

THE LOOMING WORKFORCE CRISIS

Preparing American Workers for 21st Century Competition

Introduction

Over the past year, the state of the economy and American workers has been good. Since mid-2004, the economy has grown by a solid 3.6 percent and has created 2.1 million new jobs. A record 134 million Americans are employed in the nonfarm economy and the unemployment rate currently stands at 5 percent — the lowest level since September 2001. At the same time total worker compensation has increased more than inflation.

After losing 3 million factory jobs over 43 consecutive months, down to a level of 14.3 million in February 2004, manufacturing employment has stabilized – edging down only slightly during the past 18 months. Productivity growth has been a key factor in keeping manufacturing employment essentially level. While the pace of production has averaged healthy 4.2 percent growth since the first quarter of 2004, productivity has grown an even more impressive 4.9 percent. At the same time, hourly compensation in manufacturing adjusted for inflation has risen by 5.6 percent in the past year compared to the solid 3.6 percent rise in real compensation in the overall nonfarm economy.

These statistics accurately portray a growing U.S. economy steaming steadily ahead. Yet below the seemingly calm surface an undercurrent of uncertainty is roiling the emotional waters for American workers. Rapid changes in technology and intense global competition — particularly from Asia — have fomented a gnawing anxiety about the future. If we are to alleviate this anxiety, keep our economy strong and successfully compete in the fiercely competitive international race to the top, we must recommit our nation to innovation and the concerted development of a more highly educated and skilled workforce.

Section I. New Economic Paradigm Demands Better Educated, Trained Workforce

Indeed, the world has changed over the past decade. In 1993, the United States alone accounted for 29 percent of global production.¹ The 10 largest economies accounted for three-quarters of the world economic output and, among these top-ten, the only developing nations, Brazil and India, ranked 9 and 10, respectively. Fast forward

¹ 1993 CIA World Factbook

ten years to 2003: the United States remained the largest economy, but its share of global output had fallen to 21 percent. The 10 largest economies accounted for just two-thirds of the world economy and, with China and Russia supplanting Canada and Spain, just six of the top 10 countries were traditional industrialized democracies. Today the global economy is more competitive across a broader number of nations.

Faster growth in the developing world has spilled over into global trade. Industrialized economies' share of global exports fell from two-thirds in 1994 to 58 percent last year. Exports from developing economies rose from a third to over 40 percent.² Americans, as well as Europeans and other workers in "first" world nations no longer compete simply against one another; they now compete against workers in lesser-developed countries with lower wages and increasing access to modern technology and production techniques. This is particularly true for American manufacturers who account for the bulk of U.S. exports and compete directly with most imports. But this is increasingly true for the service sector, too, as advances in communication technologies continue to shrink our world.

A more integrated global economy, with more import competition and more export opportunities, offers both new challenges and opportunities to the United States and its workforce. To succeed, it is essential that the U.S. maintain its position as the world's leading innovator.

Looking back over the 20th century, American ingenuity has been truly incredible. From Ford's Model T in 1908 and on to the washing machine (1911), refrigerator (1924), microwave oven (1953), modem (1958), hand-held calculator (1967) and the personal computer (1981), American innovations have transformed our nation, again and again, creating whole new industries and occupations. Going forward, new innovations will continue to be critical, both in maintaining a solid industrial base and increasing our standard of living. In short:

- 1) Innovation leads to new products and processes that sustain our industrial base.
- 2) Innovation depends on a solid knowledge base in math, science and engineering.
- 3) Without this knowledge base, innovation as well as our industrial base will erode.

Our economy's ability to compete in the 21st century will not be influenced by past performance. Success or failure will be determined primarily by our capacity to invent and innovate. Unfortunately, there are troubling signs that the American workforce is not ready to meet innovation's challenge, and our position as leader of the global economy is threatened.

American labor will never cost less than that of workers in the rest of the world. So instead, America's workforce must be better educated, more highly trained and efficient than the competition. U.S. manufacturing will no longer employ millions in

² International Monetary Fund

low-skilled jobs. Tomorrow's jobs will go to those with education in science, engineering and mathematics and to high-skill technical workers. Such a workforce is an important key to future growth, productivity, and competitiveness.

The most recent ten year employment projections by the U.S. Labor Department provide a good measure on what types of jobs the U.S. workforce will need to fill going forward. Between 2002 and 2012 there will be:

- 2 million job openings in computer science, mathematics, engineering and physical sciences (*i.e., physics and chemistry*).
- 2.4 million skilled production jobs available for machinists, machine assemblers and operators, systems operators and technicians.

At the same time, the current science and engineering (S&E) workforce is getting older. More than half of S&E workers are already over 40-years-old, and 26 percent are older than 50.³ Barring significant changes in retirement rates, the number of retirements among S&E workers will rise dramatically over the coming decades. Without more domestic S&E graduates or higher immigration to replace the graying S&E workforce, a significant education and skills shortage will threaten the United States' standing as the world's leading innovator. The National Association of Manufacturers believes current trends are alarming!

Section II. Looming Education and Skills Shortage Threatens U.S. Competitiveness

Widening Skills Gap. According to the latest National Association of Manufacturers Skills Gap Report (to be released in its entirety later this fall), manufacturing executives rank a "high-performing workforce" as the most important factor in their firms' future success. This finding is well matched with a recent study by the U.S. Department of Labor, which concluded that 85 percent of future jobs in the United States will require advanced training, an associate degree, or a four year college degree. Minimum skills will be adequate for only 15 percent of future jobs.

Just as this demand for better-educated and more highly-skilled workers begins to grow, troubling trends project a severe shortage of such workers. A 2005 report by the Manhattan Institute finds that 40 percent of ninth graders in 2002 will either drop out of

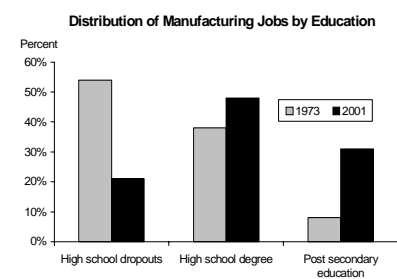
Higher Skills Demanded by Manufacturing

The transition to a more-educated workforce is well under way in manufacturing.

Thirty years ago, a majority (54%) of manufacturing workers did not have a high school degree, while only 8 percent had an associate, bachelor or graduate degree.

By 2001, the share of factory workers without a high school degree fell to just one in five (21%). At the same time, those with a post-secondary education had more than tripled to 31 percent.

If current trends continue, over 40 percent of factory jobs will require post-secondary education by 2012.



³ National Science Foundation. Science and Engineering Indicators, 2004. Chapter Overview and Chapter 3

school before completing high school or lack the needed skills for employment. At the same time, only 60 percent will get advanced training or seek a two- or four-year college degree after high school.

In fact, results of the 2005 NAM Small Manufacturers Operating Survey conducted in July 2005 show that companies are already having trouble finding qualified workers. When asked to identify the most serious problem for their company, survey respondents ranked “finding qualified employees” above high energy costs, the burden of taxes, federal regulations, and litigation. Only the cost of health insurance and import competition ranked as more pressing concerns.

Together, these studies show that U.S. employers already struggling to find qualified workers will face an increasing shortage of such workers in coming years. To make matters worse, trends in U.S. secondary education suggest that even those future workers who stay in school to study math and science may not receive globally competitive educations.

Disturbing Signs in Secondary Education. In 1995, U.S. fourth graders ranked 12th against other nations when it came to mathematics competency⁴. By the 8th grade their ranking dropped to 19th, below not only Asian students in countries such as Korea, Japan and Taiwan, but also below students in many Eastern European nations such as Bulgaria, the Czech Republic and Slovenia.

A similar deterioration has occurred in science. In 1995, U.S. fourth graders ranked 6th in science competency. By the 8th grade their ranking dropped to 18th, below many of the same countries cited above. More recent rankings of U.S. students relative to their counterparts around the globe have been no more encouraging with respect to America’s future ability to compete.

While some may claim that increased funding for education is needed to solve the problem, funding does not seem to be the determining factor in American students’ relatively poor performance. In fact, countries outperforming the U.S. in science and math, on average, spend 10 percent less of their respective GDPs on primary and secondary education than we do.⁵ Obviously, there are other important educational elements that go beyond funding, such as the fact that nearly 70 percent of U.S. middle school students are taught math by teachers with neither a major nor certification in this critical subject.⁶

U.S. Falling Behind in Science, Engineering. The Soviet Union was first out of the gate in the race to space with its launch of Sputnik into orbit on Oct. 4, 1957. America’s ensuing national priority of space exploration inspired young people’s interest

⁴ International Association for the Evaluation of Educational Achievement

⁵ OECD, 2000.

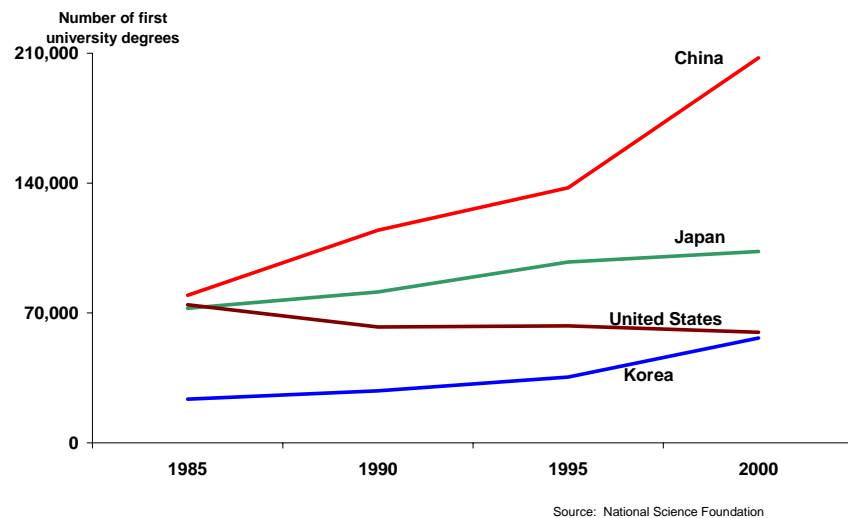
⁶ U.S. Department of Education, Qualifications of the Public School Teacher Workforce: Prevalence of Out-of-field Teaching 1987-88 to 1999-00. Statistical Analysis Report, Table 1.

in science and technology. In 1960, one out of every six (17 percent) U.S. bachelor or graduate degrees was awarded in engineering, mathematics or the physical sciences.

But the interest of young Americans' in science and technology has eroded over time. By 2001, less than one in 10 (just 8 percent) of all degrees awarded in the U.S. came in engineering, mathematics or the physical sciences. This constitutes more than a 50 percent decline from 1960. In terms of actual numbers of graduates in these critical areas, the U.S. produced just 148,000 in 2001 — the smallest number in two decades.⁷ At this rate, our educational system will fail to meet our economy's workforce demands by the end of this decade.

By itself, this problematic trend should be enough to grab the attention of our nation's leaders and compel them to develop a comprehensive strategy for reinvigorating science and engineering education. Viewed in an international context, the facts should be downright frightening for policymakers.

Chart 1: Engineering Degrees



Twenty years ago the U.S., Japan and China graduated a similar number of engineers ranging from 73,000 to 80,000, while Korean engineering graduates totaled just 28,000 (see Chart 1). By 2000:

- Chinese engineering graduates increased 161 percent to 207,500
- Japanese engineering graduates increased 42 percent to 103,200
- Korean engineering graduates increased 140 percent to 56,500
- U.S. engineering graduates *declined* 20 percent to 59,500⁸

As we entered the 21st century, China graduated 3.5 times the number of engineers as the U.S., and Korea — with an economy less than 10 percent the size of ours

⁷ U.S. Department of Education, National Center for Education Statistics, Higher Education

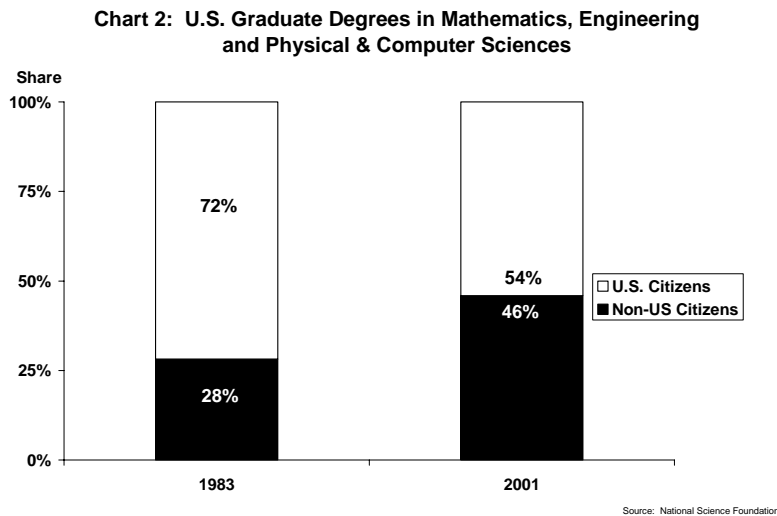
⁸ National Science Foundation. Science and Engineering Indicators, 2004. Appendix table 2-34

— was graduating roughly the same number of engineers. So, not only are we producing fewer engineers, our competitors are producing more!

By 2000, just 6 percent of U.S. undergraduates earned degrees in engineering, and that ranked us a woeful 23rd relative to other nations.⁹

American students' disinterest in math and science continues at the graduate-level, too, where less than 10 percent of degrees are conferred in engineering, mathematics and computer science. This places our country 20th internationally in terms of the share of graduate degrees in these critical areas.¹⁰

With fewer American undergraduate students studying science and engineering, our graduate-level programs have enrolled increasing numbers of foreign students during the past several decades. In 1983, close to three quarters of the graduate degrees in mathematics, engineering and physical and computer sciences went to U.S. citizens. But by 2001 just over half went to U.S. citizens and 46 percent went to foreign students — up from 28 percent two decades earlier (see Chart 2).¹¹



Historically, about half of the foreign students earning science or engineering degrees in the U.S. stayed and worked here, at least temporarily.¹² With foreigner students making up a larger share of science and engineering graduates, their desire to stay here has been good news for American companies that have increasingly relied on them to fill a growing number of scientific and engineering jobs. But recent trends call into serious question the ability of U.S. universities and employers to continue attracting the best and brightest from around the world.

⁹ OECD

¹⁰ Ibid

¹¹ National Science Foundation. Science and Engineering Indicators, 2004. Appendix table 2-12.

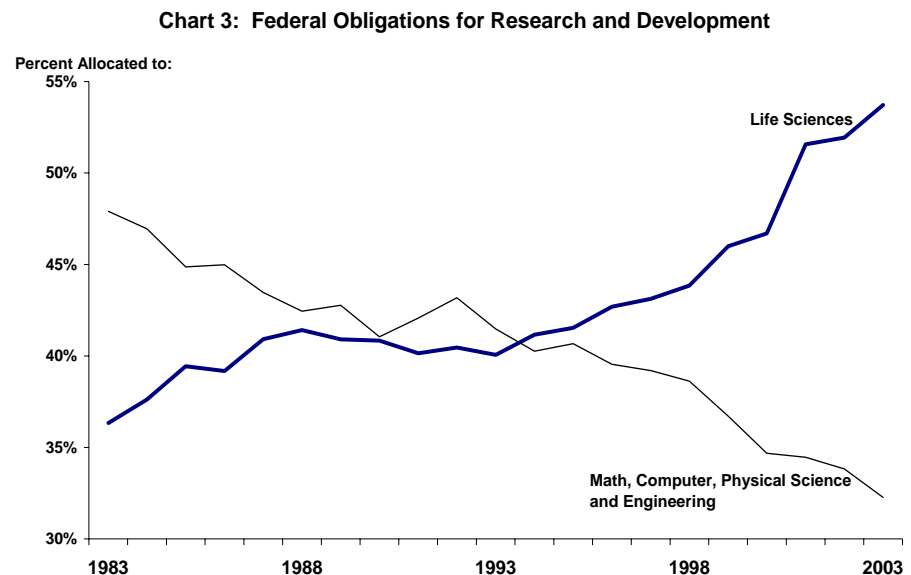
¹² National Science Foundation. Science and Engineering Indicators, 2004. Chapter 2, 2-33.

Can America Still Count on Foreign Scientists and Engineers? Between 1990 and 2000, the share of foreign-born U.S. workers with bachelors' degrees in science and engineering rose from 11 to 17 percent; the share with master's degrees rose from 19 to 29 percent; and the share with PhDs rose from 24 to 38 percent.¹³

Two developments that will not change overnight show that U.S. employers will not be able to continue relying on overseas educational systems to supply them with engineers and scientists.

- Just like the U.S., other countries are now determined to innovate and become more globally competitive. In addition to providing more and better educational opportunities for their own would-be science and engineering students, other nations are now creating employment and research opportunities for science and engineering degree holders more than twice as fast as the U.S. (23 percent growth abroad versus 11 percent growth in the United States between 1993 and 1997).¹⁴
- Since the terrorist attacks of Sept. 11, 2001, the number of students and high-skilled foreign nationals that have entered the United States has declined by 20 percent (from 772,000 in 2001 to 664,000 in 2003) due in part to fewer visa applications and increased security criteria.

Eroding Federal Funding of Basic Research. In addition to addressing our country's skilled worker shortage, the federal government's commitment to basic research in the areas of math, computer, physical sciences and engineering also needs to be strengthened. In recent years there has been a shift in funding of federal R&D away from basic research in physical sciences and engineering. After dwindling to a three-decade low of less than 0.4 percent of GDP in 1998,¹⁵ overall federal obligations to research had risen slightly to 0.5 in 2003. However, this increase has been driven exclusively by an increasing commitment to research in the area of life sciences such as that conducted at the



Source: National Science Foundation

¹³ National Science Board. An Emerging and Critical Problem of the Science and Engineering Labor Force, 2004.

¹⁴ Ibid

¹⁵ Federal Obligations to R&D Funding, Percent GDP, National Science Foundation

National Institutes of Health.

In 1995 federal R&D obligations were split evenly between (1) life sciences and (2) math, computer, physical sciences and engineering. Each received about 41 percent of the federal government's commitment to R&D. In 2003 the federal government's commitment to life sciences research increased dramatically to over half of the federal government's total R&D obligations. At the same time, federal commitment to math, computer, physical sciences and engineering fell to less than a third of federal R&D dollars — 30 percent below the share during the 1970s and 1980s (see Chart 3).¹⁶ By de-emphasizing basic research in math, engineering and physical sciences, America risks its future prosperity and even its national security.

Listed below are some of today's widely-used technologies that were spawned by federal research. The list provides context to what is at stake if our federal commitment to funding math, computer, physical science and engineering research continues to erode.

- Bar Codes track retail and wholesale inventories, cargo shipments and much more
- Doppler Radar on TV weathercasts keeps us prepared for and safe from storms
- The Internet, Web Browsers and Fiber Optics comprise our information superhighway
- Nanotechnology promises revolutionary medical and industrial applications

While research aimed at new cures and treatments for diseases are important, funding such research at the expense of basic scientific R&D could expose our economy to a plague of innovation deficiency from which it might never recover.

Section III. Call to Action; Developing a National Workforce Strategy

Together, the troubling trends detailed in Section II threaten our nation's ability to innovate and compete in the global economy. These multifaceted problems did not manifest themselves overnight, and implementing solutions will take time. There is simply no "quick fix." But the longer we as a nation fail to address these troubles; the longer we go without developing a national strategy to prepare our workforce for the demands of the 21st century, the less able we will be to compete in the future. To quote Francis Bacon, "He that will not apply new remedies must expect new evils."

Improving the future workforce of America is a major challenge. And unlike other problems such as a burdensome tax structure or legal abuses, we cannot simply pass a law or write a rule and expect a better prepared workforce – well trained in math and science – to magically materialize. Instead, it will take the concerted efforts of business, government and the American family. Below are three steps that can begin to correct our country's workforce skill deficiency.

¹⁶ National Science Foundation/Division of Science Resources Statistics, Survey of Federal Funds for Research and Development: Fiscal Years 2001, 2002, and 2003.

Step 1. Improve Secondary Science and Math Teaching to Foster Better Student Performance. One reason U.S. students under perform in math and science and are less likely to pursue post-secondary education in these disciplines is that there is a large disconnect in this country between the public education system and career opportunities that exist later on in life. As a nation, we must:

- Promote market-and-performance-based compensation and incentive packages to retain effective math and science teachers currently in the classroom.
- Improve math and science professional development to boost teachers' content knowledge and make them more effective.
- Encourage qualified professionals and retirees to become math and science teachers, even if only on a part time basis.
- Strengthen current college preparation programs for prospective math and science teachers. Increase the retention rates of undergraduate students in science, engineering, mathematics and technology disciplines. Expand the National Science Foundation's Science, Engineering and Mathematics Talent Expansion Program (STEP Tech Talent) and similarly proven retention-oriented programs.
- Strengthen and enforce the high quality teacher provisions in No Child Left Behind for math and science teachers to ensure requisite knowledge.
- Expand programs such as State Scholars and the American Diploma Project that encourage high school students to take rigorous academic courses (including at least three years of both math and science) to ensure readiness for the workplace and/or higher education.

Since math and science education is initially more abstract than other disciplines such as English, foreign languages or history, their real world utility often goes unnoticed and overlooked by students. This must change. We must initiate a national campaign to educate parents, students and teachers about the influence science and math skills will have on future success and about the types of careers available through excellence in these fields.

Step 2. Reform Visa and Immigration Policies to Attract Those Trained in Math and Science.

- Streamline the process of pursuing permanent residence status for foreign-born workers with advanced degrees from U.S. universities by allowing them to move directly from student status to permanent residence, thereby bypassing the temporary worker system (H1-B).
- Increase the number of permanent visas available for highly-educated professionals. Current demand greatly exceeds supply.
- Amend the labor certification process to ensure that employers can have access to the best talent coming out of our graduate schools.
- Prevent American companies from being "shut-out" of hiring temporary workers due to unpredictable H-1B quotas.

- Continue America's longstanding history of welcoming talented foreign students to study at our nation's universities. Processing should be transparent, predictable and streamlined.

Step 3. Increase Federal Support for Basic Research. It is essential that the federal government increase its commitment to R&D in critical areas of mathematics, engineering and computer and physical sciences. Federal agencies like the National Science Foundation, the National Institute for Standards and Technology and the Energy Department's Office of Science can stimulate valuable research to spur innovation and economic growth for generations.

Appropriately, and at the request of Congress, the U.S. Department of Commerce will convene in December a major summit to focus on the development of the 21st century technologies the United States must develop to remain the world's innovation leader. This unique and important summit, being planned by a steering committee that includes the NAM and five other organizations, will bring together business leaders and key policymakers from both the executive and legislative branches.

Summary

The NAM expects employment demands for workers with science and engineering education or technical training to grow in the United States as employers continue to seek innovation and productivity as means to compete in the global economy.

Unfortunately, the number of U.S. citizens preparing to enter these fields is not adequate to meet our needs. Meanwhile, our more populous competitors are increasing their numbers of graduates dramatically. Tougher international competition is providing new education and career opportunities for talented students and workers overseas, so that means fewer of them will look to fill jobs in the U.S. On top of all this, federal investment in math, engineering and the physical sciences is in decline.

These troubling trends can lead our country down a path we do not want to take. Without an educated and highly skilled workforce to drive 21st century innovation, America's capacity to remain the world's most advanced economy is at risk. Other countries are moving fast to educate their workers and to innovate. If we do not implement a concerted national strategy to do the same, we risk America's future.

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The National Association of Manufacturers is the nation's largest industrial trade association, representing small and large manufacturers in every industrial sector and in all 50 states. Headquartered in Washington, D.C., the NAM has 10 additional offices across the country. Visit the NAM's award-winning web site at www.nam.org for more information about manufacturing and the economy.