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ABSTRACT

This is the executive summary for "The Role of Science and Technology in Economic Competitiveness," (1987) based on a national survey on competitiveness. The study focused on three primary topics: the adequacy of human resources and its relationship to human ability to compete; investment in research and development; and technology transfer, i.e., the ability to transform research findings into new products and processes. The study participants identified a number of areas for improvement. These include science and mathematics education, university/industry cooperative ventures, and greater commercialization of research findings. The study also revealed, however, that much of the change that must occur is long-term in nature. (YP)

# EXECUTIVE SUMMARY



# *The Role of Science and Technology in Economic Competitiveness*



**prepared by**

**National Governors' Association**
**Center for Policy Research**

**The Conference Board**

**with support and participation of the**
**National Science Foundation**

The most demanding challenge facing America's leadership today is to restore this country's competitive position in the global marketplace. The pattern of the last fifteen years – slowing productivity growth combined with growing competition from foreign producers – has led to record trade deficits, a decline in real earnings of American workers, and a stagnant standard of living. While there are many reasons for the erosion of the U.S. competitive position, there is a growing national consensus regarding the underpinnings of competitiveness. One area of consensus is that U.S. investments in research and education will be critical in the long-term as the United States seeks to maintain and improve its competitive position in the world economy.

In an effort to assess the health of the U.S. research system, The Conference Board and the National Governors' Association, with the support and participation of the National Science Foundation, undertook a joint project. The project solicited the views of the nation's Governors, senior officers of U.S. companies, and presidents and deans of U.S. colleges and universities on the relationship of U.S. competitiveness to our human resource base and research and development capacity. The views of these key leaders were obtained through a survey and three regional meetings held in April, 1987.

The study focused on three primary topics: the adequacy of our human resources and their relationship to our ability to compete; U.S. investment in research and development; and technology transfer, i.e., the ability to transform research findings into new products and processes.

## Marshalling Human Resources

Education was viewed by all three groups – business, academic, and government – as the key to the nation's competitiveness. While recognizing that one of the competitive strengths of the United States has been its human resources, the participants expressed concern regarding the quality of science, engineering, and mathematics education today. Although this concern applied to all levels of education, greatest concern focused on the K-12 level.

At the university level, attention focused on the need for state-of-the-art facilities and equipment. Both business and state government officers supported the view of university officials that investment is sorely needed in laboratory instruments and buildings. There was less concern with the quality of undergraduate instruction than the preparation of undergraduate students in the sciences and mathematics, and concern was expressed regarding the ability of colleges and universities to continue to attract and retain qualified faculty.

Business executives emphasized the need for high-level technical training, continuing education, and job retraining. Pointing out that workers at every level can no longer expect to graduate from school with a skill that will last a lifetime, the business respondents emphasized the importance of maintaining a flexible workforce. While university officials agreed with this assessment, opinion was divided with regard to whether industries, community colleges, or universities should have responsibility for providing continuing education and training.

Participants recommended that science and mathematics education be improved by:

- Improving the quality and quantity of teachers at the K-12 level through the use of scholarships, grants, and loans.
- Changing certification requirements to allow engineers, physicists, and mathematicians to become certified to teach in the K-12 grades.
- Providing specialized school settings that emphasize math and science.
- Increasing the involvement of the business community in K-12 education.
- Generating greater corporate support for universities by participating in student cooperative programs providing staff members to act as adjunct faculty, and donating funds and equipment to university laboratories.

## Investing in Research and Development

With regard to U.S. investment in research and development, over half the respondents believed that increased support for civilian basic research is critical to the future competitiveness of the U.S. economy. There was some debate on whether or not the nation's current defense buildup might be draining scientists and engineers from the civilian sector, and whether this drain has an impact on the nation's competitiveness. A majority of those who expressed themselves on this issue thought that this trend was having a distinctly negative, if unmeasured, impact on America's ability to remain competitive in the civilian goods sectors. The survey respondents, however, did not believe that the concentration of research and development resources in the defense sector was a critical issue affecting competitiveness.

An interesting difference emerged from the survey in how much importance university officials placed on research and development resources as an issue affecting U.S. competitiveness as opposed to the competitiveness of their university. When asked to rank six major issue areas – human resources, research and development resources, fiscal and monetary policy, federal regulatory policy, and technology transfer – the university respondents ranked research and development resources first in terms of its impact on the university's competitiveness but sixth in terms of its impact on the nation's competitiveness. Business and state officials both ranked research and development resources as third in importance in regard to the nation's competitiveness.

The study participants agreed that in order to meet the challenge of economic competitiveness, the United States as a nation must not only make a commitment to its research system, but redefine the relationship between government, universities, and businesses in the conduct of research and the use of research findings. The study focused specifically on the new industry university research partnerships being created and sought to answer the following questions: What is the level of commitment on the part of both businesses and universities to these new partnerships? How effective do the respondents feel these joint efforts have been? What obstacles have been encountered in implementing university/industry programs? What steps could be taken to improve such partnership arrangements? What is the opinion of business and university leaders regarding state efforts to promote partnerships?

The concept of university/industry research partnerships and state efforts to promote such partnerships generally received high marks, but the study participants outlined a number of difficulties in their implementation. Both business and university officials stressed the need for greater corporate involvement. Industry, they indicated, is not committing its "best and brightest" scientists and engineers to these joint ventures. Some university officials also expressed reservations regarding the expectations being placed on these new partnerships to produce short-term economic development results.

There was general agreement that the new university/industry partnerships are experimental and that there is a need to monitor the outcomes of these efforts and assess their effectiveness.

In spite of business' support for industry/university partnerships, slightly more than half of the business respondents did not believe that cooperative research among industries and universities would have a critical impact on U.S. competitiveness and even fewer, approximately one-quarter, believed it would have a critical impact on the competitiveness of their firm. In contrast, over 80 percent of the state officials and two-thirds of the university respondents believed that cooperative research among industry and universities will have a critical impact on U.S. competitiveness.

Measures suggested for encouraging the growth of university/industry cooperative research include:

- Modification of existing anti-trust restrictions to encourage research and development joint ventures.
- Expansion of the number of technology centers.
- Provision of direct federal financial support for certain industry university partnerships.
- Establishment of multi-industry, multi-disciplinary research parks.
- Alteration of laws to allow faculty members to take equity positions in research and development joint ventures.
- Development of uniform terms and contracts for joint ventures.

## Creating an Innovative Environment: Getting Ideas to Marketplace

The final issue examined was technology transfer, the ability to apply new research findings in the marketplace. Business respondents do not believe technology transfer to be a critical issue affecting the nation's competitiveness. A review of the survey responses, however, indicates that

the term technology transfer covers a wide array of issues some of which were identified as areas of serious concern. One such issue, for example, was the excess time lag in the commercialization of technology by business. Several meeting participants argued that the United States has not had a significant problem with commercialization – that is, bringing a product to market – but that it has experienced problems involving production and marketing, i.e., being able to produce a high-quality product at a competitive price.

Respondents from all three sectors believe that business' lack of long-term goals and vision has hindered the commercialization of U.S. technology. The business community was faulted, by its own representatives, for lack of patience, and for focusing on the next quarter's profits rather than the potential payoff from long-term investments in product development.

With regard to state programs, the business and university officials indicated a greater awareness and use of the programs that support research and development rather than those designed to assist in commercialization. The fact that business officials exhibited less interest in commercialization assistance programs may reflect the fact that the majority of the business respondents represent large firms, firms which have access to in-house technical expertise. A breakdown by size of firm shows that smaller companies did, in fact, show a greater degree of interest in the state commercialization assistance programs.

Specific suggestions for improving commercialization include:

- Development of more accurate indicators of technology transfer so that U.S. strategists have a better grasp of the dimensions of this problem.
- Increased interaction between technologists at primary manufacturing firms and those in supplier firms.
- Development of a cadre of technology transfer agents or mechanisms that will permit entrepreneurs to acquire and commercialize technology discoveries unused by either major laboratories or university research centers.
- Provision of specialized advice and technical support for small firms seeking to commercialize leading-edge technologies.

## Conclusion

The industry, university, and government leaders participating in the study agreed that science and engineering research and education have in the past, and will continue in the future, to play a crucial role in determining U.S. competitiveness. They further agreed that for the most part, the United States has a healthy and vibrant research and education system. Yet to maintain its competitive position and retain its technological leadership in the face of increased investment in research and education by our foreign competitors, the United States must continue to increase its investment in these areas.

The study participants identified a number of areas for improvement. These include science and mathematics education, university/industry cooperative ventures, and greater commercialization of research findings. The study also revealed, however, that much of the change that must occur is long-term in nature. Demographic factors and the increasingly technological nature of the modern economy, for example, will require a long-term perspective of our human resource needs, with greater emphasis on life-long education and retraining. In addition, changes in the nature and conduct of research are requiring universities, industry, and government to change the way they operate and how they relate to each other. Such changes will not be achieved overnight.

In addition to determining the views of business, state government, and university officials on research, education, and competitiveness, the study raised a number of issues that merit further consideration. First, what actions should be taken to improve science and mathematics at the primary and secondary school levels? Second, demographic changes and a decline in the number of American students pursuing science and engineering degrees will necessitate increased involvement of women and minorities in science and engineering. How is this to be achieved? Third, how can long time lags in the commercialization process be reduced? Fourth, university industry partnerships should be evaluated and their performance tracked over time. By what criteria do we judge their performance and their contribution to the generation and transfer of knowledge?

Lastly, future partnerships require redefinition. What is the relationship between state initiatives and federal efforts regarding research and development? Are state/federal partnerships needed, and if so, how should they be structured? How would a restructuring affect the private sector and the academic community? These are questions that should be addressed if the United States is to meet the growing economic challenge.

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Any opinions, findings, and conclusions or recommendations expressed in this publication are those of the authors and do not necessarily reflect the views of the National Science Foundation, The Conference Board, or the National Governor's Association, or its members.

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