).

22 Both bills died at the end of the 102d Congressional session. CONG. INDEX, 1991-1992, 1 CCH, 102d Cong., H35,091, S21,029 (1992).

23 H.R. REP. No. 77, *supra* note 2, at 38.

24 *Id. See also* the legislative history of 42 U.S.C. §§ 6601-6602, 6611-6617, 6631-6635, 6651, 6683 (1988). A major reorganization had occurred within the presidential administration in 1973 with the abolishment of the Office of Science and Technology, as well as the Office of the President's Science Adviser, a top-level post, and the President's Science Advisor Committee. Pub. L. No. 94-282, 90 Stat. 459 (codified as amended in scattered sections of 42 U.S.C.).

tained progress in improving the quality of life, general welfare, and economic health and stability of the nation.[25] Due to an earlier shift in political focus, virtually all congressional committees relating to science and technology had disappeared by the early 1970s.[26] This legislation addressed the need to reinstate executive science offices and to place more emphasis on coordination and evaluation of science activities across a broad government spectrum.[27]

One of the first Congressional efforts to specifically address the United States' declining role in competitive markets was the Stevenson-Wydler Technology Innovation Act of 1980, which encouraged broad support for technological developments by officially allowing technology transfer from federal laboratories to private industry.[28] The Stevenson-Wydler Act recognized that America, traditionally a leader in innovation, had slipped relative to its past record of industrial performance, as well as relative to foreign competition.[29]

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25 42 U.S.C. §§ 6601-6602, 6611-6617, 6631-6635, 6651 (1988). *See also* VANNEVAR BUSH, SCIENCE—THE ENDLESS FRONTIER xxi (1990), reprinted by the National Science Foundation. Richard Nixon abolished the post of Science Advisor to the President due to differing political points of view on the Vietnam War. *Id.*

26 42 U.S.C. §§ 6601-6602, 6611-6617, 6631-6635, 6651 (1988).

27 *Id.* Federal support for science and technology decreased during the late 1960s, and continued to decline into the 1970s. Federal R&D had reached a peak in 1965, representing about 12.6% of the federal budget, compared to 2.5% in 1950. Political dissention existed throughout the country, and an anti-technology movement had set in by the late 1960s. Pub. L. No. 94-282, 90 Stat. 459 (codified as amended in scattered sections of 42 U.S.C.).

28 15 U.S.C. §§ 3701-3712 (1988). The Act recognized the need to strengthen relationships between government, industry and academia, which heretofore had been relatively weak. The primary purpose of the Act was to share knowledge and expertise between federal laboratories and agencies within the government, resulting in the formulation of the Federal Laboratory Consortium for Technology Transfer, a voluntary association of 200 federal laboratories that would identify and work on technical problems of potential use to industry. The ultimate goal was to stimulate industry demand for federal technologies. *Id.*

29 *Id.* This Act acknowledged the existence of vast technological resources within the government's own federal laboratories, in the hope of improving utilization of those resources by industry. *Id.* Another initiative enacted that year was the Bayh-Dole Act, also known as the University-Small Business Patent Act, which gave universities sole ownership of patents resulting from federally supported research. Elliott Negin, *Why College Tuitions Are So High (Not inflation, not enrollment decline, but the subsidization of corporate research is largely to blame)*, ATLANTIC MONTHLY, Mar. 1992, at 32-34. Under this law, universities were able to attract corporate investment through the sale of exclusive licenses based upon discoveries made under a company's sponsor-

The Federal Technology Transfer Act of 1986 authorized the establishment of research and development agreements (CRADAS) between government laboratories and private industry to promote technology transfer from federal labs to private companies.[30] This Act established a federal laboratory consortium for technology transfer to provide advice and assistance to federal government scientists on technology transfer matters, such as how to recognize laboratory innovations with potential commercial value. Additionally, it served as a clearinghouse for universities, state and local governments, businesses and nonprofit organizations interested in accessing technical expertise and innovation.[31]

In addition, Congress appropriated $100 million a year for Sematech, a research consortium formed by the U.S. semiconductor industry in 1987.[32] Sematech acquires technical knowledge that is transfered to member semiconductor companies, as well as to the Department of Defense, for development purposes.[33] Member companies and their suppliers share precompetitive — or generic — information about specialized technical processes.[34] Sematech efforts have had the effect of making member companies stronger in their ability to compete, both among themselves and worldwide,

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ship to a particular university. According to the National Coalition for Universities in the Public Interest, universities began to increase tuition costs significantly to cover the large amounts of venture capital required to pursue applied research. Since 1980, college tuition and fees have risen at twice the inflation rate. *Id.*

30 15 U.S.C. § 3710a (1988). *See also* COUNCIL ON COMPETITIVENESS, INDUSTRY AS A CUSTOMER OF THE FEDERAL LABORATORIES 9 (Sept. 1992). Between 1986 and 1991, nearly 800 CRADAS were formed, and hundreds more were signed during the last two years; however, a large percentage of the CRADAS have not been funded. Without proper appropriations or redirection of resources, these instruments represent agreements rather than results; in fact, only a small portion of technology actually has been transfered for commercial use. *Id.*

31 *Id.* at 1785-88.

32 GAINING NEW GROUND, *supra* note 1, at 16.

33 Robert Noyce, *Sematech: Necessary But Not Sufficient, in* TECH. TRANSFER IN CONSORTIA AND STRATEGIC ALLIANCES 17-19 (David V. Gibson et al. eds., 1992). Japan surpassed the United States in 1986 as the leader in worldwide semiconductor sales, and the gap has been widening. American consumers have developed a strong dependence on these electronic devices, which are present in many consumer products, such as TVs, VCRs, telephones, coffee makers, clocks and watches. According to Robert Noyce, semiconductors are analogous to the crude oil of the information age, noting that the more Americans become dependent on foreign sources of electronic components, the greater the risk of an interrupted supply of those goods. *Id.*

34 *Id.* Projects currently under development include a state-of-the-art system for finding silicon wafer defects and a next generation tool to print integrated circuit patterns directly onto silicon wafers. *Id.*

because this information flow allows companies to provide precise specifications to be met by suppliers.[35]

In 1988, Congress passed the Omnibus Trade and Competitiveness Act, which authorized spending on specific programs to enhance technological competitiveness administered by the National Institute of Standards (NIST).[36] The Act established Regional Manufacturing Centers to facilitate the development and transfer of manufacturing technology.[37] The Advanced Technology Program (ATP) was created under NIST both to assist U.S. businesses in commercializing important scientific discoveries and to improve the technological processes used to manufacture goods.[38] The initial ATP budget of $10 million has expanded to nearly $70 million in fiscal 1993, reflecting increased governmental awareness of the importance of rapid commercialization of scientific and technological ideas.[39] Congress is now considering budget appropriations for the ATP exceeding $700 million by 1997.[40] In 1991, Congress passed the High-Performance Comput-

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35 *Id.*

36 *See* 19 U.S.C. §§ 2901-2906 (1988), 15 U.S.C. § 271 (1988): The statute states that the "future well-being of the United States economy depends on a strong manufacturing base and requires continual improvements in manufacturing technology, quality control, and techniques for ensuring product reliability and cost-effectiveness." *Id.* The National Bureau of Standards was renamed the National Institute of Standards and Technology to improve its ability to enhance competitiveness in American industry. *Id.*

37 *Id.* "Advanced manufacturing technology" is broadly defined as numerically controlled machine tools and devices, robots, automated process control equipment, computerized manufacturing systems, including computer software, as well as novel manufacturing techniques and processes, not previously made available, that improve manufacturing quality, productivity, engineering design and inventory management. H.R. REP. NO. 77, *supra* note 2, at 11.

38 19 U.S.C. §§ 2901-2906 (1988). *See* Advanced Technology Program, 15 U.S.C. § 278(n) (1988). *See also infra* note 91 and accompanying text. The ATP is important in its role as a source of funding for a wide range of technologies that have a high potential for commercialization into products. According to Professor Paul Krugman of the Massachusetts Institute of Technology, there is an overwhelming case for U.S. policy to support generic technologies—those which can benefit large numbers of companies—in industries where companies depend on the reinforcing effects of each other's success. This is especially true with respect to high technology advancements. H.R. REP. No. 841, 103d Cong., 2d Sess. 75 (1992) [hereinafter H.R. REP. No. 841].

39 UNITED STATES DEPT. OF COMMERCE, THE ADVANCED TECHNOLOGY PROGRAM: AN ENGINE FOR ENHANCING U.S. ECONOMIC GROWTH 1 (1993). The Advanced Technology Program was modified by the American Technology Preeminence Act of 1991, 15 U.S.C. §§ 271, 278n, 3701 (1992).

40 UNITED STATES DEPT. OF COMMERCE, THE ADVANCED TECHNOLOGY PROGRAM: AN

ing Act, a bill sponsored by former Senator Albert Gore, providing appropriations for developments in advanced computing and computer networking.[41] A year later, Gore sponsored the Information Infrastructure and Technology Act of 1992, whose provisions are now included in the National Competitiveness Act of 1993.[42]

On September 23, 1992, the House of Representatives passed H.R. 5231 as its version of the National Competitiveness Act.[43] The bill was sponsored by Rep. Tim Valentine (D-N.C.), chair of the Subcommittee on Technology, Environment and Aviation of the House Committee on Science, Space and Technology, and Rep.

ENGINE FOR ENHANCING U.S. ECONOMIC GROWTH 1 (1993). Thus far, the ATP has been funded on an experimental rather than a strategic basis, with large technology developments funded by the Department of Defense. As the DOD budget narrows, government support for civilian technology increasingly will become a priority. H.R. REP. NO. 841, *supra* note 38, at 55-56. As stated by the Senate Commerce, Science and Transportation Committee, the ATP does not support the actual development of products. It supports industry led efforts at the "precompetitive" stage of research, when difficult technical problems have to be overcome before companies can benefit from turning inventions into commercial products. The purpose of the ATP is to ensure that Americans benefit from American innovations. 138 CONG. REC. S7255 (daily ed. May 21, 1992). Rep. Timothy Roemer (D-Ind.) views the increase in appropriations for such programs as essential for America's economic growth. According to Congressman Roemer, The National Competitiveness Act

> incorporates some of the most important, innovative, change-oriented ideas that we in Congress need to be working on to get this country moving in the right direction again. . . . We need to see jobs that provide the people in this country the opportunity to live in dignity and not have three jobs at $4.25 an hour where they never see their families. The best kind of family value that we can espouse in this country is a job that keeps our families together, a job that rewards people for working hard, a job that allows people to save money to get their children to college and to buy the high-definition televisions to keep our economy moving, to sell that high-definition television to the Japanese and the Germans.

138 CONG. REC. H9147 (daily ed. Sept. 23, 1992) (statement of Rep. Roemer).

41 15 U.S.C. §§ 5501-5503, 5511-5512, 5524-5528 (1992).

42 S. 2937, the Information Infrastructure and Technology Act of 1992, was incorporated under § 302(d) of H.R. 820 as the outreach program information network, which provides for an instantaneous, interactive electronic communications network using existing public and private computer networks, databases and electronic bulletin boards. Under § 4 of Title VI, the program would promote development of computer applications in education, health care, manufacturing and libraries.

43 Holly Idelson, *Competitiveness Logjam Breaks*, 50 CONG. Q. 2929, 2929 (Sept. 26, 1992). The motion to authorize $2.2 billion for H.R. 5231 from 1994 to 1997 passed in a 287-122 house vote. *Id.* at 2982. The appropriations figure since has been reduced to $1.54 billion for 1994-95. *See also Senate Commerce, Science, and Transportation Committee Approves Competitiveness Bill*, SCI. & TECH. IN CONGRESS (Carnegie Comm'n on Science, Technology, & Gov't, Wash. D.C.), July 1993, at 6 [hereinafter *Committee Approves Competitiveness Bill*].

George Brown (D-Cal.), chair of the House Committee on Science, Space and Technology.[44] H.R. 5231, when introduced on May 21, 1992, contained only those provisions of an earlier bill, H.R. 5230, which fell under House Science Committee jurisdiction.[45]

The Senate version, S. 1330, co-sponsored by Senators Ernest Hollings (D-S.C.) and Albert Gore (D-Tenn.), was entitled the Manufacturing Strategy Act of 1991. This bill was introduced on June 19, 1991, reported on October 3, 1991, and passed the Senate on June 30, 1992, with an amendment by voice vote.[46] A House motion to strike all text following the enacting clause of S. 1330 and insert H.R. 5231 was passed on September 23, 1992.[47] The Senate blocked compromise legislation at the end of the 102d Congressional session.[48]

The purpose of the Act is to promote the development and implementation of technologies by U.S. firms to enhance eco-

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44 138 CONG. REC. H9142 (daily ed. Sept. 23, 1992). No comments were made on the introduction date. However, much of the legislative intent surrounding H.R. 820 appeared two months later in the Chairman's Report to the House Committee on Science, Space, and Technology. The report, authored by Rep. Brown, outlined broad strategies by which Congress could strengthen its oversight of federally funded research, namely by creating a national policy that would link federal R&D funding to national goals, such as increased economic competitiveness, improved human health, environmental protection and energy security. CHAIRMAN'S REPORT TO THE HOUSE COMM. ON SCIENCE, SPACE AND TECHNOLOGY, 102D CONG., 2D SESS., REPORT OF THE TASK FORCE ON THE HEALTH OF RESEARCH 4 (Comm. Print July 1992) [hereinafter CHAIRMAN'S REPORT]. On September 21, 1992, Rep. Mary Rose Oakar (D-Ohio) urged immediate enactment of the National Competitiveness Act, noting that too little emphasis has been placed on civilian R&D for a prolonged period of time, and that this has negatively impacted America's ability to compete with major economic leaders such as Japan and Germany. "If this country does not take corrective action soon, it is in danger of becoming a second-rate economic power," Oakar stated. 138 CONG. REC. H9149 (daily ed. Sept. 23, 1992) (statement of Rep. Oakar).

45 *House Science Committee Addresses U.S. Technological Competitiveness*, SCI. & TECH. IN CONG. (Carnegie Comm'n on Science, Technology, & Government, Wash. D.C.), Sept. 1992, at 11. H.R. 5230 was similar to H.R. 5231 in language, but was substantially broader in its congressional jurisdiction, including the following congressional committees: Banking, Finance, Urban Affairs, Judiciary, Education and Labor, Ways and Means, and Armed Services. H.R. 5231 was referred to the Committee on Science, Space and Technology only. *Id.*

46 CONG. INDEX, 1991-1992, 1 CCH, 102d Cong., S21,029 (1992).

47 Idelson, *supra* note 43, at 2982, 2929. The motion passed 248-151. In addition, the House rejected by a vote of 161-248 Rep. Robert Walker's (R-Pa.) motion to recommit the bill to committees. Walker's motion was championed by President Bush, who was expected to veto H.R. 5231. *Id.*

48 *Id.*

nomic growth and employment.[49] In particular, Congress has identified several targeted goals: (1) to promote and facilitate the creation, development and adoption by U.S. companies of technologies that will contribute to sustainable economic growth;[50] (2) to improve the competitive position of small businesses through the creation of a technology outreach program for better access to information and expertise required to compete globally;[51] (3) to promote faster application of advanced manufacturing technologies, emphasizing environmentally sound practices;[52] (4) to stimulate long-term investment in companies participating in critical and advanced technologies;[53] (5) to create linkages among federal, state and local initiatives; (6) to enhance the Department of Commerce's National Institute of Standards and Technology, including the Advanced Technology Program;[54] and (7) to monitor foreign technological capabilities.[55]

III. The National Competitiveness Act

A. *Current Status of H.R. 820*

Under the sponsorship of Rep. Valentine and Rep. Brown, the National Competitiveness Act was introduced in its present form as H.R. 820 on February 4, 1993.[56] An amended version of the bill was reported and passed the House Science, Space and Technol-

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49 H.R. REP. NO. 77, *supra* note 2, at 3.

50 *Id.*

51 *Id.* at 3-4.

52 *Id.* at 4.

53 *Id. See* UNITED STATES OFFICE OF SCIENCE & TECHNOLOGY POLICY, U.S. TECHNOLOGY POLICY: EXECUTIVE OFFICE OF THE PRESIDENT 11 (Sept. 26, 1990). The major categories of advanced technologies were listed by the U.S. Office of Science and Technology Policy under the direction of Dr. Allan Bromley. *Id.* They are: robotics, high-performance computing, semiconductors, superconductivity and advanced imaging technologies. These are also described as dual-use technologies because they meet both military and civilian R&D needs. *See* COUNCIL ON COMPETITIVENESS, *supra* note 30, at 10. In an informal study performed by the Council on Competitiveness, the top four categories that industry ranked as crucial to their needs were: (1) advanced materials and processing; (2) advanced computing; (3) environmental technologies; and (4) manufacturing processing, testing and equipment. In addition, critical technologies were listed as new power sources, sensors, photonics and optoelectronics. *Id.*

54 H.R. REP. NO. 77, *supra* note 2, at 4.

55 *Id.*

56 H.R. 820, 103d Cong., 1st Sess. (1993). There were 36 original co-sponsors of the bill.

ogy Committee on May 3, 1992, and in a vote of 243 to 167, passed the full House on May 19, 1993.[57] The language resembles that of the earlier version, H.R. 5231,[58] although H.R. 820 contains a controversial provision regarding venture capital funding from the federal government.[59] The Senate companion bill, S. 4, was introduced in the 103d Congress on January 21, 1993, by Senator Hollings, and passed the Senate on March 16, 1994 by a 59 to 40 vote.[60]

The impetus for H.R. 820 is the result of technological, political and economic changes around the globe that have forced the United States to reassess its national science and technology policies.[61] Senator Ernest Hollings, chairman of the Senate Commerce, Science and Transportation Committee, has stated that America must make an investment in its future science and technology programs to expand its technological base by enabling the U.S. government to play a more active role in promoting industrial competitiveness.[62] According to Lewis Branscomb, professor at

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57 *National Competitiveness Bill Moves Through Congress*, SCI. & TECH. IN CONGRESS (Carnegie Comm'n on Science, Technology, and Government, Wash., D.C.), June 1993, at 1 [hereinafter *National Competitiveness Bill*]. Some critics charge that H.R. 820 creates unwarranted federal control over the marketplace, thus prompting a letter of dissent that was included in the committee report. *Id.* at 10.

58 *See Committee Approves Competitiveness Bill, supra* note 43, at 6.

59 Gene Koprowski, *Competitiveness Bill Stalled as CBO Ups Loan Exposure Estimate Tenfold, GOP Frets*, NEW TECH. WK. (King Communications Group, Inc., Wash., D.C.), May 17, 1993, at 11. Rep. Norman Mineta (D-Cal.) sponsored the new provision. *Id.*

60 *See National Competitiveness Bill, supra* note 57, at 10. *See also Senate Passes National Competitiveness Bill*, SCI. & TECH. IN CONG. (Carnegie Comm'n on Science, Technology and Government, Wash., D.C.), Mar. 1994, at 3. The Senate version of the bill would authorize $1.9 billion during 1995-96. *Id.*

61 *National Science and Technology Policy; National Needs, Major Choices, Emerging Priorities, and Major Institutions: Hearing before the Subcomm. on Science, Technology, and Space of the Senate Comm. on Commerce, Science, and Transportation*, 101st Cong., 1st Sess. 2-3 (1989) (opening statement by Chairman Ernest F. Hollings) [hereinafter *Subcommittee Hearing*]. Some of the major changes referred to include the political transitions within Eastern Europe that have forced the United States to shift from a Cold War economy to one based upon civilian research, in which the ability to produce sophisticated products at home is paramount, as well as the growing trends among other industrialized countries toward government participation in industrial policy to increase productivity, manufacturing capacity and world leadership in important industries. *Id.*

62 *Id.* at 3. Senator Hollings stated the following in regard to America's growing need for a long-term, cohesive technology policy:

> We cannot just win Nobel prizes, we have to also win foreign markets for American products. That requires not just research scientists in the labs,

Harvard University's John F. Kennedy School of Government, this approach requires a fundamental change in the way Americans view science and technology, and its impact upon society.[63]

The world has witnessed a dramatic rise in the high technology commercial industry, with global civilian R&D growing two and one half times more rapidly than military R&D.[64] According to business leaders, the American workforce must be properly trained and educated to deal with this major change, specifically by developing advanced technical skills to successfully operate and manage highly efficient production systems.[65] Moreover, America's youth

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> but world-class engineers in our factories. New discoveries from the lab need to be put to use quickly if we are to beat the foreign competition. Keeping America competitive will require science and technology policies that both maintain our research labs, where new ideas are born, and improve and expand our industrial labs, where [ ] ideas are turned into products and profits. We must have both.

Id.

63 *Id.* at 211-13 (testimony of Prof. Lewis M. Branscomb, John F. Kennedy School of Government, Harvard University). Americans currently view science and technology as areas handled by private industry, with 70% performed by the private sector, and half of that funded by private businesses. Today, however, there are enormous resource allocation pressures within government, and private industry is finding that the cost of capital is too high to pursue the same path of privatized R&D. *Id.* at 10-12. Professor Branscomb notes that both of these conditions call for an investment strategy in science and technology that would require a central budgeting process for commercial research. In addition, Frank Press, former president of the National Academy of Sciences, has stated that one of the main concerns in the United States is the country's inability to make use of limited resources to maximize scientific productivity and fulfill national objectives. *Id.*

64 *Id.* at 12. Today, major innovations worldwide are more apt to come from the private, commercial sector than from government military and space programs, and these innovations are far more likely to be non-exclusive to the United States, and hence more competitive. Military and space technology no longer are the primary sources for innovations as they were during the 1960s. In Japan and Germany, which have proportionately smaller military R&D budgets than the United States, private civilian R&D clearly dominates. *Id.* Worldwide, commercially relevant technological developments are springing from the commercial sector, as evidenced in the fields of electronics, computers and biotechnology. This trend is the result of the enormous range and number of high-tech consumer products available in the global marketplace. Japan and Germany have consistently increased their civilian R&D investments, reaching approximately 3% of GNP for Japan and 2.7% for Germany. In contrast, the U.S. has remained at 1.9% of GNP since 1983. 138 CONG. REC. H9149 (daily ed. Sept. 23, 1992).

65 *PBS Series: Challenge to America* (PBS television broadcast, Jan. 3-4, 1994) (transcript of broadcast on file with the *Seton Hall Legislative Journal*). This segment, produced by Hedrick Smith, dealt with America's educational system. *See also infra* note 100 (worker training programs).

are less proficient in math, science and technical skills than their counterparts in the industrialized world, which has led many to suggest that a comprehensive apprenticeship program for America's youth is in order.[66]

In summary, the purpose of the legislation is to create a partnership between public and private entities so that federal funding is made available to private firms investing in technologies from which many companies can benefit.[67] Where the marketplace is either slow or unable to respond to societal needs, government initiatives to remedy marketplace deficiencies are intended to provide opportunities for small to medium-sized American companies to compete globally.[68] The goal established by Congress and the Administration for the country in the next ten years is as follows: the U.S. should stand second to none in its ability to develop and use advanced technology.[69] In meeting this target, government officials have stated that the federal government must undertake an ambitious technology policy that transcends traditional boundaries of trade, economic and domestic policies.[70]

B. *Major Provisions of the Act*

The Act creates a policy of greater interaction and cooperation among federal agencies, manufacturers and labor groups to ensure that the United States plays *the* leading role in the development of advanced manufacturing technologies.[71] Specifically, the Department of Commerce assumes the strategic role as the lead agency to carry out Congress' mandate.[72] It would be designated

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66 *Id.*

67 *Hearings on S. 4, the National Competitiveness Act of 1993 Before the Subcomm. on Technology, Environment and Aviation of the House Comm. on Science, Space and Technology*, 103d Cong., 1st Sess. 2 (1993) (statement of Ronald Brown, Secretary of Commerce) [hereinafter Ronald Brown's Statement]. *See infra* note 135.

68 Ronald Brown's Statement, *supra* note 67, at 2. For instance, the United States has failed to keep pace with global competition in the specific areas of materials technology, such as silicon and ceramics, as well as electronic components, including memory chips and liquid crystal displays, and engineering and production technologies, including robotics and automated equipment. GAINING NEW GROUND, *supra* note 1, at 33-34.

69 H.R. 820, 103d Cong., 1st. Sess. § 301(c)(1)(1993). *See also* Ronald Brown's Statement, *supra* note 67, at 9.

70 Ronald Brown's Statement, *supra* note 67, at 5.

71 H.R. 820 § 203.

72 *Id.* § 203.

as the primary agency to coordinate resources and provide funding to companies implementing the latest, most advanced techniques and processes available to produce goods, and would do so in conjunction with other federal agencies.[73]

Under NIST, a National Technology Outreach Program would be established to increase the use of modern manufacturing methods via small businesses by electronically connecting technology and manufacturing extension centers.[74] Eligible participants include local, state and federal government agencies, universities, laboratories, professional societies, industrial organizations, vocational schools and nonprofit groups.[75] The Act also authorizes expansion of the existing State Technology Extension Program and the National Manufacturing Technology Center Program.[76] The Manufacturing Outreach Program is expected to link statewide Manufacturing Extension Centers with Manufacturing Technology Centers.[77]

A major element of the House version of the Act is the creation of an Advanced Manufacturing Technology Development Program to improve manufacturing methods and facilitate technology transfer to U.S. manufacturers.[78] Companies, universities and independent research groups would be encouraged to participate in

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[73] *Id.* § 203. The Secretary of Commerce would operate and maintain an electronic communications network for instantaneous and interactive communication for users of public and private information in the form of a clearinghouse. *Id.* The Commerce Department also would coordinate with other federal agencies, such as the Department of Energy, Department of Defense, and the National Aeronautics and Space Administration, as well as the Office of Science and Technology Policy, in terms of information resource-sharing and determining the priorities for funding.

[74] *Id.* § 204. *See also* UNITED STATES DEPT. OF COMMERCE, *supra* note 39, for specific types of manufacturing processes.

[75] H.R. 820 § 204(c).

[76] *Manufacturing Extension Programs Find Support in Congress and Administration*, SCI. & TECH. IN CONG. (Carnegie Comm'n on Science, Technology & Gov't, Wash., D.C.), Mar. 1993, at 12. The Omnibus Trade and Competitiveness Act of 1988 authorized National Manufacturing Technology Centers within NIST.

[77] *Id.* According to Ronald Brown, Secretary of Commerce, such a program would provide one-stop shopping to small and medium-sized companies, since Commerce would be responsible for awarding grants and providing information, resources and access to technical expertise. Ronald Brown's Statement, *supra* note 67, at 9-10.

[78] H.R. 820 § 205. A significant number of small defense contractors already have commercial customers, and are more capable of converting from military to civilian markets than larger contractors. Specifically, these small firms need guidance in terms of purchasing and using the latest, off-the-shelf computer technologies available. 138 CONG. REC. S7253 (daily ed. May 21, 1992).

the development of manufacturing standards and techniques.[79] The federal government's effort to promote technology transfer would be implemented by the establishment of manufacturing technology centers, each of which would receive no more than one-third federal funding and would be evaluated after six years.[80] Individual annual awards of $500,000 for industry-sponsored demonstration projects would be authorized, and an extension program would be established to provide funding to states to support worker training, education and quality assessment programs.[81]

Such government initiatives are viewed as part of the solution to America's industrial modernization problem. Because the average firm typically has fewer than 500 employees, it often lacks the necessary resources to upgrade to new manufacturing methods and equipment.[82] Dissemination of scientific, technical, engineering and management know-how to these manufacturing companies is seen as vital.[83] In particular, Rep. Valentine, author of the House version, has emphasized the importance of worker training and education to move ideas from the laboratory to the factory floor.[84]

In addition, the Act calls upon the National Science Founda-

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79 H.R. 820 § 205. One or more development demonstrations would be set up, in accordance with the cost-sharing measures established by the ATP, to match private funding to explore technology transfer in the manufacturing sector. *Id.*

80 *Id.* § 207. Manufacturing technology centers would function similarly to agricultural extension centers, which have assisted farmers in the use of modern agricultural production methods for decades. The purpose of the manufacturing technology center is to bring together a number of small and medium-sized manufacturers within a region and demonstrate to these companies the beneficial applications of automated equipment. *Id.*

81 *Id.* In selecting award recipients, preferential consideration shall be given to companies with existing computer expertise in manufacturing, especially in the areas of materials research, environmental science and concurrent engineering. Preferred applicants also would have the ability to transfer their testbed results to other participants in the program to maximize benefits for the entire industry. *Id.* tit. III.

82 The nation's 355,000 small- and medium-sized manufacturing companies account for 99% of the total U.S. manufacturing output. *Technology Transfer: Federal-State Collaboration on Industrial Extension Programs*, SCI. & TECH. IN CONG. (Carnegie Comm'n on Science, Technology & Gov't., Wash., D.C.), Jan./Feb. 1993, at 3.

83 *Id.*

84 Tim Valentine, *Technology Policy in the 103d Congress*, SCI. & TECH. IN CONG., (Carnegie Comm'n on Science, Technology & Gov't, Wash., D.C.), Mar. 1993, at 4. As stated by Rep. Valentine:

> The Act establishes training and teaching partnerships with the private sector to increase the level of manufacturing training in the workplace and the classroom. It has been proven time and again that innovation is not enough. An educated work force is essential for an improved national

tion (NSF) to identify research areas that conceivably would improve productivity and sustainable economic growth.[85] It would be the responsibility of the NSF to strengthen relationships between industry and universities in an effort to promote technologies that would lead to improved U.S. manufacturing and engineering capabilities.[86] Under NSF supervision, several engineering research centers would be established, of which at least one would be dedicated to manufacturing needs.[87]

In proposing that the NSF take an active role in engineering research, Congress has articulated its deep concern that both science and technology organizations cooperate to lessen the negative impact of global competition on a wide range of technological areas in the United States.[88] This urgency prompted Congress to include a provision in the Act calling for the collection, evaluation and dissemination of information to U.S. firms, universities, and state and local governments regarding comparable foreign capabilities.[89] The Department of Commerce would serve as the central

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standard of living. Educated, skilled workers are essential to the transfer and implementation of an idea from the laboratory to the factory floor.

Id.

85 H.R. 820 § 211. Areas of interest that have been discussed are robotics, high-performance computing, semiconductors, superconductivity and advanced imaging.

86 *Senate Commerce, Science, and Transportation Committee Approves Competitiveness Bill*, SCI. & TECH. IN CONG. (Carnegie Comm'n on Science, Technology & Gov't, Wash., D.C.), July 1993, at 6. These relationships primarily would be strengthened through government-supported research at universities targeted to engineering and manufacturing needs. *Id.*

87 H.R. 820 § 212. The goal of the research engineering centers would be to increase the number of engineering students specializing in technology transfer to provide a larger talent base for the future. *Id.*

88 *Id.* § 301. According to Rep. Brown, "federal research policy decisions must not be based solely on the promise of research, but on concrete outcomes as well." CHAIRMAN'S REPORT, *supra* note 44, at 16-17. The direction Congress is taking is such that agencies and researchers alike would be able to set specific goals and recommend budgets that are realistic. Evaluation of programs should occur independently from the researchers, and researchers themselves should be given greater incentives to meet the goals within their own programs. The aim of such an approach is that top-level science research will be applied to industrial research areas where relevant policy needs have been identified. *Id.*

89 H.R. 820 § 301. The coordination and dissemination of information would be handled by the Department of Commerce. *Id.* Dr. Craig Fields, president of the consortium Microelectronics and Computer Corp., Austin, Tex., stated that many of the organization's members have changed their research and investment strategies after monitoring foreign capabilities in science and technology. H.R. REP. NO. 77, *supra* note 2, at 48-49. Jim Wells, of the Government Accounting Office, cited 30

agency responsible for assessing the comparative scientific and technological strengths of the United States in relation to its foreign competitors.[90]

A major component of the Act is the Advanced Technology Program, originally authorized in 1988,[91] which calls for closer cooperation with the Advanced Research Projects Agency (ARPA), as well as federal funding of large scale government/industry research and development consortia.[92] Consortia receiving government attention would be those best able to provide major contributions to economic growth, quality of life and environmental soundness.[93] Another provision of the Act encompasses the stimulation of long-term investment capital for the formulation of businesses engaging in technological development under the Civilian Technology Development Program.[94] Under the program, it is envisioned that technology investment firms, overseen by the Technology Administration[95] of the Department of Commerce, would provide seed monies and early financing to businesses with the purpose of increasing industrial competitiveness and providing more jobs.[96] There is serious debate, however, as to the appropriateness

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government agencies collecting such information, with little coordination and minimal sharing among agencies or with industry. Open-source databases would be one way in which to disseminate this valuable material. *Id.* at 51-52.

90 H.R. 820 § 301. Such an assessment would encompass market information on foreign process and product technologies, productivity and production statistics, and published scientific materials. *Id. See* H.R. REP. No. 77, *supra* note 2, at 60-61.

91 The Advanced Technology Program was established under the National Institute of Standards and Technology Act. *See* 15 U.S.C. § 278(n) (1988).

92 H.R. 820 § 321. Congress has stated that preference would be given to large-scale research and development consortia engaged in projects that otherwise would not be undertaken by the private sector without a federal investment of at least $50 million each year. *Id.*

93 *Id.* § 322.

94 *Id.* § 343.

95 The Technology Administration in the Department of Commerce (15 U.S.C. § 3704) was established in 1988 and includes the National Institute of Standards and Technology, the National Technical Information Service and the Office of Technology Policy. It is the executive department within the Commerce Department authorized to manage science and technology policy. *Id.* Included in its purview would be the oversight of civilian R&D, including manufacturing technology centers, and cooperation with states regarding funding of those centers. H.R. 820 § 343.

96 H.R. 820 § 343. Emphasis is placed on an outreach initiative for economically depressed areas. The Secretary of Commerce, through the Undersecretary, would ensure that qualified businesses would be notified of their ability to obtain federal financing and would be encouraged to participate in the program. Notification is not limited to economically depressed areas only; the legislative intent of H.R. 820 also

of the government's participation in venture capital financing to enhance economic competitiveness.[97]

There is also some debate as to whether the federal government should be awarding grants to specific companies to encourage technological development.[98] Supporters of the bill, however, say critics' fears are unfounded, as much of the federally supported R&D dollars would be directed at precompetitive technological research only, with no one company benefiting more than any other.[99]

Finally, the Act incorporates a workforce quality partnership program directed at industries immediately threatened by heightened foreign competition, a situation that is seen to have a significant impact either on the nation's economic or military security.[100]

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reaches out to those geographic areas with a large concentration of defense-related industries, as well as any areas experiencing high levels of unemployment. Companies in these areas would be given preference to take advantage of expertise provided through manufacturing or engineering research centers to improve their productivity. *Id.*

97 *Id.* § 349. Venture capital financing is defined as a means of investing funds at considerable risk of loss in potentially highly profitable enterprises. Any incorporated body, state or limited partnership qualifying under the Civilian Technology Development Program would be eligible to apply for a license to formulate a technology investment firm, subject to final approval from the Undersecretary of Commerce. *Id.* § 345. Carl B. Wooten, director of the Office of Technology Transfer at the University of California, testified at a subcommittee hearing on Feb. 16, 1993, that the venture capital industry is not meeting the needs of the majority of small high technology companies. A great need exists in the marketplace for "patient" capital to be invested in early stage companies. Many high technology industry leaders favor the legislation, claiming that government initiatives will help the United States regain world leadership in all phases of the product cycle. H.R. REP. NO. 77, *supra* note 2, at 47.

98 H.R. REP. NO. 77, *supra* note 2, at 112. Representative Walker opposed the legislation, charging that the bill will have the unwanted effect of subsidizing a very limited number of federally selected technologies, culminating in industry winners and losers. Walker's concern is that federal support of actual product development could lead to the nationalization of industries. *Id.*

99 *Id.* at 49. Sematech, Inc. is proffered as an example of a successful government-sponsored consortium that was able to demonstrate its capability of manufacturing leading-edge integrated circuits using American-made equipment after five years in operation, according to testimony from Dr. William J. Spencer, the consortium's president and CEO during a Feb. 17, 1993 subcommittee hearing. *Id.*

100 H.R. 820 § 305. Improving worker skills and training is highlighted in the National Competitiveness Act to establish and encourage workforce training seminars between industry and institutions of higher learning, such as community technical colleges or vocational training organizations. *Id.* Also, the Act would enhance the existing Malcolm Baldrige National Quality Award program to promote industry workshops on increasing production efficiencies, initiating product improvements using market-driven practices, and developing better relations between suppliers and

To date, the programs authorized to implement many of the initiatives set forth in the Act are deemed insufficient to meet the growing challenges of national competitiveness facing the United States.[101]

C. *Legislative Committee Action*

Representative George Brown (D-Cal.), a long-time proponent of America's need to develop and adopt advanced technologies in manufacturing and service industries, led the legislative effort on H.R. 820 through his work as Chair of the House Committee on Science, Space, and Technology.[102] Mr. Brown makes it clear that the federal government has been extremely slow to respond to the competitive pressures of rapid foreign technological advancement confronting the nation.[103]

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end users. *Id.* The legislative intent behind affected industries is largely due to the massive military dislocation resulting from the post-Cold War period. Attempts will be made to assist defense contractors and subcontractors, especially smaller firms, in developing competitive engineering technologies suitable to the civilian sector. *Id.*

101 H.R. 820 § 506. Appropriations for all programs under the bill total $1.54 billion for fiscal years 1994 and 1995 combined. The combined appropriations during those two years for the following programs are: $647.5 million for the ATP, $422 million for manufacturing and engineering programs, $539 for NIST core technology programs, $167.7 for NIST lab facilities, $72 million for a civilian technology program, $52 million for workforce quality and assessment programs, $13.4 million for the Technology Administration, with a proviso for a total expenditure limit on the bill of $1.54 billion. H.R. REP. No. 77, *supra* note 2, at 71-72. Recognizing that a $1.54 billion appropriations bill alone will not solve the country's competitiveness problem, Congress has simultaneously articulated its intent on reducing the federal budget deficit, providing tax incentives, and reforming antitrust and anticompetitive laws to improve America's position in commerce and manufacturing. *Id.* at 36.

102 *See* CHAIRMAN'S REPORT, *supra* note 44, at 4.

103 H.R. REP. No. 77, *supra* note 2, at 37. Representative Brown explained:

> The economic situation facing the United States is increasingly serious. As the competitive position of the U.S. has deteriorated over the last twenty years, it has become apparent that new approaches on restoring our economic health are needed. A central part of that effort must be the development of advanced technologies which promise sustained economic growth well into the future. Numerous recent studies and most industrialized nations have concluded that technology development and adoption throughout an economy are essential to continued competitiveness in today's world where the technological sophistication of manufacturing and services will continue to grow at an accelerating pace and where the marketplace will become less and less forgiving of companies that cannot or will not modernize and continuously improve their quality. Most of the United States' major competitors have several year's head start in industry-government cooperation. While the United States has been

Senator Ernest Hollings (D-S.C.) also has played a key role in spearheading legislative efforts to create a federal technology policy through the Senate Committee on Commerce, Science and Transportation.[104] While noting that U.S. productivity for the manufacturing sector is one of the highest in the world, Senator Hollings also has pointed out that the rate of productivity growth during the last twenty years has fallen behind that of other industrialized countries.[105] Today, manufacturing accounts for approximately 19 million U.S. jobs and represents 23% of America's gross national product, as well as 75% of U.S. exports.[106]

> stuck at the starting blocks debating the various philosophies related to industrial policy and carrying out relatively small experimental programs in industry-government cooperation, foreign competitors have implemented large, sophisticated cooperative programs. The time has come for the United States to begin to catch up.

Id. at 36-37.

104 The Senate introduced a number of bills on this topic. *See* S. 1327, S. 1328, S. 1329, 102d Cong., 1st Sess. (1991). Senator Hollings was instrumental in drafting this earlier legislation with Senators Jeff Bingaman (D-N.M.) and Al Gore (D-Tenn.) on June 11, 1991. Early legislation addressed similar concerns regarding the need to promote technologies crucial to America's economic well-being. According to Sen. Hollings, federal support is appropriate for technologies which can offer large potential benefits to the nation but which are risky and require very long-term commitments, such that no one company alone could justify the investment.

105 S. REP. No. 226, 102d Cong., 1st Sess. 2 (1991) [hereinafter S. REP. No. 226]. According to a Massachusetts Institute of Technology study published in 1989, entitled *Made in America: Regaining the Competitive Edge*, several factors explain why U.S. productivity is not rising rapidly: the short-term business outlook; outmoded business strategies; weaknesses in technological development and production; neglect of human resources; lack of cooperation; and finally, government and industry groups working at cross-purposes. *Id.* at 2-3. Moreover, the growth rate of productivity in the U.S. has dropped by a factor of three, from 2.7% annually from 1960 to 1970 to .9% from 1979 through 1985. Lester C. Thurow, *A Surge in Inequality*, SCI. AM., May 1987, at 30, 32. While the causes of this slowdown are difficult to ascertain, it is noted that a reduction in productivity growth precludes the creation of new jobs reflecting the wage gains that ordinarily would exist if productivity and output were expanding more rapidly. To compete globally in industries associated with high wages, America's workforce must be as educated and skilled as that of any other industrialized nation. *Id.* at 36.

106 S. REP. No. 226, *supra* note 105, at 2. According to a study published by the National Science Board, two major weaknesses in management practices among U.S. businesses that have contributed to a decline in manufacturing are: (1) slowness in product development and commercialization relative to competitors, and (2) reluctance to invest in R&D for new technologies due to high costs, long-term timeframes, and the interdisciplinary nature of research involving many industries. STRATEGIC ISSUES, *supra* note 5, at 43. The survey found that general management practices and external financial pressures, rather than federal technology policy, are to blame for the decline in America's technological leadership. *Id.* at 41.

1. America's Declining Standard of Living

At the heart of the debate is identifying the appropriate strategy to reverse the decline in America's standard of living.[107] Congress conducted thirty hearings and received testimony from 120 expert witnesses during the 102d and 103d Congresses, all of which illustrated an emerging consensus that the federal government should play a prominent role in promoting national competitiveness.[108] Germane to this new way of thinking was the sober realization that the American standard of living has indeed declined.[109]

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107 In July 1992, nearly 10 million people were unemployed in the United States, 3.6 million of whom were unemployed for more than 15 weeks. According to a *Washington Post* study in September 1992, Americans fortunate enough to have jobs are working longer hours and are earning less than at any time since 1980, with unemployment spreading to white collar occupations. In addition, medium income grew only $1528 between 1979 and 1989, the slowest growth since 1945. Since 1990, median family income has declined two percent. 138 CONG. REC. H9149 (daily ed. Sept. 23, 1992).

108 *See* H.R. REP. No. 77, *supra* note 2, at 40. Numerous hearings also were conducted during the 101st Congress. Experts testifying included: The Honorable Richard Celeste, former governor of Ohio; Dr. Mary Good, senior vice president of technology at Allied Signal, Inc., Morristown, N.J., indicating that the content of the government/industry partnership must be customer-focused and market-driven, with a sunset clause allowing for programs to end if they are not successful; Dr. John McTague, vice president, Technical Affairs, Ford Motor Company, noting the positive evolution from an adversarial relationship between business and government to one of cooperation; John Carruthers, director of components research, Intel Corporation, and chairman of the Technology Manufacturing and Infrastructure Committee of the American Electronics Association, stating that formal mechanisms need to exist for industry input into federal manufacturing and technology programs; John F. Hodgman, president, Massachusetts Technology Development Corporation; and Ernest Daman, chairman emeritus, Foster Wheeler Development Corporation, N.J., representing the American Association of Engineering Societies, stating that the AAES characterizes the national competitiveness problem as the United State's difficulty in going from innovation to product. *Id.* at 44-51.

109 *Id.* at 40. According to the Office of Technology Assessment, real hourly wages of manufacturing workers had plummeted to $8.00 by 1990, well below the 1964 level, after peaking in 1978 at $9.50. The Economic Strategy Institute reported in May 1992 that real wages dropped 7.3% between 1979 and 1990, indicative of a longer-term negative trend toward lower-paying jobs. During this same time period, based upon statistics from the U.S. Census Bureau, the category of low-wage earners grew from 12% to 18% of the workforce. *Id.* "The important question is not whether the United States will have a manufacturing industry but whether it will compete as a low-wage manufacturer or as a high-productivity producer." S. REP. No. 226, *supra* note 105, at 2. The reasons for the decline are complex, but a number of comparative statistics illustrate some of the major differences between the United States and its industrial partners in national savings as a percentage of gross national product (GNP) and in national research and development as a function of GNP. *See* Paul A. Krugman, *Myths*

2. Accelerating Technology Commercialization

Congress has targeted advanced manufacturing technology as an area of increasing importance to U.S. businesses.[110] Without the ability to produce high-quality products quickly, reliably and cost-effectively, even the greatest new innovations translate into little commercial value.[111] The United States is the envy of the world in its ability to create scientific knowledge and technology, but this advantage, per se, has proven insufficient in ensuring the economic well-being of the country.[112] The proposed legislation addresses specific areas in which the United States appears to be relatively weak:[113] support technology, generic manufacturing and a communications infrastructure for modern manufacturing.[114]

One of the articulated goals of this legislation is to establish additional Manufacturing Extension Centers beyond the seven already in operation under NIST, to promote greater technology transfer for rapid commercialization of technology into beneficial

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and Realities of U.S. Competitiveness, 254 SCI. 811, 814 (Nov. 8, 1991). For instance, the savings rate as a percentage of GNP in Japan and West Germany is 17.8% and 9.8%, respectively. In the United States, the rate is 3.6%. In addition, the unprecedented growth of America's $4 trillion debt has exacerbated the problem of U.S. competitiveness. *See also* H.R. REP. NO. 77, *supra* note 2, at 27.

110 S. REP. NO. 226, *supra* note 105, at 3.

111 *Id.*

112 *Commerce Department Technology and Manufacturing Programs: Hearing before the Senate Comm. on Commerce, Science, and Transportation*, 102d Cong., 1st Sess. 12 (1991) [hereinafter *Commerce Department Technology*]. Deborah Wince-Smith, Assistant Secretary for Technology Policy, Technology Administration, Department of Commerce, reported that enabling technologies, such as those defined as critical technologies, are too complex, expensive and broadly applied to be developed by individual companies. Foreign industrial competitors are structured differently than their U.S. counterparts, and this has created an enormous competitive advantage for foreign firms developing multi-use technologies. By participating on an interindustry basis, these foreign competitors are able to share long-term risks and thus reap the return on investment more quickly. *Id.*

113 H.R. 820 tit. III, IV. These areas generally are comprised of technologies that would directly improve manufacturing techniques and processes not specific to any particular industry, such as the use of the most modern computer and communications systems available for manufacturing operations. *Id.*

114 *Id.* To complement its existing efforts, the Japanese government has proposed a 10-year, $1 billion, government/industry advanced manufacturing collaboration called the Intelligent Manufacturing Systems Initiative. In contrast, the United States has no industry/government strategy to prepare for the future in general manufacturing. Thus, America continues to fall behind other industrialized countries in the development, adoption and use of modern manufacturing technologies. *See* S. REP. NO. 226, *supra* note 105, at 6-7.

products.[115] President Clinton has proposed establishing 170 Manufacturing Extension Centers at a cost of $510 million by 1996, with funding projections estimated at $150 million for 1994 and $280 million by 1995.[116]

3. Federal Laboratory Participation

An important portion of the Act calls for greater efforts to create technological transfers among the nation's federal laboratories.[117] The task will not be an easy one.[118] The federal

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115 *1993 House Small Business Hearings*, *supra* note 4, at 6. Nearly $90 million in federal funding was appropriated as part of the Administration's defense conversion plan in 1993. *Id.*

116 *Manufacturing Extension Programs Find Support in Congress and Administration*, SCI. & TECH. IN CONG. (Carnegie Comm'n on Science, Technology & Gov't., Wash., D.C.), Mar. 1993, at 12. In Japan, 169 kohsetsushi centers have been established, all of which are jointly funded by the country's federal and local governments at a level totaling $500 million each year. Kohsetsushi centers are similar in concept to U.S. manufacturing extension centers in that they serve the purpose of providing government funding to private initiatives that have been approved by the national government as beneficial technology initiatives. S. REP. NO. 226, *supra* note 105, at 7. To properly analyze the scope of America's expenditure on manufacturing extension centers in 1992, a comparison with the federal government's agricultural extension service program is appropriate: U.S. agricultural extension centers received a total of $405 million during 1991; however, the agricultural sector employs only two percent of the total U.S. workforce. The manufacturing sector represents 19% of the workforce, yet receives only $16.3 million in federal funding. *Id.* at 8.

117 Federal laboratories are research institutions funded and supported by the federal government, and operated predominantly under contract by the Department of Energy. *See Commerce Department Technology*, *supra* note 112, at 7 (testimony of Robert M. White, Undersecretary for Technology, Technology Administration, Department of Commerce). Specifically, Mr. White stated:

> As to technology commercialization, I would only note that we can hardly expect the private sector to adopt modern ideas toward technology management, especially a willingness to seek out and adopt technology developed outside of their own corporate labs, if the Federal Government itself does not take steps to promote its own technology. For far too long we let Federal technology languish on the shelf unused and unappreciated. Fortunately, . . . that whole culture is changing as Federal laboratories expand their outreach effort to involve the private sector in joint research ventures with a view toward developing the full commercial potential of Federal R&D.

Id.

118 *See* COUNCIL ON COMPETITIVENESS, *supra* note 30, at 4. There are 726 federal laboratories in the U.S. with a combined budget of more than $22 billion in 1991. The majority of laboratories are small groups employing five to ten researchers focusing on either fundamental research or specialized applications. Large federal laboratories such as Sandia and Los Alamos, both in New Mexico, employing staffs of 8000

laboratories were originally established to serve national security interests and military concerns.[119] Today, America's knowledge infrastructure is changing, and the federal laboratories have been given a new mission—making U.S. industry its new customer.[120] Approximately one-half of the federal laboratories' total budget is currently directed toward military research. Thus, the shift toward more civilian industrial research has placed substantial pressure on this institution.[121] Industry also has been slow to exploit new technologies emerging from the laboratories for commercial applications.[122]

D. *Major Changes at the Department of Commerce*

The Department of Commerce has been charged with the responsibility of serving as the civilian technology agency to fulfill the goals outlined in the House version, a bill marked for $1.54 billion in appropriations.[123] Historically, the Department of Commerce has lacked both the prominence and resources needed to improve

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to 10,000, are exceptions. Thus, the challenge of redirecting such research to industry needs is an imposing one. *Id.*

119 *Id.* at 3.

120 *Id.* Making U.S. industry the new customer for federal laboratories is the new market-driven approach the government is taking to most effectively allocate resources within the $22 billion federal laboratory budget. The goal is to direct more government research in the future toward commercial development. *Id.* An example of industry/government cooperation with respect to the federal laboratories is the agreement now in place between the U.S. automobile industry and the federal government to design cars for the 21st century. It is hoped that the project will result in long-term innovations that serve practical ends, such as dramatically improved fuel efficiency. Eliot Marshall, *Reinventing the Automobile - And Government R&D*, 262 SCI. 172, 172 (Oct. 8, 1993).

121 *See* COUNCIL ON COMPETITIVENESS, *supra* note 30, at 3-5. The organizational structure and mission of the federal laboratories is now going through a substantial transformation to change its priorities, policies and programs. The purpose of these changes is to define, articulate and conduct research beneficial not only to defense, which is undergoing budget cuts, but primarily to the consumer market. In broad terms, it is the difference between building B-2 bombers and developing high-definition television. *Id.*

122 *Id.* at 4. Federal agencies with the largest budgets for federal laboratory research in 1991 were: Department of Defense, $7 billion; Department of Energy, $6 billion; Department of Health and Human Resources, $3.4 billion; NASA, $3.3 billion; and the Department of Commerce (NIST), $183 million. *Id.* at 5.

123 *See* McCormack, *supra* note 9, at 14. *See also* Gene Koprowski, *Vote Nearing on the Competitiveness Bill*, NEW TECH. WK. (King Communications Group, Inc., Wash., D.C.), May 10, 1993, at 1.

competitiveness.[124] Supporters of this dramatic new role for the Commerce Department contend that the federal government must provide critical support in aiding industry to develop advanced technologies. Conversely, critics argue that government participation will lead only to "picking winners and losers" among both companies and entire industries.[125]

In a dramatic break with tradition, the Department of Commerce will increase its budget by 30% in the next year.[126] Central to the expanded role and new mission of the Department of Commerce is the Advanced Technology Program (ATP).[127] Authorized by the Omnibus Trade and Competitiveness Act of 1988,[128] and strengthened by the American Technology Preeminence Act of 1991,[129] ATP awards matching grants to assist companies developing precompetitive and generic technologies.[130] Since its inception, almost half of all ATP grants, representing 24% of total program award funding, have been awarded to small businesses; furthermore, 50% of ATP funding was awarded to joint ventures in which small businesses participate.[131] The program operates

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124 UNITED STATES GENERAL ACCOUNTING OFFICE, COMMERCE ISSUES 9 (Dec. 1992). This function has rested largely with agencies such as the Department of Defense and Department of Energy. To complicate matters, the Department of Commerce shares many of its missions with all major federal agencies, departments and offices, creating a web of divided authorities, with each group retaining its own organizational power structure. *Id.*

125 *See* Greenhouse, *supra* note 10, at 5. Source materials espousing the need for an industrial policy in America today are books entitled *Head to Head* by Lester Thurow, dean of M.I.T.'s Sloan School of Management, and *A Cold Peace* by Jeffrey E. Garten, an investment banker and former State Department official.

126 Mark Crawford, *Clinton's R&D Budget Shows Modest Growth*, NEW TECH. WK. (King Communications Group, Inc., Wash. D.C.), Apr. 12, 1993, at 1. Such an increase is considered very substantial. *Id.*

127 Ken Jacobson, *ATP Funding Jump - Scale-Up, New Award Strategy*, NEW TECH. WK. (King Communications Group, Wash., D.C.), Apr., 5, 1993, at 1.

128 *See* 19 U.S.C. §§ 2901-2906, *supra* note 21. The Advanced Technology Program was established to improve competitiveness by supporting industry led development projects in emerging technologies. *Id.*

129 American Technology Preeminence Act of 1991, 15 U.S.C § 3701 (1992).

130 Advanced Technology Program Procedures, 15 C.F.R. § 295 (1992). Precompetitive and generic technologies are terms often used interchangeably. Precompetitive and generic technologies are defined as those that present an enormous technical risk to companies, but a reasonable business risk. Eliot Marshall, *R&D Policy that Emphasizes the 'D'*, 260 SCI. 1816, 1818 (Mar. 26, 1993).

131 Awards to small businesses are important, as the majority of manufacturing in the U.S. is conducted by small- to medium-sized companies. *See* 1993 *House Small Business Hearings*, *supra* note 4, at 5.

under the direction of NIST, the core technology agency under the Department of Commerce.[132]

The Clinton Administration has expressed its interest in seeing the ATP become the primary civilian technology program for the nation, thus significantly enhancing the stature of the Department of Commerce.[133] So far, the ATP has allocated sixty grants worth more than $400 million in public and private money to precompetitive efforts, especially in the areas of intelligent machines and software/hardware tools.[134] All of the projects involve broad-ranging technologies with excellent potential for product or process applications.[135]

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132 NIST's budget in 1993 was $381 million and is expected to rise to $1.2 billion by 1997. Christopher Anderson, *Clinton's Technology Policy Emerges*, 259 SCI. 1244, 1245 (Feb. 26, 1993).

133 H.R. REP. No. 77, *supra* note 2, at 41. President Clinton has expressed his support of the National Competitiveness Act, and believes that a successful technology policy is one which is spearheaded by the Department of Commerce through programs such as the ATP. *Id.* Key senators supporting increased expenditures for the Advanced Technology Program have been those senators responsible for the senate version of the legislation: Senators Hollings, Bingaman, Glenn and former Senator Gore. Senator Bingaman (D-N.M.) views S. 4 as the beginning of a much broader strategy in formulating technology policy, encompassing not only advanced manufacturing technology programs and extension centers, but also federal initiatives to support investment capital and quality programs. Mark Crawford, *Congress Wakes Up to Competitiveness*, NEW TECH. WK. (King Communications Group, Inc., Wash., D.C.), Jan. 25, 1993, at 3.

134 Jerome Cramer, *NIST: Measuring Up to a New Task*, 259 SCI. 1818, 1818-19 (Mar. 26, 1993). The government has targeted two main areas of R&D interest for the development and demonstration of new technologies: intelligent machines and computer software/hardware. Intelligent machines are computer-controlled robots and devices capable of producing high-quality, low-cost products quickly. The R&D effort required here is to produce such machines that work reliably under modern industrial conditions. Secondly, the development of new software/hardware tools will enable companies to speed the design and production of new products, as well as improve overall coordination throughout a business organization. S. REP. No. 113, 103d Cong., 1st Sess. 5-6 (1993) [hereinafter S. REP. No. 113].

135 Ronald Brown's Statement, *supra* note 67, at 10. An identical statement was submitted to the Senate Committee on Commerce, Science, and Transportation regarding S. 4 on Feb. 24, 1993. In addition, the ATP has received an increasing number of proposals from defense contractors for conversion from military to civilian commercial production. Another program now in place to aid the conversion effort is the Technology Reinvestment Project, begun in 1992, which will provide approximately $500 million to ARPA, NASA, the Department of Commerce, the NSF and the Department of Energy. The project's stated purpose is to help defense companies redirect resources to provide dual-use technologies. *See 1993 House Small Business Hearings*, *supra* note 4, at 5. *See also* Ken Jacobson, *Race for Conversion Bucks Awaits July*

IV. Presidential Strategy

A. *Presidential Transition to Clinton*

The development of a U.S. federal technology policy has been evolutionary, but the vigor with which such a policy is implemented, and the scope to which it is applied, lies to a large extent in presidential direction.[136] Administrative policy emanating from the Executive Office greatly influences the extent to which the federal government interacts with industry in promoting technology.[137] Historically, the Reagan and Bush years from 1980 to 1992 reflected a laissez-faire approach toward a national technology policy.[138] The Clinton Administration has taken a markedly different position as to the role of the federal government in cooperating with industry to enhance the country's technological prowess.[139]

During the 1992 presidential race, both Bush and Clinton agreed that the federal government should help high technology industries through fiscal measures such as federal funding for research and development, as well as improved schools and tax reform.[140] Beyond that, however, each candidate held dramatically different views as to how best to spur national growth and enhance America's competitiveness.[141] Incumbent Bush maintained that

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Starting Gun, NEW TECH. WK. (King Communications Group, Inc., Wash., D.C.), Mar. 22, 1993, at 1.

136 *See* Greenhouse, *supra* note 10, at 5.

137 *See* Idelson, *supra* note 43.

138 Greenhouse, *supra* note 10, at 5. The Reagan Administration strongly opposed President Carter's industrial innovation initiatives. Carter made plans to increase funding for the Office of Productivity Technology and Innovation in the Commerce Department, as well as the Cooperative Automobile Research Program. The research program's goal was to join government and the auto industry in an effort to develop more fuel-efficient cars by the 1990s. Reagan eliminated these programs. *See generally* CLAUDE E. BARFIELD, SCIENCE POLICY FROM FORD TO REAGAN, CHANGE AND CONTINUITY 61-62 (1982).

139 Hamilton, *supra* note 11, at 1076. *See also* William J. Broad, *U.S. Panel Asks for More Science*, N.Y. TIMES, Aug. 13, 1992, at D1. The National Science Board, a federal panel that is the policy-making arm of the National Science Foundation, issued a report on Aug. 12, 1992, stating that scientific research in American industry was in a "perilous state of stagnation" and urged immediate steps be taken to promote scientific investment in the United States. The report called for stronger federal leadership, as well as education of top corporate managers regarding the importance of linking technology to business strategy. *Id.*

140 *See* Peter Dunn, *Bush, Clinton In Showdown on R&D Role*, ELECTRONIC NEWS, Sept. 14, 1992, at 1.

141 *Id.*

adopting a national civilian technology policy would create an "intrusive, government-dominated industrial policy."[142] President Bush was a strong supporter of federal funding for basic research, and relied heavily on the federal laboratories through his National Technology Initiative to facilitate economic growth.[143] He did not support direct government funding of government/industry consortia, preferring instead to let aggressive market forces predominate.[144]

President Clinton proposed a less patient strategy, immediately calling for the transformation of the military research organization, the Defense Advanced Research Projects Agency (DARPA) into a civilian agency now known as ARPA, to promote dual-use technologies, launch new growth industries, and reinvigorate traditional ones.[145] Specifically, Clinton proposed that federal funding be taken out of military R&D and placed in civilian R&D, and that conversion loans be provided to small defense manufacturers to aid in their adaptation to a post-Cold War economy.[146]

In his campaign platform, Clinton promised to rebuild America by developing the world's best communication, transportation and environmental systems, all to create millions of high-paying jobs that would serve the country well in its transition from a defense-based economy to a commercial one.[147] Clinton made clear during his campaign that he strongly supported a significant role for the federal government in helping private companies exploit new technologies.[148] In essence, the Administration points to

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142 *Id.* at 7. The dissenting views published with H.R. 820 are consonant with former President Bush's views regarding the promotion of technology policy. Bush was opposed to the bill on the grounds that the federal government was not better able to make business decisions than the marketplace itself. To Bush and the bill's opponents, H.R. 820 was viewed as another federal spending program. H.R. REP. NO. 77, *supra* note 2, at 112-17.

143 Dunn, *supra* note 140, at 7.

144 U.S. OFFICE OF SCIENCE & TECHNOLOGY POLICY, *supra* note 53, at 3.

145 Dunn, *supra* note 140, at 7.

146 *Id.*

147 Governor Bill Clinton, Putting People First, A National Economic Strategy for America 5 (1992) (Campaign Report on file with the *Seton Hall Legislative Journal*).

148 *1993 House Small Business Hearings*, *supra* note 4, at 3. More than 500 high technology executives, who traditionally voted Republican, chose to endorse Clinton for one specific reason: they wanted a candidate who would work closely with industry and adopt a long-term strategy to ensure America's technological superiority. *Id.* President Bill Clinton announced his direction for technology policy just one month after entering office:

government's role in creating technology policy as an engine of growth.[149]

To reach his stated technology goals, President Clinton outlined four areas to be addressed concurrently: (1) permanent research and development tax credits; (2) a trade policy encouraging fair and open trade; (3) an efficient regulatory policy achieving social objectives; and (4) additional education and training programs for all Americans.[150] In strengthening government and industry cooperation, President Clinton has called for the civilian R&D portion of the federal R&D budget to rise from 41% to more than 50% by 1998.[151] This development is indicative of the direction in which the National Competitiveness Act, which has received broad support from the House, would steer the country.[152]

> American technology must move in a new direction to build economic strength and spur economic growth. The traditional federal role in technology development has been limited to support of basic science and mission-oriented research in the Defense Department, NASA, and other agencies. This strategy was appropriate for a previous generation but not for today's profound challenges. We cannot rely on the serendipitous application of defense technology to the private sector. We must aim directly at these new challenges and focus our efforts on the new opportunities before us, recognizing that government can play a key role helping private firms develop and profit from innovations.

CLINTON & GORE, *supra* note 5, at 1.

149 *Id.* On November 22, 1993, President Clinton signed an executive order creating a new National Science and Technology Council to coordinate all federal R&D budgets throughout the government. The Council, which is now on par with the National Security Council, the National Economic Council and the Domestic Policy Council, is to provide policy guidance in preliminary meetings with each executive agency and the Office of Management and Budget. Irwin Goodwin, *New Cabinet-Level Council to Shape Clinton Science Policy and Budgets*, PHYSICS TODAY, Jan. 1994, at 35.

150 CLINTON & GORE, *supra* note 5, at 3. These four concurrent objectives are similar to those outlined during the Bush Administration. *See* UNITED STATES OFFICE OF SCIENCE & TECHNOLOGY POLICY, U.S. TECHNOLOGY POLICY: EXECUTIVE OFFICE OF THE PRESIDENT, *supra* note 53, at 7-8.

151 CLINTON & GORE, *supra* note 5, at 8. Japan and West Germany currently invest 3% and 2.7% of their respective gross domestic product on non-defense R&D, in contrast to U.S. spending of only 1.9%. *Id.* at 12. A significant portion of the civilian and dual-use R&D funding would be targeted to small- and medium-sized businesses, which are considered to be more flexible and innovative than large conglomerates. *1993 House Small Business Hearings*, *supra* note 4, at 5. *See* Hamilton, *supra* note 11, at 1077.

152 Idelson, *supra* note 43. The bill passed the House in 1992 in a vote of 287-122. *Id.* Representative Robert G. Torricelli (D-N.J.) believes the change is long overdue:

> Our nation's future as a superpower relies on its economic strength, but our government's hands-off attitude toward technology has kept us on the sidelines. President Clinton's proposal to reverse that trend will ready us

Furthermore, a major program the Administration has targeted for special attention has been dubbed "information superhighways," a program to create a national high-speed computer network linking ever more powerful supercomputers, as well as a national information infrastructure for businesses, schools and libraries.[153] Under the High-Performance Computing Act of 1991, Congress authorized appropriations to develop a computer network that will connect millions of researchers and educators to large amounts of data at very high speeds.[154] The program also serves as a testbed for further R&D developments in high-performance computing.[155] Specifically, the NSF was given the task of providing the infrastructure to support the science, engineering and human resource development of this super network as well as serving as the primary source of information regarding access to databases on the network.[156]

B. *Facing a Steady Decline in Manufacturing*

The Clinton Administration notes that only 2% of the nation's $70 billion R&D budget in 1992 was dedicated to manufacturing R&D, underscoring the continued underinvestment in that area.[157] However, experts on international competitiveness state that while President Clinton's goal to increase manufacturing jobs may hold

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> for the economic rigors of the 21st century. The Clinton blueprint is centered on the notion that government must become actively involved in supporting the development and commercialization of new technologies. Federal support for commercial technology has been minimal in the past, especially when compared with Japan and Europe, which regularly subsidize industries considered crucial to the country's economic well-being.

Robert G. Torricelli, *Yes, We Need a High-Tech Fast Track*, BERGEN RECORD (Hackensack, N.J.), Feb. 28, 1993, at 1, 6. Representative Torricelli acknowledges that the notion of a national industrial policy has been sorely ridiculed under the belief that private markets are best able to determine how to commercialize technologies rather than government bureaucracies. Torricelli's response to such critics is to argue that the private market model was successful for the United States when the United States dominated world markets, such as during the post-World War II era, regardless of how much other countries were subsidizing their industries. Today, this private market model approach, by itself, is insufficient. Europe already has taken the lead in the global aerospace industry, and Japan dominates the electronics market worldwide. *Id.*

153 CLINTON & GORE, *supra* note 5, at 17.

154 15 U.S.C. §§ 5501-5503, 5511-5512, 5524-5528 (1992). This Act was sponsored by former Senator Albert Gore. *Id.*

155 *Id.*

156 *Id.* tit. II, § 201.

157 CLINTON & GORE, *supra* note 5, at 31.

widespread appeal, it is not a realistic one.[158] Labor experts predict that maintaining the absolute number of U.S. jobs in manufacturing will be the best the country can expect.[159] It is predicted that the manufacturing industry will employ less than 15% of the workforce by 2005, representing a reduction from current levels of almost 20% employed today.[160] Approximately 67 million new jobs have been created in the United States since World War II, and nearly all of them have been in the service sector.[161]

C. *Linking Science & Technology to Societal Goals*

According to the Carnegie Commission on Science, Technology and Government, in order to redefine the nation's technology policy, it is crucial that a number of groups join in the public policymaking process, including government, industry, universities and nongovernmental organizations.[162] Closing the gap between the research community and policymakers, the Carnegie Commission argues, is imperative to ensure that the United States is indeed able to make economic and technological competitiveness a national priority.[163] To realize this goal, the Commission has recommended that the federal government's science and technology policies be rooted in long-range goals that are linked to societal benefits, with cost-benefit assessments woven into the process, rather than in short-term goals, which have been the practice.[164] Tradeoffs will be required as public demand for greater long-term societal goals increases, but not all tradeoffs have to result in

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158 Sylvia Nasar, *Clinton Job Plan in Manufacturing Meets Skepticism*, N.Y. TIMES, Dec. 27, 1992, at 1.

159 *Id.* (statement of Richard Freeman, a labor economist at Harvard University).

160 *Id.* Industrial production is expected to continue to grow; however, efficiencies created by industrial automation mean that manufacturers can produce more goods with a smaller workforce. *Id.*

161 *Id.* at 28. Economists argue that the comparative advantage America should be striving for is a better trained, better educated workforce. *Id.*

162 *Enabling the Future: Linking Science and Technology to Societal Goals*, SCI. AND TECH. IN CONG. (Carnegie Comm'n on Science, Technology & Gov't., Wash., D.C., Sept. 1992, at 13 [hereinafter *Linking Science*]. The Commission recommends that a nongovernmental National Forum on Science and Technology Policy Goals be established to accomplish this objective. *Id.*

163 *Id.*

164 *Id.* at 20, 24. Moving from a military-based research effort to a civilian one requires the ability to plan for long-range efforts that have a beneficial impact on society's infrastructural, environmental and health concerns. *Id.* at 24.

harm.[165] A classic example is the application of technological advancements used to ameliorate environmental pollution, wherein environmental progress actually can enhance economic development.[166]

However, one particular concern that Congress has articulated is the problem of academic pork:[167] ten states were the recipients of about half of all federal research and development appropriations during the last decade, reflecting a preference for those represented on congressional appropriations committees.[168] According to Lewis Branscomb, Harvard professor of public policy and former chief scientist at IBM, Congress and the public should be far more cautious about the nature of large-scale, government-funded technology projects, and should seek to incorporate effective means of comparing the relative merits of big projects, as well as encouraging international collaboration where appropriate to reduce costs.[169] In many of the large R&D projects undertaken since the 1970s, scientific and technical performance goals were discarded once political and financial decisions were made, thus fueling technology "pork barrel" politics.[170] According to the finding of a congressional task force, one vehicle that could provide greater assistance in developing and monitoring science and technology policy is the Office of Science and Technology Policy (OSTP), in conjunction with the Federal Coordinating Council on Science, Engineering, and Technology (FCCSET).[171] However, for much of the last fifteen years since its inception, OSTP has not been assigned a leadership position in the executive branch.[172]

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165 *Id.* at 25.

166 *Id.*

167 Federal funding of university grants earmarked for specific universities in congressional districts is termed "academic pork." *See Clinton Clears Way for Academic Pork Roast*, 260 SCI. 883, 883 (May 14, 1993).

168 The 10 states are: Massachusetts, Oregon, Pennsylvania, Louisiana, New York, Florida, Iowa, West Virginia, Alaska and Mississippi. Representative Brown discerned that approximately $2.5 billion appropriated for R&D purposes during the last decade was associated with no clear rationale. Eliot Marshall, *George Brown Cuts Into Academic Pork*, 258 SCI. 22, 22 (Oct. 2, 1992).

169 *See supra* note 63, at 11 (testimony of Lewis Branscomb).

170 Lewis M. Branscomb, *Does America Need a Technology Policy?*, HARV. BUS. REV., Mar./Apr. 1992, at 4.

171 CHAIRMAN'S REPORT, *supra* note 44, at 14. *See also* Goodwin, *supra* note 149, regarding the emergence of a new presidential National Science and Technology Council.

172 *Id. See also* Gene Koprowski, *Vote Nearing on House Competitiveness Bill*, NEW TECH.

1. New Directions for the NSF

Many scientists worry that the recent emphasis on advanced manufacturing strategies promulgated by The National Competitiveness Act will consume research dollars needed to support a solid, basic science program, the fundamental underpinning from which technological advancements spring.[173] Dr. Vannevar Bush, the leading proponent of a national science policy during the 1940s, argued that basic science is of vital interest to the U.S. government.[174] Dr. Bush's position, widely accepted in government circles for the past forty-five years, was that universities, colleges and research institutes should serve as the centers of basic research.[175] As long as universities were healthy, Dr. Bush reasoned, scientific knowledge eventually would flow to those interested in applying that knowledge to the practical industrial problems of the day.[176]

WK. (King Communications Group, Inc., Wash., D.C.), May 10, 1993, at 4 (quoting a technology policy expert: "OSTP (the White House Office of Science and Technology Policy) is a disaster zone these days. They haven't got enough warm bodies to do the work."). *Id.*

173 Federal funding for basic research experienced a real increase of less than 1% in 1992, far less than the average 3% annual increases since 1982. Kitta MacPherson, *Scientists Welcome Clinton-Gore Interest, Fear Basic Research May Suffer*, STAR-LEDGER (Newark), Jan. 10, 1993, at 23-24. *See also* J. Michael Bishop et al., *Science and the New Administration*, 259 SCI. 444, 444 (Jan. 22, 1993). While opportunities for scientific progress have increased, the infrastructure for science in the United States has eroded in the last decade. *Id.*

174 According to Dr. Bush, "Without scientific progress the national health would deteriorate; without scientific progress we could not hope for improvement in our standard of living or for an increased number of jobs for our citizens; and without scientific progress we could not have maintained our liberties against tyranny." BUSH, *supra* note 25, at 11. *See generally Updating Vannevar Bush: Academy Panel Calls for New Strategy for Science*, PHYSICS TODAY, July 1993, at 67. The Committee on Science, Engineering and Public Policy, representing the National Academy of Sciences, the National Academy of Engineering and the Institute of Medicine, has called for continued strong support for federal R&D funding. The committee contends that public support for R&D eventually leads to improvements in the quality of life, and thus a "renewed and strengthened covenant between science, technology and society" must be developed. *Id.*

175 BUSH, *supra* note 25, at 12.

176 *Id.* The NSF, in reprinting Dr. Bush's book, stated that one of Vannevar Bush's critics was Senator Harley Kilgore, a West Virginia New Deal Democrat, who believed that a national science policy should encompass socially purposeful research, and proposed that a portion of the federal science dollars be apportioned on a geographic basis. *Id.* at xiii. Senator Kilgore emphasized the need for small businesses to reap the benefits from federally funded R&D contracts, as well as large corporations, who

This perspective appears to be under attack, as Congress reconsiders the proper role of federal research and, in particular, the most effective role for the National Science Foundation, America's leading government agency for science policy.[177] Congress is challenging the NSF to refocus its mission to contribute to national goals by closely tying its research efforts to applied problems.[178] President Clinton is aware of the importance of preserving the nation's lead in science, and has made efforts in his budget proposal to restore federal funding to NSF's core basic research program, which had been cut by the 102d Congress.[179] Science proponents argue that the social rate of return on society's investment in fundamental science—or that from which society benefits—is approximately 28%, which is considered a very impressive, yet conservative figure.[180] In addition, technological innovations are estimated to yield anywhere from 44% to 77% of society's rise in productivity.[181] Nonetheless, the modified focus of the NSF, as the result of the National Competitiveness Act, would place greater emphasis on using NSF resources to drive technology transfer efforts, rather than promoting the agency's traditional successes—discoveries in basic science.[182]

2. A Debate on Science & Technology Policy

The open debate on the House version[183] regarding science policy is a phenomenon that has not occurred for twelve years. This has paved the way for a broader discussion on the priorities and agenda for science.[184] Such a forum increases the ability of

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often were granted patents from discoveries originating from publicly funded research. *Id.*

177 *See* CHAIRMAN'S REPORT, *supra* note 44, at 2-3.

178 *See National Competitiveness Bill, supra* note 57. The NSF is expected to receive approximately $50 million to increase the number of engineering research centers and to expand industry/university collaborations. *Id.*

179 *See supra* note 132.

180 *See Subcommittee Hearing, supra* note 61, at 212 (testimony of Frank Press, former president, National Academy of Sciences).

181 *Id.*

182 *See* Hamilton, *supra* note 11, at 1076.

183 Representative Walker, an outspoken critic of H.R. 820, believes the bill's effect simply would be to provide subsidies to technology companies. The Citizens Against Government Waste and the National Taxpayers Union also oppose the bill. *See* Koprowski, *supra* note 172.

184 *See supra* note 61.

Congress to allot federal funding toward research that contributes to the nation's welfare.[185] There is growing friction between the expectations of the research community and the governmental direction of policymakers, who are urging that interdisciplinary approaches to federal research be undertaken to solve fundamental problems now facing our society,[186] including such issues as energy security, high technology manufacturing and environmental protection.[187]

Another political consensus that has emerged from the debate is that federal funding of research and development alone, without the requisite initiatives to guarantee successes in technology transfer, is insufficient to ensure economic growth.[188] As a result, there is presently strong support for a science and technology policy that meets America's changing national needs, employing a new interdisciplinary paradigm rather than the traditionally disciplined approaches of the past.[189] The difficulty in successfully implementing this approach, however, is inherent in the nature of science itself, which often involves a process of unexpectedly uncovering new insights that further continue the discovery process.[190]

The Carnegie Commission has warned that the United States, in setting its long-range technological goals, must allow basic science to continue to prosper, as current gaps in the support for fundamental science can lead to detrimental effects years later.[191]

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185 Mark Crawford, *Brown: Management of R&D Must Change*, NEW TECH. WK. (King Communications Group, Inc., Wash., D.C.), Sept. 14, 1992, at 1-2 (citing CHAIRMAN'S REPORT, *supra* note 44).

186 CHAIRMAN'S REPORT, *supra* note 44, at 5.

187 *Id.* at 1.

188 *Id.* at 6. The breakdown of federal civilian R&D funding is as follows: 38% to universities; 28% to federal laboratories; 11% to industry; and 10% to university national laboratories. *Id.* at 7. According to Rep. Brown, "there is a growing perception that federally funded research is not contributing enough to economic competitiveness, human health and environmental protection, both basic and applied." *Id.* at 11. "The Committee may wish to consider fundamental reformulation of science policy principles, with the view toward exploiting research as a tool designed to achieve national goals, rather than as a black box into which federal funds are deposited, and from which social benefit is somehow derived." *Id.* at 10.

189 *Id.* at 5.

190 *See Linking Science, supra* note 162, at 28. *See also* VANNEVAR BUSH, ENDLESS HORIZONS 52 (1946) ("further progress of industrial development would eventually stagnate if basic scientific research were long neglected. . . . Many of the most important discoveries have come as a result of experiments undertaken with very different purposes in mind.").

191 *Linking Science, supra* note 162, at 28-29. National science goals are very differ-

The budget for NSF in 1993 was $2.73 billion, reflecting a 6% increase over the prior year; however, $13 million was cut from actual research-related activities, such as principal investigator award funding, the major component of the nation's basic science research efforts.[192] Congress reduced NSF's core program, despite the widely held belief among academics that government support of principal investigators has been highly successful and, in many cases, has lead to breakthroughs that have transformed entire industries.[193]

The NIH also has been affected by the recent shift in Congressional thinking, leaving the federal health agency to contend with a shrinking budget.[194] With congressionally favored projects taken into account, NIH officials argue that the core basic research efforts will experience a one percent reduction in 1994.[195] Critics of the new change in funding direction warn that failure to emphasize basic research will lead to sacrificing the country's future for its present.[196]

3. New Jersey's Technology Initiative

The state governments are essential to the federal govern-

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ent from national technology goals. Technology goals focus on clearly articulated social purposes, while science goals are exploratory, multipurpose and often provide the initial knowledge base required to pursue technological goals. The dynamic relationship between the two requires that collaboration occur within both sets of policy goals. *Id.* *See* Eliot Marshall, *NSF: Being Blown Off Course?* 258 SCI. 880, 880 (Nov. 6, 1992). The NSF received an onslaught of letters from the research community in an effort to address the new government mandate requiring science to meet national goals. To the horror of basic researchers, Sen. Barbara Mikulski, chair of the appropriations subcommittee that funds NSF, recommended that the NSF focus its work on applied research. *Id.*

192 Eliot Marshall & David P. Hamilton, *R&D Budget Collides with the Deficit*, 258 SCI. 208, 208-209 (Oct. 9, 1992). The $13 million budget cut, a 1% decrease, is viewed by basic scientists as detrimental to the advancement of science in the future. *Id.*

193 Ralph Gomory, *Goals for the Federal Role in Science and Technology*, PHYSICS TODAY, May 1993, at 42-43. Examples include remarkable devices such as the transistor, which revolutionized the electronics and computer industries, as well as achievements in molecular biology, which led to advances in medicine. *Id.* at 43.

194 Christopher Anderson, *Healy Slams Clinton's NIH Budget*, 260 SCI. 1067, 1067 (May 21, 1993). The annual budget for NIH in 1993 was more than $10 billion; however, less than 2% was allocated to basic medical research. *See* Bishop et al., *supra* note 173.

195 *See* Anderson, *supra* note 194.

196 Jon Cohen, *NIH: Glossy Strategic Plan Hits the Streets*, 260 SCI. 888, 888 (May 14, 1993).

ment's success in creating and implementing a national technology policy.[197] Historically, state governments have participated actively in national concerns such as education, agriculture and transportation.[198] According to the Carnegie Commission on Science, Technology, and Government, the federal government should play a limited role in deciding exactly how interregional collaborations should be established, letting states determine how best to use their own resources and expertise.[199] Setting long-range science and technology goals to meet the needs of the nation will undoubtedly require the representation of states.[200]

In particular, New Jersey has engaged in technology initiatives to address the competitiveness issue through the New Jersey Commission on Science and Technology, which was created in 1985[201] and is viewed as an appropriate model for larger joint efforts.[202] The research initiative—spawning state government and industry cooperation—has begun to pay dividends to the state of New Jersey after almost a decade.[203] The Commission has allocated more than $1.44 million in 1993 for an Enhanced Technology Transfer Program toward the distribution of grants to encourage closer ties between business and research, with work being conducted at a total of sixteen research and extension centers in New Jersey.[204] The four primary areas of emphasis for the academia/industry collabo-

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197 CARNEGIE COMM'N ON SCIENCE, TECHNOLOGY & GOV'T, SCIENCE, TECHNOLOGY, AND THE STATES IN AMERICA'S THIRD CENTURY 21 (Wash. D.C., Sept. 1992). *See Linking Science, supra* note 162, at 35. State governments have been involved in establishing science and technology efforts since the mid-19th century, culminating in a major debate during the 1940s. Almost all states have science and technology advisors or economic development programs focusing on the subject. *Id.*

198 CARNEGIE COMM'N ON SCIENCE, TECHNOLOGY & GOV'T, *supra* note 197, at 21.

199 *Technology Transfer: Federal-State Collaboration on Industrial Extension Projects,* SCI. AND TECH. IN CONG. (Carnegie Comm'n on Science, Technology & Gov't, Wash., D.C.), Jan./Feb. 1993, at 3, 15.

200 *See* UNITED STATES OFFICE OF SCIENCE & TECHNOLOGY POLICY, U.S. TECHNOLOGY POLICY: EXECUTIVE OFFICE OF THE PRESIDENT, *supra* note 53, at 6. *See also* CARNEGIE COMM'N ON SCIENCE, TECHNOLOGY & GOV'T, *supra* note 197, at 51. The Carnegie Commission estimates that together, all 50 states spend approximately $2 billion on industrial cost-sharing, as well as on science and technology programs. *Id.*

201 *See* N.J. STAT. ANN. §§ 52: 9X-1 to -10 (West 1985) (enabling legislation for the Commission on Science and Technology).

202 MacPherson, *supra* note 173 (quoting William Baker, vice chairman of the Commission).

203 *Id.* at 24.

204 NEW JERSEY COMM'N ON SCIENCE AND TECHNOLOGY, TRANSFERING TECHNOLOGY, ANNUAL REPORT 2-3 (1992).

rations are advanced materials, biotechnology, information systems and environmental protection technologies.[205] Overall, $37 million is generated in private and federal non-state grants and $15 million in grants from state appropriations, serving 800 participating firms, the majority of which are New Jersey-based.[206]

The state also is taking advantage of the federal Small Business Innovation Research (SBIR) program, a highly successful federal initiative that enables small start-up businesses to market new technologies.[207] Since 1988, the state's funding from SBIR has increased from $5.5 million to $13 million in 1991.[208] The federal government established another program in 1992 to complement the SBIR program called the Small Business Technology Transfer Program, which encourages small businesses to move promising technologies from laboratories and universities to the marketplace.[209] Five federal agencies are involved in the program.[210]

Ranking tenth among all fifty states in Department of Defense military spending, New Jersey has been affected to a greater degree than many other states by the economic changes resulting from the end of the Cold War.[211] Former Governor Florio established the Commission on Defense Conversion and Community Assistance to coordinate state initiatives that would help defense companies and affected communities in converting to civilian-

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205 *Id.* at 3.

206 *Id.* The Commission also sponsors a Venture Development Program, with $600,000 in funding, to help burgeoning technology companies receive federal dollars for their start-up ventures. *Id.* at 20.

207 *Id.* at 21.

208 *Id.*

209 *See 1993 House Small Business Hearings, supra* note 4, at 6.

210 The five federal agencies involved in the SBTTR program are: the NSF, NASA, the Department of Defense, the Department of Energy, and the Department of Health and Human Services. *Id.*

211 Bill Gannon, *Jersey Faces Challenge of U.S. Military Cuts*, STAR-LEDGER (Newark), Mar. 28, 1993, at 1, 24. New Jersey's dependence on the defense industry has been a contributing factor with respect to the state's difficulties in battling the recession. New Jersey has experienced a 30% decline since 1988 in the number of defense-related companies, compared to an 8% national decline. A study by the Defense Budget Project has predicted the 30% decline as the military budget continues to be pared well into the future. *Id.* A steady erosion of jobs in New Jersey's manufacturing sector has been especially prominent in the last decade. Even more disturbing, the situation since 1988 has become acute with the loss of 150,000 jobs, one of the worst records in the nation. Joe Donahue & Rudy Larini, *State's Economic Growth Fails to Stem Job Loss*, STAR-LEDGER (Newark), May 16, 1993, at 1, 26 (statistics provided by Samuel Ehrenhalt, New York regional Commissioner of the U.S. Bureau of Labor Statistics).

military dual-use technologies.[212]

New Jersey's statistics reveal a gradual decline in manufacturing in the state for the past thirty years, and thus mirror the national trend.[213] However, with a high concentration of research and development firms in the state, New Jersey is well positioned for future growth, especially for small businesses, in the export, high technology, information and medical products industries.[214]

V. Conclusion

Congress is placing a new focus on science and technology policy as a means to address some of the more persistent social problems of our time, including issues of human health, the environment, and America's declining standard of living. The National Competitiveness Act, with its proposed appropriations mark ranging between $1.5 billion and $1.9 billion, certainly cannot address all of these issues. It can, however, be the catalyst to force a change in the way Americans view, and value, science and technology in our society. The focus of this legislation, advanced manufacturing technologies, speaks to only a portion of the economic problems America is facing today. The U.S. manufacturing sector has been declining for decades, and many believe that the trend will continue. Nonetheless, a better educated workforce capable of developing and using modern technologies in communications, medicine and the environment, in order to improve daily life, is mandatory if America is to reverse the trend of a declining standard of living.

The emergence of the post-Cold War economy has altered dramatically the opportunities and challenges for all Americans, and substantial changes must occur before the United States can successfully adapt to a knowledge-based economy oriented toward both civilian and military research and technology. The need for

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212 Gannon, *supra* note 211, at 1. The process is expected to be painful, former Commerce Commissioner Barbara McConnell noted, because there are insufficient jobs available on a national level to counter the effects of massive base closings and realignments. *Id.*

213 John Harding, *New Jersey's Business Retention Program Criticized by Banker*, STAR-LEDGER (Newark), Jan. 10, 1993, at 5. According to the New Jersey Department of Commerce and Economic Development, it is unlikely this trend would be reversed in the short term. Donohue & Larini, *supra* note 211.

214 Alexander Milch, *McConnell Underlines Importance of Small Business to State Economy*, STAR-LEDGER (Newark), May 2, 1992, at 5.

basic research, as the Clinton Administration has cautioned, will continue to exist, regardless of the shift in emphasis from a defense-related to a civilian-based economy. Congress is expanding its expertise and authority by grappling with the difficulties associated with technological advancements. In particular, Congress is resolute in its goal to exploit technological advances to meet societal needs. While the specific means of ultimately realizing this goal have yet to be delineated, a new strategy to direct national science and technology appears to be taking hold. As this national technology policy continues to emerge, the relationship between the federal and state governments will be crucial to ensure efficient, cost-effective allocation of funding, as well as implementation and evaluation of technology initiatives, all dedicated toward successful technology transfer in the United States.