

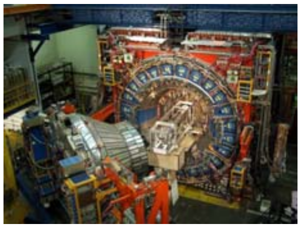


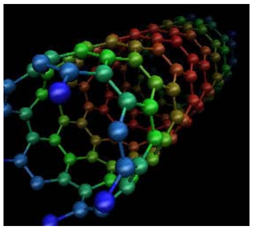

ENGINEERING AMERICA'S FUTURE
Economic Growth Through Technological Innovation

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GOVERNMENT RELATIONS
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INTRODUCTION

Economic prosperity and growth in the global age is at root a story of technological innovation. Various economic analyses ascribe up to 80% of economic growth in the industrial era to technological advancements. Innovation allows us to make continual improvements in our quality of life and maximize the productivity of our citizens. It also enhances our ability to identify and collect scarce resources and use them efficiently, and to optimize our adverse impact on the earth and its environment. Appropriately directed, technological advancements can also be delivered to the benefit of the global community and can be a driver for national security.

The emergence of the United States in the 20th century as the preeminent world economic power was largely attributed to the country's stable political system, vast natural and human resources, and agricultural, manufacturing and engineering prowess. Underlying all of this has been an unceasing capacity for innovation. This innovation made possible remarkable productivity gains in agriculture. Beginning in the 19th century, the development and dissemination of science-based best practices in agriculture allowed the nation's growing food needs to be met by ever-smaller numbers of farm workers. This improvement in farm labor productivity enabled people to focus on producing in other markets. Today this manifests itself in our ability to engineer new technologies in areas such as life sciences, environmental sciences, energy, advanced manufacturing and information technology, which define our quality of life and will be crucial to economic growth and prosperity in a global economy.

RECOMMENDATIONS

Private enterprise will continue to take the lead in technological and engineering innovation, particularly regarding commercialization of new ideas and technologies. The government plays a role through the promulgation of policies that encourage innovation. These policies must be mindful of the long-term, capital-intensive nature of engineering and basic science innovation, recognize the interdisciplinary nature of R&D and understand the need to bridge different funding paths for technology transition. These policies should encourage a regulatory environment for the transfer of research results to application developers and for ease of commercialization. The goal of these policies should support the development and sustenance of a well-educated, technically sophisticated workforce that is sufficiently agile to respond to rapid developments in technology.

Specific recommendations are:

1. Ensure substantial public investment in science-based engineering research that recognizes the interdisciplinary nature of innovation.

Federal funding is crucial to the nation's R&D enterprise. This funding encompasses both publicly supported laboratories operated directly by federal agencies, as well as grants to non-profit research-performing organizations such as universities and research institutions. In particular basic research, which is defined as that work that is not directly motivated by specific applications, is almost exclusively the domain of government support. The divide between basic research and applications means that there can only be limited assurances that commercial applications will result even from successful research projects. In most cases, private enterprises cannot justify investments in research for which the promise of revenue-generating applications is not imminent. In such areas only a shared investment in the precompetitive Science and Technology realm will allow the market to develop. Leadership by the federal government through its investment is a critical component of this enterprise.

Federal research funding should be balanced between biology and the life sciences, where funding generally is largely provided by the National Institutes of Health (NIH), and engineering and the physical sciences, where funding is provided by the Department of Defense (DoD), Department of Energy (DoE), Department of Commerce, National Aeronautics and Space Administration (NASA), or the National Science Foundation (NSF). A balanced federal research portfolio is especially vital to emerging technical areas, which may be highly interdisciplinary and may require distinctly different funding avenues. Balancing the federal investment in multiple fields will foster a knowledge base and capability in multiple research areas.

Federally funded research also supports graduate education. A large percentage of doctoral degree recipients in engineering and science are supported in part by federal funds. These degree recipients go on to play key roles not only in carrying out research, but in training successive generations of engineers and scientists.

The federal government should consider an investment balance that:

- Ensures long-term commitments to science and engineering research by devoting a

fixed amount of more than 3% of the total U.S. gross domestic product (GDP) to research and development or a fixed percentage of the federal revenues.
- Continues to support robust investments in basic research for the National Science Foundation, the Department of Energy's Office of Science, the National Institute of Standards and Technology, and the Department of Defense, which supports high risk, but high reward projects.
- Pursues a balanced portfolio of research in physical sciences, engineering, and life sciences, with commitment to the research activity supported by all agencies. This balance should be coordinated through government investment priorities and shared research areas among multiple agencies. Research into focus areas where multiple agency missions benefit should be high in that priority.

2. Establish policies that encourage private investment in R&D, including basic research.

The private sector accounts for an estimated two-thirds of all R&D spending in the U.S. This private R&D effort is focused on development and applications. The federal government has been the primary source of basic research funding in the U.S. for the last century. In order for technology to drive our economic growth in the future, incentives such as R&D tax credits that are dependable and not year to year must be provided.

The role of intellectual property protections in encouraging private R&D investment should also be strengthened and enforced. Such protections, which have both domestic and international implications, can provide strong financial incentives to undertake fundamental R&D by increasing the likely investment return.

The federal government should:

- Maintain the permanence of the R&D tax credit.
- Protect intellectual property and copyright.

3. Enact measures to strengthen partnerships between R&D performers and users.

While it is primarily private industry that innovates through transforming knowledge into new products and services, industry depends heavily on government-funded basic research. The task of transitioning basic research has long been identified as a major obstacle in the R&D pathway.

Partnerships between industry and academic or other research institutions allow industry to be better informed about recent research advances, while allowing the performers of basic research in turn to be cognizant of the needs of industry. Planning and coordination is essential for optimal performance of these partnerships. Federal agencies have long and valuable experience in interacting with industry, academic institutions, and research institutions, and benefit from expanded partnership efforts.

Accordingly, the federal government should:

- Strengthen industry/academic/government partnerships to facilitate the flow of ideas between these parties.
- Stipulate communication on technology transition between parties as conditions of research grants both on the basic research side and the application and development side.
- Support partnerships involving competitive programs that are both cost-shared and merit-reviewed.
- Invest in partnerships that apply commercial technologies to meet government needs in areas such as energy, advanced manufacturing, defense, intelligence, transportation, space, education, and the environment.

4. Promote a system of standards and conformity assessment procedures that facilitates the transfer and commercialization of innovative technical advances.

The globalization of business, the rapid implementation of new technology, and the economic and technological convergence of markets are significantly changing the dynamics of global competition – particularly with respect to the areas of energy and workforce development. As a result, the influence of international product standardization and conformity assessment procedures on the marketability of U.S. products and services abroad is becoming increasingly important. The significance of supporting sound standardization policy is underscored by the U.S. Department of Commerce estimate that standards affect 80% of world commodity trade.

U.S. international trade policies and the bilateral and multilateral agreements designed to harmonize standardization systems are intended to ensure fair and equitable cross border commerce among the signatory nations to these agreements. Intra-national technical standards and conformity assessment systems should not be used by some countries as an exclusionary tool to inhibit extra-national competition. Preservation of U.S. market access for innovative technology developments will require due diligence by both government and the private sector on the evolving state of international standards practices.

To enhance the commercialization opportunities for new technologies, international standards development and conformity assessment procedures must preserve industry's ability to market products based on those technologies. To accommodate this need, the federal government, through its international trade negotiators and representatives and federal agencies, should:

- Continue to implement provisions of PL 104-113, The Technology Transfer and Advancement Act, to encourage greater use of, and participation in, voluntary consensus standards, accreditation, and conformity assessment programs by government agencies, allowing for increased efficiency, public safety, and reduced costs for taxpayers.
- Support the principles of international standardization including transparency, impartiality and consensus, effectiveness and relevance, and coherence during development, in accordance with the Technical Barriers to Trade (TBT) Agreement.
- Continue to recognize that U.S. domiciled standards-developing organizations produce standards that meet the above criteria, and thus are entitled to favored treatment under the TBT Agreement.
- Support private sector efforts to harmonize requirements among U.S. and international conformity assessment bodies and recognize that harmonization of standards should be addressed on a sectoral basis.
- Protect intellectual property rights in standards.

5. Create initiatives to broaden the science, technology, engineering and mathematics (STEM) pipeline at the university level, and strengthen STEM education in primary and secondary schools.

The U.S. economy relies on the productivity, creativity and entrepreneurship of all U.S. citizens. As the workforce becomes increasingly more global and technology-driven, it is essential that the United States align its K-12 core curriculum to the knowledge and skill requirements of its 21st century workforce.

The number of undergraduate engineering degrees awarded annually by U.S. universities has fallen from its peak in the mid-1980s, even as overall undergraduate enrollments are increasing; in fact, where engineering degrees made up almost 8% of all earned degrees in the mid-1980s, that figure is less than that amount today. The percentage of women earning B.S. degrees in engineering also peaked in 2002 at nearly 21%, but has not reached that level since that time. Increasing the participation of women and minorities is essential for broadening the STEM pipeline.

The lagging performance of U.S. primary and secondary school students on international math and science assessments similarly augurs poorly for our future global competitiveness. It is vitally important to strengthen STEM education at the K-12 levels. This will require a variety of measures, including the recruitment and training of qualified teachers; the development of curricular standards and materials that emphasize creativity, problem-solving, and critical thinking, along with assessments aligned with those standards; and the encouragement of partnerships between public and private stakeholders to bring practical and hands-on STEM experiences to the classroom.

Proper investment in K-12 STEM education aimed both at improving the performance of U.S. students and increasing recruitment to STEM fields will require substantial, rigorous research into best practices. There has historically been a dearth of research in STEM education, meaning that the true nature of deficiencies in STEM education are ill-defined, as are the proposed remedies. For example, it is not well-understood if the lack of diversity among STEM university graduates owes to problems of recruitment and retention at the university level, to inadequate technical preparation at the secondary school level, or to cultural biases at the different levels of education; nor is it understood even if the problems of racial and gender diversity are fundamentally similar. If these issues can be properly defined, it will be essential to evaluate the proper methods for addressing them. These research efforts would naturally be the domain of NSF or the Department of Education.

The federal government should:

- Coordinate federal programs and activities in support of STEM education and require them to develop a STEM education strategic plan to inform coordinated program and budget planning across the agencies.
- Establish and maintain an inventory of federally sponsored STEM education activities, including documentation on program assessments.

- Support rigorous research, through the Department of Education or NSF, aimed at understanding the current deficiencies in STEM education both in the K-12 and the post-secondary levels, and at identifying best practices for addressing those deficiencies.
- Pursue the adoption of aggressive standards and effective assessment for STEM education in K-12, including reward systems to improve recruitment and retention of outstanding teachers.
- Encourage partnerships to involve private organizations in addressing STEM education improvements.
- Leverage programs such as NSF's Broader Impacts Criterion to encourage large-scale, sustained partnerships among higher education institutions, museums, industry, content developers and providers, research laboratories and centers, and elementary, middle, and high schools to deploy the Nation's science assets in ways that engage tomorrow's STEM innovators.
- Encourage mentoring opportunities for students in K-12 and partnerships that engage students and teachers in K-12 in entrepreneurial, innovative environments.
- Strengthen and re-examine oversight of existing legislation and programs aimed specifically at broadening participation by under-represented groups in STEM fields.
- Award grants to colleges and universities to reform undergraduate STEM education in their institutions, and specify that proposals must include evidence of institutional support for, and commitment to, the proposed reform effort.
- Promote the adoption and/or improvement by states of high-quality common standards and assessments in STEM subject areas.

6. Support life-long education initiatives to provide employees and employers with the tools necessary to compete in the global economy.

Continuing education enables the workforce to stay abreast of technological advances, respond to shifting trends, and supports employability. A technically literate workforce is essential for economic growth and prosperity in today's global economy. Continuing education also fosters stability in the population of technical workers. This workforce stability is important in attracting promising students to technical fields, and also in helping to ensure that institutional knowledge is retained and can be imparted to successive generations of workers. Return on investment in continuing education must be measured in the long term rather than the short term. Encouragement of continuing education must combine elements of measure intended to promote employment, R&D investment (including fiscal incentives), and aimed at strengthening STEM education.

The federal government should:

- Strengthen tax incentives for workforce development and continuing education, including at the graduate level, both for employers and employees.
- Support research to identify effective means for maintaining the technical currency of the workforce.

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