THE ROLE OF COMMUNITY COLLEGES AND INDUSTRY IN MEETING THE DEMANDS FOR SKILLED PRODUCTION WORKERS AND TECHNICIANS IN THE 21ST CENTURY ECONOMY

HEARING

BEFORE THE

SUBCOMMITTEE ON RESEARCH AND SCIENCE EDUCATION

COMMITTEE ON SCIENCE AND TECHNOLOGY

HOUSE OF REPRESENTATIVES

ONE HUNDRED TENTH CONGRESS

FIRST SESSION

JUNE 19, 2007

Serial No. 110–42

Printed for the use of the Committee on Science and Technology

Available via the World Wide Web: http://www.house.gov/science

U.S. GOVERNMENT PRINTING OFFICE

36–000PS WASHINGTON : 2007

For sale by the Superintendent of Documents, U.S. Government Printing Office
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TUESDAY, JUNE 19, 2007

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON RESEARCH AND SCIENCE EDUCATION,
COMMITTEE ON SCIENCE AND TECHNOLOGY,
Washington, DC.

The Subcommittee met, pursuant to call, at 3:03 p.m., in Room 2318 of the Rayburn House Office Building, Hon. Brian Baird [Chairman of the Subcommittee] presiding.

BART GORDON, TENNESSEE
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The Subcommittee on Research and Science Education

Hearing on:

The Role of Community Colleges and Industry in Meeting the Demands for Skilled Production Workers and Technicians in the 21st Century Economy

2318 Rayburn House Office Building
Washington, D.C.

June 19th, 2007
3:00 p.m.

WITNESS LIST

Dr. Gerald Pumphrey
President
South Puget Sound Community College

Dr. Stephen J. Fonash
Director
Center for Nanotechnology Education and Utilization
Pennsylvania State University

Mr. Eric Mittelstadt
CEO
National Council for Advanced Manufacturing

Ms. Monica Poindexter
Associate Director, Corporate Diversity
Genentech, Inc.

HEARING CHARTER

SUBCOMMITTEE ON RESEARCH AND SCIENCE EDUCATION
COMMITTEE ON SCIENCE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

The Role of Community Colleges and Industry in Meeting the Demands for Skilled Production Workers and Technicians in the 21st Century Economy

TUESDAY, JUNE 19, 2007
3:00 P.M.–5:00 P.M.
2318 RAYBURN HOUSE OFFICE BUILDING

Purpose

The purpose of this hearing is to explore the current challenges facing industry in meeting its needs for skilled technicians and production workers in advanced manufacturing and other technology intensive sectors. Witnesses will identify the issues contributing to the problem and address the mechanisms community colleges and industry at large are employing to increase the number of these skilled individuals in the workforce.

Issues

- What are the biggest challenges to attracting more individuals to careers as skilled production workers and technicians? What are community colleges and industry doing to attract more individuals to these careers?
- What are key factors in successful partnerships between tech-training programs and community colleges? How have both community colleges and industry had to adapt to meet each others' needs?
- How are community colleges training students to deal with the fast-paced changes that occur in modern industry? How can industry facilitate this type of learning?

Witnesses

- **Dr. Gerald Pumphrey** is the President of South Puget Sound Community College, Olympia, Washington. He has had extensive experience developing technician training programs for community colleges and engaging industry partnerships in Washington and North Carolina.
- **Dr. Stephan Fonash** is the Director of the Center for Nanotechnology Education and Utilization, Pennsylvania State University's Nano-Technician Advance Technology Education Center. The center, developed in response to industry needs, serves as a regional hub for Pennsylvania community colleges to train students in advanced manufacturing.
- **Mr. Eric Mittelstadt** is the CEO of the National Advisory Council for Advanced Manufacturing (NACFAM), which is an industry-led, non-profit organization that develops and advocates public policies that foster the growth and development of the U.S. advanced manufacturing sector.
- **Ms. Monica Poindexter** is Associate Director, Corporate Diversity, for Genentech, Inc., a large California based biotechnology company. Ms. Poindexter has worked with local community colleges to develop training programs for dislocated workers and others to help meet Genentech's needs for technicians and skilled production workers.

Brief Overview

Technology and innovation have kept the American economy strong in the face of increasing competition in the global marketplace. Many reports have stated the critical importance of American science and engineering graduates in helping the country's economy keep pace with this rapid change. The National Academies' 2006 publication, *Rising Above the Gathering Storm,* is one of the most recent and influential of these reports. As industry moves toward producing more high-tech products and employing technology intensive production methods, the need for technologically and scientifically literate individuals at all levels of the workforce will increase. Thus, the need for science, technology, engineering, and mathematics (STEM) training is now as important for the worker running the production process, as it is for the researcher who created that process.

Manufacturing Jobs in the U.S. Economy

The U.S. economy has lost a considerable number of manufacturing jobs. Still, the sector is responsible for 14 percent of the country's GDP and 11 percent of its employment, employing over 14 million workers. Despite cuts in the number of workers, productivity in manufacturing has increased substantially. The key to this productivity has been the adoption of technology by U.S. firms. Increasingly, production in American factories is driven by technology, giving rise to the term advanced manufacturing to describe the activities of today's factories.[1] According to the National Council for Advanced Manufacturing, advanced manufacturing makes extensive use of computer, high precision, and information technologies and a high performance workforce to efficiently produce many different types of "high-tech" or commonplace products.

Many reports find that there are not enough people with the requisite skills to fill the manufacturing jobs that remain. Moreover, just as technology has fundamentally changed the nature of manufacturing, it has also changed or created many other jobs, such as environmental technicians and information technology specialists. Low-skilled jobs, like those that used to exist at many factories, are increasingly rare in manufacturing; technician and production work is now highly specialized and highly skilled. Industry has found it difficult to find enough qualified workers for these jobs. The *Manufacturing in America* report cites the lack of adequately skilled workers for production jobs as an important issue that needs to be addressed to ensure the competitiveness of American manufacturing. In the *2005 Skills Gap Report—A Survey of the American Manufacturing Workforce,* the National Association of Manufacturers (NAM) surveyed their members and found that 80 percent of manufacturing companies surveyed reported difficulty in finding enough skilled workers, and 90 percent reported a shortage of skilled production employees. Similar findings are reported by Manpower Inc., a leading company in the employment services industry. Their 2007 *Talent Shortage Survey Result,* released with a corresponding white paper, found that skilled technician and production jobs ranked as the fourth most difficult positions for U.S. employers to fill and the third most difficult when looked at internationally. Employers today need their technicians and production workers to be technologically literate and have math and problem-solving skills, while also having "soft skills," like communication abilities and a strong work ethic.

Many states have studied their own industry needs and concluded that their workforce is lacking in the requisite skills. This issue is prevalent at the "mid-level" of preparation, referring to those that have post-secondary training, but not a Bachelor's degree. In a 2005 study of the needs of New Jersey manufacturers, specialized fields like scientific glassware, chemical processing, and food processing were projected to grow in New Jersey despite an overall decline of manufacturing jobs. The report noted that these industries will need workers who "possess the technical expertise to both understand underlying principles of the production process and interact effectively with advanced machines and computers to control these processes," and it highlighted that the state did not have enough of these people in its work-

[1] U.S. Department of Commerce, *Manufacturing in America: A Comprehensive Strategy to Address the Challenges to U.S. Manufacturers,* January 2004.

force.[2] Similar reports noting the shortage of workers for skilled production and technician jobs can be found in Washington[3], Indiana[4], Ohio[5], and Texas[6].

State and local officials realize that the presence of skilled workers in their population is an important factor in the growth and development of industry within their borders. For instance, Arizona's *Two-Year State Workforce Investment Plan: June 2005–June 2007* stresses the importance of a well trained workforce for the development of its economy and places increased training of workers for its high-tech industries as one of the state's priority goals. Furthermore, Maricopa Community College, in Phoenix, commissioned its own study highlighting the importance tech-training has on the development of the regional economy.[7] Georgia is also among the states attempting to use access to tech-training to attract businesses to the state.[8]

Community College Programs

Community and technical college programs can produce the kind of graduates industry needs to fill these positions. These institutions have long been involved in training technicians for the Nation's workforce, but there is now a growing awareness that community colleges can provide industry with the adequately skilled workers it needs. Serving as models for technology training, the National Science Foundation (NSF) Advanced Technology Education (ATE) centers at community colleges develop tech-training programs that prepare students for a wide variety of jobs in high-tech settings. This program funds 33 centers throughout the country that offer both training for local community college students and a research enterprise to develop and disseminate best teaching and curriculum practices for fields such as biotechnology, chemical processing, advanced manufacturing, and information technology. These programs rely on a partnership between the community college and industry, and throughout the country other institutions can look to ATEs as they develop their own training programs.

Feedback from both colleges and industry personnel on their partnerships, in general, and ATEs, specifically, is positive. Employers like and readily hire the graduates of these programs. However, community colleges face many challenges in creating and developing tech-training programs. Perhaps the most vexing is that these programs often face low enrollment. Since community colleges typically incur a much greater expense in capital costs and maintenance for these programs, they can find it difficult to begin or continue a program without a large number of students, especially on their relatively tight operating budgets. Both community college personnel and industry representatives claim that careers in manufacturing are either unknown by or considered undesirable by students and their parents. NAM has recently begun an outreach campaign to high school students to counter their negative perceptions. ATE programs also engage in outreach but it is unclear as to the degree of their success in these endeavors.

An issue very closely related to attracting large numbers of students to the program is the inadequate math and science backgrounds of many students enrolled in community colleges. Community colleges must attract students to these programs, while also taking measures to remediate basic skills, most commonly in math. Another challenge the community college must address is balancing its role as a "feeder" institution for four year programs with its ability to deliver specialized training for industry. Though articulation between tech-training programs and university is not always possible, community college administrators and tech-training faculty are increasingly embracing the need to endow their technology students with problem-solving skills and an ability and willingness to learn so as to enable them to navigate the inevitably changing skill needs of industry.

Highly involved industry partners are a common theme among the most successful tech-training programs. Representatives from both industry and colleges claim

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[2] New Jersey State Employment and Training Commission, *Ready for the Job: Understanding Occupational and Skill Demand in New Jersey's Manufacturing Industry, Chemical Processing, Food Processing, Glass Production, and Printing and Publishing,* Spring 2004.

[3] Washington State's Higher Education Coordinating Board, State Board for Community and Technical Colleges, and Workforce Training and Education Coordination Board, *A Skilled and Educated Workforce: An Assessment of the Number and Type of Higher Education and training Credentials Required to Meet Employer Demand,* January 2006.

[4] The Indianapolis Private Industry Council, *Industry Transformation: Growth and Change in Advanced Manufacturing in Central Indiana,* Spring 2006.

[5] Rhodes State College, *Building an Advanced Manufacturing Pathway in West Central Ohio: A Study of Manufacturing Workforce Development Needs,* Fall 2004.

[6] Texas Workforce Commission, *Strategic Plan: Fiscal Years 2007–2011,* 2007.

[7] Battelle's Technology Partnership Practice, Prepared for Maricopa Community College District and the Salt River Project, *Competing with Talent: High-Technology Manufacturing's Future in Greater Phoenix,* December 2005.

[8] *http://www.gaworkready.org/Technical_Colleges/aboutTechColleges.html*

that a willingness to devote time and resources to the partnership is crucial for the program to yield the most qualified graduates. Studies like Manpower Inc.'s *2007 Talent Shortage Survey Result* suggest industries partner with educational institution based tech-training programs to address the high need for more qualified workers.

Questions to Witnesses

Dr. Pumphrey was asked to address the following questions:

- What factors are involved in a decision by a community college when deciding whether to develop or continue a tech-training program in a particular field? How does the college evaluate the potential impact of the program in comparison to its associated costs? What are the biggest challenges faced by a community college in either initiating or continuing a program with low enrollment?
- What factors influence the low enrollment of tech-training programs? How can low enrollment be remedied? What efforts do your college and others make to attract the widest possible population of students to tech-training?
- What challenges does inadequate math/science preparation pose to tech-training programs? Do you know of colleges engaged in innovative ways of addressing this dilemma, particularly through collaborating with secondary schools?
- What is an industry partner's ideal role in a community college tech-training program? Please elaborate on your experiences with industry partners.
- What impacts do shifts in industry demand have on tech-training programs and how do community colleges address these?

Dr. Fonash was asked to address the following questions:

- Please describe the evolution of your program—how it began in response to industry's stated needs and how the program has changed as the industry needs and focuses have changed. Please describe how the program adjusted after the drop-off in demand for semi-conductor manufacturing technicians occurred around the year 2000. How do you prepare your students to be adaptable to the changing needs in high-tech manufacturing?
- What demographic profile does your program draw? How have you faced the challenge of recruiting more students to your program?
- How do you determine your math/science curriculum? What steps do your partner community college institutions take to ensure students can meet the demands of your program?
- What is the ideal role for industry partners in developing and running a successful tech-training program? Please elaborate on industry's role in creating skill standards, developing curriculum, providing student development opportunities, defraying the cost of equipment, and hiring graduates.

Mr. Middlestadt was asked to address the following questions:

- How have the labor needs of the manufacturing sector changed, and what do the current and near-future opportunities look like for graduates of tech-training programs? Are there technician shortages in advanced manufacturing and is the problem more concentrated in particular industries?
- What steps, such as increasing wages, benefits, and training, or being more flexible with their hiring qualifications are companies taking to attract more students to careers as skilled technicians and production workers? Also, what are companies individually and collectively doing to raise the perception of manufacturing careers among current students and potential students?
- What influences a company's decision to take an active partnership role in advising a community college tech-prep program? From an industry point of view, what factors foster a successful partnership? To what extent can particular industries prepare training programs for changes in the skills they need?
- One of NACFAM's current focuses is on STEM education. Can you please describe how deficiencies in STEM education affect a company at the technician and production worker level of its workforce?

Ms. Monica Poindexter was asked to address the following questions:

- Please describe how Genentech's partnership with local community colleges began, how it currently operates, and its plans for future directions. What factors contribute to the development and maintenance of a successful program? What challenges did you need to address in developing this program?
- What is the ideal role for the community college in providing training for your future employees?
- How does Genentech benefit from hiring community college graduates? How important are well qualified technicians and production workers to your business?
- What opportunities does Genentech provide to its technicians and skilled production workers to develop new skills as your industry changes?
- How can community colleges and industry attract more people to careers as technicians and skilled production workers?

Chairman BAIRD. Good afternoon. I would like to welcome everybody to today's hearing which will look at the vital role skilled production workers and technicians play in today's workforce.

The Science and Technology Committee as a whole, and this subcommittee, particularly, is focused on improving math and science education. In this technology-driven world, giving our students a thorough science, technology, engineering, and mathematics, or as we say, STEM, education is the best way to ensure that they, and our country, will stay competitive and prosperous.

Reports like the National Academies' *Rising Above the Gather Storm,* have sent up a number of red flags warning that we are not graduating nearly as many scientists and engineers to keep up with the growing economies in China and India.

Similarly troubling are recent reports that we may not have enough qualified individuals to take the production jobs and technician jobs that keep U.S. manufacturing and other industries running. According to the National Association of Manufacturers, 80 percent of their survey respondents report difficulties in finding qualified people to run their production processes and serve as technicians. Other State and regional studies report that manufacturers in their areas are experiencing the same difficulties.

It is well known that U.S. manufacturing has lost a significant number of jobs in recent years, whether to off-shoring or automation; but this is only part of the story. Our manufactures have embraced technology and lean production methods to stay competitive within the global economy. This, in turn, has shifted the labor requirements away from unskilled workers to skilled, technology-literate men and woman who can run and maintain complex machines and produce a high-quality product. These jobs do not require a Bachelor's degree at all times, but they do require specialized knowledge; a good understanding of technology, math and science; good problem-solving skills and strong communication skills. And since the footprint of technology has profoundly changed many jobs, it is not just the manufacturers that rely on people with these skills.

Unfortunately, however, today's students do not seem motivated to go into manufacturing or purse technician jobs. Many are unaware that manufacturing is a good career path or that the jobs are even available. Their impressions, shaped by parents, teachers, and the media, often see factories, and hence manufacturing, as dirty and dreary. As our witnesses, however, will attest today, this is not the case in modern factories, which are clean and not at all characterized by drudgery. As increasing numbers of "baby-boomers" retire, changing the impression of young people will be an important part of recruiting more young people to these jobs.

Offering our students training opportunities for promising careers is just as important as changing their perceptions. Community colleges can provide this bridge to students—those fresh from high school as well as older students who may be retraining for other work. Many of these schools offer tech-training programs that prepare students with the kinds of skills now highly in demand by industry.

The National Science Foundation funds the operation of 33 centers around the country that are at the forefront of tech-training

education. Specializing in training for careers as diverse as environmental technician or micro-systems specialist, these centers offer excellent training to students at their host institutions and work to provide community colleges across the country with best practices in curriculum and industry skill standards. These centers maintain strong partnerships with industries that guide the development of a program. One of the important focuses of this hearing is how these partnerships between community colleges and industry create the programs that are most beneficial to students and to their future employers.

As we will hear this afternoon from our outstanding witnesses, community colleges face steep challenges to implementing these important programs. Mainly, the programs suffer from unfortunately low enrollment in some cases, which makes them difficult to develop and maintain on a community college's tight budget. Also the schools must deal with the reality that many of their students are not adequately prepared coming in, in basic math and science to immediately enter these programs, which sometimes discourages potential applicants. These are challenges that must be addressed if the country is to have a workforce that is congruent with industry needs.

Most importantly, I hope this hearing will highlight that it is time to get serious about better equipping all students to compete in the global economy. There are good jobs waiting to be had, and if we don't want to lose those jobs because companies can't find qualified employees here in the U.S., we need to act. And I look forward to the comments of our outstanding witnesses today.

And with that, I now recognize Dr. Ehlers for an opening statement.

[The prepared statement of Chairman Baird follows:]

PREPARED STATEMENT OF CHAIRMAN BRIAN BAIRD

Good afternoon. I'd like to welcome everybody to today's hearing which will look at the vital role skilled production workers and technicians play in today's workforce.

The Science and Technology Committee as a whole, and this subcommittee especially, is very focused on improving math and science education. In this technology driven world, giving our students a thorough science, technology, engineering, and mathematics—or STEM—education is the best way to ensure that they, and our country, will stay competitive and prosperous.

Recent reports, like the National Academies' *Rising Above the Gathering Storm,* have sent up red flags warning that we are not graduating nearly as many scientists and engineers to keep up with the growing economies in China and India.

Similarly troubling are recent reports that we may not have enough qualified individuals to take the production jobs and technician jobs that keep U.S. manufacturing and other industries running. According to the National Association of Manufacturers, 80 percent of their survey respondents report difficulties in finding qualified people to run their production processes and serve as technicians. Other State and regional studies report that manufacturers in their areas are experiencing the same difficulties.

It is well known that U.S. manufacturing has lost a significant number of jobs in recent years either to off-shoring or automation. But this is only part of the story. U.S. manufacturers have embraced technology and lean production methods to stay competitive within the global economy. This has shifted the labor requirements away from unskilled workers to skilled, technology-literate men and women who can run and maintain complex machines and ensure a high-quality product These jobs do not require a Bachelor's degree, but they do require specialized knowledge; a good understanding of technology, math, and science; good problem solving skills and good communication skills. And, since the footprint of technology has pro-

foundly changed many jobs, it's not just manufacturers that rely on people with these skills.

Unfortunately, today's students do not seem motivated to go into manufacturing or pursue technician jobs. Many of them are unaware that manufacturing is a good career path or that these jobs are even available. Their impressions, shaped by parents, teachers, and the media, see factories as dirty and dreary. As I'm sure our witnesses will attest today, this is not the case in many modern factories, which are clean and not characterized by drudgery. As increasing numbers of "baby-boomers" retire, changing the impressions of young people will be an important part of recruiting more young people to these jobs.

Offering students training opportunities for promising careers in these fields is just as important as changing their perceptions. Community colleges can provide this bridge to students- those fresh from high school and as well as older students. Many of these schools offer tech-training programs that prepare students with the kinds of skills now highly in demand by industry.

The National Science Foundation funds the operation of 33 centers around the country that are at the forefront of tech-training education. Specializing in training for careers as diverse as environmental technician or micro-systems specialist, these centers offer excellent training to students at their host institutions and work to provide community colleges across the country with best practices in curriculum and industry skill standards. These centers maintain strong partnerships with industry that guide the development of a program. One of the important focuses of this hearing is how these partnerships between community colleges and industry create the programs that are most beneficial to students and their future employers.

As we will hear this afternoon, community colleges face steep challenges to implementing these important programs. Mainly, the programs suffer from low enrollment, making them difficult to develop and maintain on a community college's tight budget. Also, the schools must deal with the reality that many of their students are not adequately prepared in math and science to immediately enter these programs, which discourages potential applicants. These are challenges that must be addressed if the country is to have a workforce that is congruent with industry's needs.

Most importantly, I hope this hearing will highlight that it's time to get serious about better equipping ALL students to compete in the global economy. These are good jobs and it we don't want to lose them because companies can't find enough qualified employees here in the U.S.

Mr. EHLERS. Thank you, Mr. Chairman.

A century-and-a-quarter ago, 80 percent of our workforce worked on farms. That began to change at that time, with the beginning of the industrial era. Most of the workers did not have a high school education, but they didn't need it for the industries of that time, the manufacturers, for two reasons. First of all, the manufacturing process was fairly simple. Secondly, when you grow up on a farm, you learn an immense amount about machinery. You live with tools. You learn how to make things and do things, and so they transferred very easily into the industrial workplace and into manufacturing. Today, technical training and jobs have change significantly since that time and even since I joined the workforce. At that time, many manufacturing workers did not need a high school diploma to do their job well, and if they had a high school diploma it was a definite plus. Things have changed. Today, we hear from employers that the K–12 education system is not sufficiently training students to meet the demand for technically-skilled positions. My mantra has been that all jobs require a basic understanding of science and math and technical jobs are no exception. We must improve science, technology, engineering and math literacy for all students.

It is interesting that the international tests that have been done to compare our K–12 educational system with the equivalents in other countries have made our system look very bad, very deficient. And I believe that it is extremely important that the community

colleges and industry have stepped in to fill the gap. Both of them have done this each in their own way. Despite the challenges facing our K–12 system, our workforce still remains globally competitive, so how can it be that we are doing less well in K–12 education than all of the other nations, and yet we are competitive. As I said, it is due to community colleges filling the gap between a high school education and employment. And furthermore, these institutions prepare students for the workforce, lay a foundation for further study at four-year institutions and provide continuing education for experienced workers. I do not believe community colleges receive the recognition they deserve for providing these education services critical to our economy.

Another factor is the training that industry itself has provided. It may shock you to know—it certainly did when I first heard it—that the amount spent by industry, both on remedial training for lack of education as well as upgrading education to handle more technically complex equipment, the total amount they spend exceeds the total amount the Federal Government uses to fund elementary and secondary education. That is a huge drain on our financial resources in industry. If we could only do better in the school systems, then the industry and the manufacturing would be far more efficient.

In its 2005 survey of the U.S. manufacturing workforce, the National Association for Manufacturers found that skill shortages are extremely broad and deep, cutting across industry sectors and impacting more than 80 percent of the companies' surveys. In fact, the shortage is so severe in some cases that some positions remain unfilled for long periods of time.

I am glad that industry is taking action to address the skills gap, as I mentioned earlier, but in addition to that, they are working with educational institutions to develop innovative mechanisms to attract students to these fields instead of relying purely on traditional recruiting strategies. Companies have identified the high performance skills in their workforce as the most critical component of their future business success. In Michigan, manufacturing accounts for almost 20 percent of the state's GDP. Nationwide, our workforce in manufacturing is 14 percent. In agriculture, now, it is less than two percent, a major shift in our economy in 125 years.

Like our witnesses today, our Grand Rapids Community College, in my district, and the Michigan Small Business and Technology Development Center are working to alleviate the skills gap between industry and education in my region. The Federal Government supports these goals through programs such as Workforce Innovation and Regional Economic Development, the WIRED program, and the Manufacturing Extension Partnership Program, better known as the MEP. I am a strong supporter of both. Unfortunately, we have not had a lot of strong support for the MEP program, but the WIRED program is very successful, and the remnants of the MEP program are also successful.

I note that some of today's submitted witness testimony addresses the need to reverse the waning student interest and negative perception of these fields. The historic perception that technical fields are dark, dirty, dangerous, and dull, to add to your description, reflects the larger cultural battle we are fighting about how

young people perceive science and technology. I look forward to working with each of you and my colleagues on making science and math more approachable and subsequently shifting attitudes towards technical education and employment.

I thank our witnesses for being here today to discuss these important issues, and I thank Chairman Baird for organizing this hearing. Thank you.

[The prepared statement of Mr. Ehlers follows:]

PREPARED STATEMENT OF REPRESENTATIVE VERNON J. EHLERS

Technical training and jobs have changed significantly since the time I entered the job market. At that time, many manufacturing workers did not need a high school diploma to do their job well. Things have changed! Today, we hear from employers that the K–12 education system is not sufficiently training students to meet the demand for technically-skilled positions. My mantra has been that all jobs require a basic understanding of science and math and technical jobs are no exception. We must improve science, technology, engineering and math literacy for all students.

Despite the challenges facing our K–12 system, our workforce still remains globally competitive. I believe that is largely due to community colleges filling the gap between a high school education and employment. These institutions prepare students for the workforce, lay the foundation for further study at a four-year institution, and provide continuing education for experienced workers. I do not believe community colleges receive the recognition they deserve for providing educational services critical to our economy. In its 2005 survey of the U.S. manufacturing workforce, the National Association for Manufacturers found that skill shortages are extremely broad and deep, cutting across industry sectors and impacting more than 80 percent of companies surveyed. In fact, the shortage is so severe in some cases that some positions remain unfilled for long periods of time. I am glad that industry is taking action to address the skills gap and working with educational institutions to develop innovative mechanisms to attract students to these fields, instead of relying purely on traditional recruiting strategies. Companies have identified the high-performance skills of their workforce as the most critical component of their future business success. In Michigan, manufacturing accounts for almost twenty percent of the state's GDP. Like our witnesses today, Grand Rapids Community College and the Michigan Small Business and Technology Development Center are working to alleviate the skills gap between industry and education in my region. The Federal Government supports these goals through programs such as the Workforce Innovation and Regional Economic Development (WIRED) and the Manufacturing Extension Partnership Program (MEP).

I note that some of today's submitted witness testimony addresses the need to reverse the waning student interest and negative perception of these fields. The historic perception that technical fields are "dark, dirty, dangerous and dull" reflects the larger cultural battle we are fighting about how young people perceive science and technology. I look forward to working with you and my colleagues on making science and math more approachable and subsequently shifting attitudes towards technical education and employment.

I thank our witnesses for being here today to discuss the important topic of educating skilled technicians, and thank Chairman Baird for organizing this hearing.

Chairman BAIRD. Thank you, Dr. Ehlers. I also want to acknowledge the presence of Mr. Miller, the Chair of the Oversight Committee, and the gentleman from Maryland, Dr. Bartlett. If there are any Members who wish to submit additional opening statements, those statements will be added to the record at this point.

[The prepared statement of Ms. Johnson follows:]

PREPARED STATEMENT OF REPRESENTATIVE EDDIE BERNICE JOHNSON

Thank you, Mr. Chairman.

Community colleges play a key role in providing access to tomorrow's high-technology workforce.

Of particular interest to me are minority-serving institutions such as Historically Black Colleges and Universities and their importance in training students to fill tomorrow's high-tech jobs.

In Texas, there are near 50 minority serving institutions, including Paul Quinn College in the Dallas area. Minority-serving institutions contain disproportionately high enrollments of African American, Hispanic, and Native American students.

My district, in Dallas, contains a majority of individuals who are Black and Hispanic. Over the years, I have worked to increase federal efforts to encourage these groups to pursue careers in science, technology, engineering and math.

The U.S. Census reports that Hispanics are already the largest minority population in the country, and the numbers are growing.

Hispanics are projected to account for more than 16 percent of the U.S. population in 2014.

Hispanics are expected to account for 24 percent in 2050.

These increases will affect the racial and ethnic make-up of enrollment rates at colleges and universities, and I predict that Minority Serving Institutions will become even more important in creating educational opportunities.

Today's witnesses will share with Subcommittee Members the challenges faced in attempting to serve this segment of the future high-tech workforce as well as strategies for success at smaller colleges and universities.

Again, welcome to today's witnesses.

Thank you, Mr. Chairman. I yield back.

[The prepared statement of Mr. Carnahan follows:]

PREPARED STATEMENT OF REPRESENTATIVE RUSS CARNAHAN

Mr. Chairman, thank you for hosting this hearing to examine the challenges facing advanced manufacturing industry in attracting skilled production workers and technicians, and to consider the role of community colleges in recruiting and training students for these careers.

As the demand for high-skilled, high-tech production workers increases, manufacturing companies have found the supply of well-trained employees lacking such that the growth and development of industry may be threatened. I look forward to exploring ways that Congress can help to counteract this disturbing trend.

Numerous reports such as the *2005 Skills Gap Report—A Survey of the American Manufacturing Workforce* have shown that eighty to ninety percent of manufacturing companies are having difficulty finding skilled production workers, a role which is rapidly surpassing that of low-skilled employees. While community colleges have been identified as one of the best sources of training for such jobs, lack of funding, low enrollment, and students' inadequate math and science backgrounds create major obstacles, severely limiting the technical training these institutions can offer.

Today's hearing focuses on the important task of bolstering the ability of America's community colleges, in collaboration with industry partners, to develop and publicize successful tech-training programs. I am eager to hear our witnesses' assessments of the programs and partnerships implemented thus far so that we can reflect on the successes and inefficiencies of the current strategies and seek to make modifications for improvement. Your first-hand experiences are vital to overcoming the technician shortage through technical education programs and industry support.

To all the witnesses—thank you for taking time out of your busy schedules to appear before us today. I look forward to hearing your testimony.

Chairman BAIRD. And now it is my great privilege to introduce our witnesses, and I will start with a friend from my home district, who is the very distinguished president of South Puget Sound Community College, who has also served as president of Bellingham Technical College and held positions at Guilford Technical in North Carolina. Dr. Pumphrey, thank you for being here.

Dr. Stephen Fonash is the Director of Penn State's Center for Nanotechnology Education and Utilization and is an active researcher in the field of nanotechnology.

Mr. Eric Mittelstadt is the Chief Executive Officer of the national Counsel for Advance Manufacturing. He has been very active in industry, serving as the Chair of America's leading robotics manufacturer, FANUC, among many other projects and activities. Mr. Mittelstadt, thank you for being here.

And finally, Ms. Monica Poindexter, who is currently Director of Corporate Diversity at the California-based Genentech, Incor-

porated. Her work in workforce development for Genentech led to the company's colaboration with community colleges to train technicians for the biotech industry.

So we have got an outstanding panel of witnesses to address precisely the questions before us today. As our witnesses should know from our prior communications, we try to keep the testimony limited to five minutes. Under Dr. Ehlers's term as Chair, we had a push-button up here that has a trapdoor below your seat, and you get about a 15-second grace period, and then you vanish, and we shall carry on without you. So try to keep it down to five minutes. I know these are tremendously important topics. We will have a good opportunity for give-and-take in the questioning, so we very much appreciate your presence, and we shall just work from the left to the right as we look at it.

Dr. Pumphrey, please, enlighten us with your remarks.

STATEMENT OF DR. GERALD PUMPHREY, PRESIDENT, SOUTH PUGET SOUND COMMUNITY COLLEGE

Dr. PUMPHREY. Thank you, Chairman Baird, Dr. Ehlers, Members of the Committee. I have been asked to respond to a few questions. The first series of questions is "what factors are involved in the decision by a community college when deciding whether to develop or continue a technical training program in a particular field?" How does the college evaluate the potential impact of the program in comparison to its associated costs, and what are the biggest challenges faced by a community college in either initiating or continuing a program with low enrollment?

First, I would say that it is useful to think of a publicly funded community college as a state-assisted business, because we do very much operate on a business model. It happens that our capital facilities and a substantial portion of our revenue in the State of Washington are provided by the state, but the students' tuition and fees are part of that revenue stream as well. So when we look at an opportunity to start a new technical training program, we are looking at employment demand and differentiating amounts of growth, retirements and turnovers, and the potential costs. We are also looking at the potential for student demand.

We evaluate potential new programs as a business opportunity by looking at the cost and availability of faculty, facilities, and technology and also the willingness of the industry sector to collaborate on curriculum. Given that our margins are often very thin, we need to evaluate the possibility of external funding to help offset startup and/or operating costs for highly specialized or technically sophisticated programs, and the more specific it is, the more likely we are to need external help to do it.

And there are the political considerations around program approval and accreditation requirements and other sorts of issues. We have to understand whether another college offers a similar program within geographic proximity, and that is why we have State-approval boards.

There are two big challenges as I see it. The first is our ability to respond at industry's pace. We are not organized like industry, and it's very difficult for us to move as quickly as industry does, and that, in fact, is one of my greatest fears for the effectiveness

of community colleges over time. The second challenge is around capitalization, where you get the money to respond with.

We really do run these technical programs as separate business units, so we are paying a lot of attention to enrollment and its effect on revenue. If we do not have the students in the program, it is very difficult for us to sustain it.

The next set of questions surround what factors influence the low enrollment of technical training programs and how the low enrollment can be remedied, and what efforts do yours and other colleges make to attract the largest population of students to technical training. Well, there is a fundamental problem these days in the technical trades: 40 percent of the enrollment in higher ed. in the U.S. is by males, 60 percent by females. If you are looking at manufacturing, that is a traditionally male-dominated industry. It need not be so. There are many women in a wide variety of careers, and many of us have special outreach programs to recruit women, but that is a fundamental problem for recruitment.

Student interest in the program is driven by a variety of factors, including wages, advancement opportunities, perceived working conditions, visibility of the industry, the availability of alternative opportunities, the relative effect of education or training on employment prospects. If the job is available without education or training, that is a deal breaker for students interested in enrolling in the program. Colleges do employ a wide variety of outreach efforts in high schools. Many of us have tech-prep programs. We have articulated dual-credit arrangements. We have outreach coordinators that work with the high school to communicate the opportunities. These work better when industry goes with us. We are selling training; the industry is selling the jobs. The student is interested in the job, so we are more effective when we work together on that.

The last set of questions were what challenges does inadequate math/science preparation pose to technical training programs. Do you know of colleges involved in innovate ways of addressing this dilemma, particularly in collaboration with secondary schools? I can tell you that inadequate math and science preparation has an impact on the operating budgets of the college, because we have to divert substantial resources from college-level work to remedial work, whether it is in literacy through adult basic education, the GED program, English as a Second Language—all of which are vital parts of our mission, but they are not college-level work—also through the developmental education programs that we run that take students who need some amount of brushing up on their math skills in particular to bring them up to entry level for college-level courses, so it is a diversion of effort. It is a diversion of money, and we are proud to do it because it is an absolutely vital service for our community, but typically that is not funded at the same level as college-level work.

Ultimately, as much as we would like to say it is not the case, I feel it has an impact on the quality of the graduates that we put out. We know that the longer a student spends in remedial or developmental education, the less likely they are ever to make it into college-level work. There is a certain threshold they have to meet to get there.

And I think I am out of time, so I will stop here.

[The prepared statement of Dr. Pumphrey follows:]

PREPARED STATEMENT OF GERALD PUMPHREY

What factors are involved in a decision by a community college when deciding whether to develop or continue a tech-training program in a particular field? How does the college evaluate the potential impact of the program in comparison to its associated costs? What are the biggest challenges faced by a community college in either initiating or continuing a program with low enrollment?

Good afternoon, Chairman Baird, Ranking Member Ehlers, and Members of the Subcommittee on Research and Science Education. I thank you for the opportunity to testify before your subcommittee today. My name is Gerald Pumphrey, and I am President of South Puget Sound Community College. It is my privilege to speak with you today on the topic of technician education. It is a topic within my experience at four community and technical colleges in the States of Washington and North Carolina, and as a consultant within the Program Development Services section of the State Board for Community Colleges in North Carolina.

Community and technical colleges initiate technical training programs in response to employment demand, most often in the geographic region they serve. Employment demand often results from the growth of an industry and thus job openings within it. Also, the pending wave of retirements by baby-boomers will require replacement of skilled workers in many technical occupations. In other cases, increasing sophistication of technology will require retraining of incumbent workers and a higher level of education for entry-level workers. A sustainable and sufficient level of job openings for graduates is a necessary condition for any successful technical education program. Programs that serve a cluster of similar or related industries are usually more stable than one that serves a single large industry.

Prior to starting a new program, community and technical colleges will verify that career entry into the targeted occupation or range of occupations requires education and skills that are appropriate to a certificate or an associate degree. If these knowledge and skill requirements are minimal, the college may explore a customized skill training approach rather than a full program with permanent facilities, equipment, and faculty. If the program demands more extensive theoretical preparation and skill development than can be provided at the associate degree level, the college may partner with a university or pass up the opportunity altogether.

As a condition for creating a new program, colleges will assess the potential for student enrollment demand, sometimes directly through surveys of high school students, groups of incumbent workers, or unemployed workers. This phase of exploration usually includes a study of potential starting wages and career progression opportunities. If there is no positive differential in the starting wage of a training program graduate, student demand for the training is likely to be suppressed. Likewise, the ability to advance in the career by initial hiring is a positive indicator for starting a new technical education program.

If the college is governed by a State board or other program approval authority, it may be required to demonstrate that initiating a new program is not unduly competitive with similar programs at other colleges in its geographic proximity. The college may take under consideration whether a new program will have a synergistic or competitive relationship with its own existing programs. Often, a college will weigh the prospects of success for the proposed program and the potential benefit it offers its community. If the proposed program is understood to be critical to local economic development or services in the community, the college may engage in intense political activity on its own campus or before the body that has authority to approve the program.

Ideally, curriculum will be designed in conjunction with industry partners. Other considerations in curriculum development potentially include requirements for external program-level accreditation, industry-wide skill standards, and licensure standards for graduates, etc. Close collaboration with industry at this stage of program design is essential to successful technician education.

The academic and technical curriculum content drives requirements for faculty, facilities, and equipment. As technology becomes more specialized and advanced, colleges can face difficulty in finding and affording qualified faculty. Colleges may face constraints in the availability of classroom/laboratory space, particularly when programs require specialized electrical, mechanical, or data connections. Colleges vary widely in their ability to acquire and maintain sophisticated equipment, and the rapid evolution of technology makes this a particularly daunting task. Some

technician education programs experience high costs for consumable supplies, utilities, and software licensing agreements.

Before making a decision to implement a new program, the college must determine if it can muster the operating and capital funds to sustain it. Sources often include revenue from State funding, tuition, fees, and external training contracts. Colleges often face multiple, simultaneous opportunities to develop technical education programs, and usually must engage in a comparative cost analysis and reach some judgment concerning opportunity costs. In many cases, support from the relevant industry is essential to start and continue operation of the program.

What factors influence the low enrollment of tech-training programs? How can low enrollment be remedied? What efforts do your and other colleges make to attract the widest possible population of students to tech-training?

Low enrollment in technical training programs can result from a variety of external and internal factors. Among the external causes, the perception of a lack of employment opportunities can be a strong influence. In 2007, many colleges' information technology programs are only now recovering from enrollment declines that followed the recession in that industry after 2001. If it is possible to begin a career without technical education, or if having that technical education secures no wage advantage, fewer students will enroll in a training program. Sometimes, students perceive that better opportunities are available in a more dominant or more visible industry, leaving both viable jobs and the training programs that support them behind.

In some cases, factors internal to the college can have a negative influence on enrollment in technician education programs. If the college is unable to identify a target student population and market the program effectively, enrollment may suffer. If, over time, the college allows its facilities and equipment to become obsolete, enrollment will decline. If the program faculty do not maintain their own technological currency, or if their teaching skills decline, students will not continue to participate. These issues highlight the critical importance of maintaining strong, industry-based advisory committees for each of the college's technical programs.

Community and technical colleges employ a variety of strategies to attract students to technical education programs. Most work with the high schools in their service areas to connect related secondary career and technical education programs with college programs in similar disciplines. These connections are often made within the context of Tech Prep articulation agreements that give the high school student advanced placement credit for college-level work. Many colleges engage in a variety of other high school outreach programs in which college recruiters present programs for high school students and parents, along with workshops for teachers and counselors. Some colleges offer summer camps for middle and high school students to provide them exposure to technical or scientific careers. The last two colleges for which I have worked have held fairs to provide exposure for women to nontraditional careers in the trades or technical careers. In both colleges, we have had active referral systems in place with our regional WIA one-stop centers. In my experience, two factors are worthy of note. First, employers and their representatives usually have a higher impact on recruitment for training programs related to their industries than do college personnel. Second, community and technical colleges rarely have sufficient funding for effective marketing.

What challenges does inadequate math/science preparation pose to tech-training programs? Do you know of colleges engaged in innovative ways of addressing this dilemma, particularly through collaborating with secondary schools?

The fact that nearly half of the students entering community and technical colleges require at least some remediation in mathematics is a multi-dimensional problem for the colleges. Remedial or developmental education clearly diverts resources from college-level programming. These pre-college courses are typically funded by the states at a lower value per full-time equivalent student than college-level courses. This dilutes the funding stream and financial health of the institutions. The greater the length of time a student spends in remedial or developmental courses, the less likely she or he is to matriculate into and complete a college program.

To the extent a student's remediation is incomplete or imperfect, the technical education curriculum is invariably diluted. As a case in point, I was once summoned to a pharmacology class by the department chair of a medical assisting program. Her colleague was engaged in a laborious process of teaching the students long division of decimals for the purpose of calculating drug dosages. As frightening as this revelation was, there was also an undeniable shortchanging of the intended pharmacological content.

Washington State has a promising initiative to improve the ability of high school students to enter college-level mathematics courses without remediation. The Math Transitions Project is built on a detailed curriculum analysis and defines competency-based standards for college readiness in mathematics. The standards and additional information about the project are available at *http://www.transitionmathproject.org.*

What is an industry partner's ideal role in a community college tech-training program? Please elaborate on your experiences with industry partners.

Once the determination is made that employment opportunities and student enrollment demand are sufficient to sustain a technical education program, a college and the supporting industry can begin the detailed work of creating a partnership. Curriculum development presents an early opportunity. In the past, I have worked with technicians, front-line supervisors, human resource professionals, industrial trainers, and engineers to create curriculum for educating computer-aided machine operators and programmers (Outboard Marine Corporation, Burckardt Amerida, Amp, Inc.), chemical process technicians (Dow Corning, Proctor & Gamble, Stockhausen, Ciba Specialty Chemicals), and process operators (Conoco-Phillips, BP, Shell, Tesoro.) In most cases, we used source documents from National Science Foundation-funded Centers of Advanced Technology, or from organizations promulgating skills standards (National Institute for Metalworking Skills) as a starting point. We often prioritized, selected, and occasionally modified these curriculum materials to fit local needs. When working with multiple industrial partners, the process often involves reaching a consensus on the content needs shared by all the partners and an agreement that any additional proprietary training be done in-house after hiring. Collaboration among the college and its industrial partners on curriculum design is a fundamental building block of a successful partnership.

While developing a program in Chemical Process Technology at Guilford Technical Community College in Greensboro, North Carolina, a group of engineers from the participating companies identified nine unit operations that their future employees needed to perform. Using standardized connections, they designed modular units for each of these processes, facilitating interchangeable sequencing and simulating manufacturing of a variety of products. These engineers produced CAD files of this modular equipment and the laboratory space that the college planned to renovate for use by the new program. They secured substantial donations of pumps, valves, and other components from surplus inventory in their plants. They worked with their purchasing managers to leverage deep discounts for remaining equipment purchased by the college. The result was a laboratory that supported the curriculum and was flexible enough to meet the needs of both career-entry trainees and the companies' incumbent work forces. Dow Corning provided a two-for-one matching grant to cover the hard cash costs of the project.

Conoco-Phillips, BP, Shell, and Tesoro provided similar assistance with the development of a Process Technology program at Bellingham Technical College in Bellingham, Washington. Industry support for that program and a related one in Instrumentation and Process Control Technology led to the college's designation by the state as a Center of Excellence in Process Manufacturing.

One of the most productive models for a partnership between community and technical colleges and an industry is the approach to service technician training developed first by General Motors and now shared by most automotive manufacturers. As microprocessor technology spread throughout a host of automotive applications, General Motors foresaw the need for a higher level of theoretical preparation for the technicians who serviced its products in the dealerships. They developed a program that is structured with alternating periods of study and practice on campus and periods of cooperative education work experience supervised by seasoned technicians in the workplace. The manufacturers have typically supported these programs with donated vehicles and components, technical update training for the faculty, and real time access to the latest technical service databases. At Guilford Technical Community College, both General Motors and Ford contracted with the college to provide update training for dealership technicians. The income from these training contracts was used to further augment the quality of the tools and technology for the career entry programs.

In all of the colleges for which I have worked, we have had a strong system of advisory committees. These committees are constituted by members representing employers and who are close to the evolving skill needs of their workforce. They provide feedback on developments in their industries to keep the programs current. Many are involved in student recruitment and outreach, securing cooperative education work opportunities, and assisting with the placement of graduating students in jobs. They have often assisted in securing donations of equipment and sometimes

funding. Many have served as guest speakers for classes or assisted in finding other speakers to do so.

In some rare cases so far limited to the medical industry, I have received help from partners through salary supplements or relocation assistance for faculty in high skill, high wage career fields. At South Puget Sound Community College, we have a three-year contract with Providence St. Peter Hospital to expand our nursing program by an additional class cohort. We would not have been able to respond to their employment needs to the same extent without the contract.

What impacts do shifts in industry demand have on tech-training programs and how do community colleges address these?

There are three principle types of shifts in industry demand that affect technical education programs. Most industries are now on a constant path of technology renewal in attempts to gain competitiveness by increasing productivity, reducing costs, speeding product development cycles, customization of products to customer specifications, or some combination of these efforts. In the face of this accelerating evolution in technology, colleges face increasing difficulty in keeping curriculum current, helping faculty keep their skills up-to-date, and in keeping instructional equipment and software parallel with industry practice. An effective advisory committee can keep a college apprised of the nature and extent of these requirements, but many colleges struggle with the costs of remaining current. The colleges most successful in meeting these demands are those in effective partnerships with industries that participate financially to keep technology in the training environment equivalent to that deployed in the production setting.

The technological evolution has also been accompanied by a large-scale shift by industries to embrace the quality movement, lean manufacturing, and other strategies for improving productivity and quality by empowering employees closest to the work processes to make decisions about them. This has fundamentally changed the goal of most technical education programs from producing workers outfitted with a specific set of skills and a narrowly defined knowledge base toward producing employees with a broader contextual knowledge of an industry, including its technology, production processes, business practices, and the culture of its customer base. Educated technicians are now also expected to be fluent in the use of a variety of information technologies, participate fully in team-based problem solving strategies, and to have a broader knowledge base that allows them to absorb future shifts in production processes and technologies at a minimum expense to the employer for re-training.

These changes in expectations have caused colleges to seek mechanisms for better connecting the student learning experience across academic and technical disciplines. Many colleges have experimented with team teaching and learning communities in which intact cohorts of students enroll in blocks of related courses. Colleges still struggle to an extent to develop tools for assessing cross-functional learning. These types of changes have not been easy to implement within the architecture of college organizational structures and cultures. Most of the colleges have broad missions that include not only technician education, but academic transfer programs, remedial and developmental education, and continuing education that respond to a broad variety of interests in their communities. This breadth of mission, along with the momentum of academic and institutional cultures, has not created the conditions for many colleges to emulate the organizational structures or thoroughly integrate the quality and productivity tools that have been widely adopted by their industry partners.

The third type of shift in industry demand is directly related to the expansion or contraction of labor market demand. These shifts can arise from industry-wide responses to fluctuation in the business cycle, or from the start-up, expansion, or failure of individual companies. Obviously, these changes have an impact on the demand for graduates, and they also have an impact, sometimes delayed, on student enrollment in related technical education programs.

It is easier for the college to respond to expansions. In some cases, the college can hire an additional instructor and schedule classes in existing facilities during extended hours of the day. In others, the college can respond with highly focused classes to up-skill incumbent workers for promotion into more advanced positions while offering accelerated, customized training for entry-level workers. If the growth in demand is broad across industry sectors and projected to be sustained, the college can plan to rent or build additional capacity. Industries are often much more likely to enter into substantive partnerships with colleges in periods of strong expansion and short labor supply.

Contractions are far more difficult for colleges to deal with. If the industry demand remains strong, but student enrollment is weak, the college will assess the

underlying reasons and may choose to develop an action plan. The action plan may involve a renewed marketing effort and/or address fundamental issues of program quality, including the technical or pedagogical skills of the instructor and/or the adequacy of instructional equipment.

Assuming a decline in demand for graduates or by students for enrollment is projected to continue, the college must face the difficult question of whether to continue the program. It is often the case that the college needs to redirect the funding that supports the program in question for responding to a new or different demand. Most often, some students are enrolled in the program and provisions must be made for them to graduate. Faculty contracts often specify detailed procedural requirements for terminating programs. If the positions of tenured faculty are to be eliminated, the process can be lengthy, contentious, and expensive. Often, a residual level of demand continues in the employment sector, but it is too low to sustain a college program. In these situations the college may face vocal opposition to terminating the program from industry representatives allied with the affected faculty. The college may need to make a sound business decision in an unsupportive political environment, but the resistance more often delays than prevents a choice that is ultimately inevitable in the face of inadequate enrollment.

BIOGRAPHY FOR GERALD PUMPHREY

Gerald Pumphrey was appointed President of South Puget Sound Community College in August, 2006. He was President of Bellingham Technical College in 2001–2006. Positions he has held at Guilford Technical Community College in Jamestown, NC include: Vice President of Instruction, 1999–2001; Dean of Instruction, 1998–1999; Director of Workforce Preparedness, 1996–1998; and Division Chair of Transportation, 1995–1997. He received a B.A. from Florida State University, FL; a M.A. from Appalachian State University, NC; and an Ed.D. from Clemson University, SC.

His memberships include: Economic Development Council of Thurston County, 2006–present, Board of Directors; Rotary Club of Olympia, March 2007–present; Thurston County Roundtable 2006–present; South Sound Manufacturers' Alliance, 2006–present, Executive Committee; Pacific Mountain Workforce Development Council, 2006–present; American Association of Community Colleges, Presidents' Academy Executive Committee; Transatlantic Training and Technology Alliance; Junior Achievement of Pierce and Thurston Counties, 2006–present; Board of Directors Downtown Renaissance Network, 2002–present; Northwest Workforce Development Council, 2002–present, Executive Committee; Center for Information Services, 2001–present; Past memberships include: Rotary Club of Bellingham, 2003–2005; GHG Housing Corporation, 1998–2001; Piedmont Triad Center for Advanced Manufacturing, 2000–2001.

Chairman BAIRD. That threat of the trapdoor gets them every time.

Dr. PUMPHREY. It does.

Chairman BAIRD. Dr. Pumphrey, thank you for your remarks. I think you were very cogent and concise, and I appreciate it.

Dr. Fonash, please?

STATEMENT OF DR. STEPHEN J. FONASH, CENTER FOR NANOTECHNOLOGY EDUCATION AND UTILIZATION, PENNSYLVANIA STATE UNIVERSITY

Dr. FONASH. Thank you, Mr. Chairman and Members of the Subcommittee for inviting me to testify before you today. I am an active nanotechnology researcher, but I have also become involved in community college education, and my comments come from that kind of a perspective.

Now, let me begin by saying that the generally accepted picture of manufacturing in today's work-world, and one which I strongly agree with, is that, as technology fields mature, their manufacturing components tend to migrate out of the United States. A good example of this is the semiconductor industry. The consequence of this picture is that manufacturing in the United States must be cutting edge and innovative. It must define the forefront to survive.

It follows that America's technical workforce must be equally cutting edge and prepared for a lifetime of learning. It must be prepared for innovation and innovating.

Much of the cutting-edge research that flows into industry and into U.S. manufacturing comes from research-intensive universities. I believe these institutions also have a role in bringing cutting-edge technology and the spirit of innovation to community college education, and thereby to America's technical workforce. Research-intensive universities have the facilities, the means to sustain these facilities and the resident expertise to give technology students intensive hands-on exposure to the equipment, concepts and innovation that will drive tomorrow's manufacturing. A partnership of community colleges, industry, and research-intensive universities is a very powerful one which can create and sustain strong associate degree technology education essential to continued U.S. global competitiveness.

In Pennsylvania, we have created such a partnership in the critical far-reaching field of nanotechnology. This is a partnership that we have named the Pennsylvania Nanofabrication Manufacturing Technology Partnership. It receives support from the Commonwealth of Pennsylvania and has since 1999, and in July 2001, it was established as a National Science Foundation Advance Technology Education center. With the addition of the resources of being designated an ATE center, the program has grown from a partnership of seven community colleges, Penn State, and industry in 2001, to a partnership, today, of the 14 community colleges in Pennsylvania, Penn State campuses across the Commonwealth, the Pennsylvania State System of Higher Education and industry. Today graduates of the partnership's programs earn their two-year nanotechnology degrees from 21 different Pennsylvania institutions. With the addition of the resources of the ATE center, we have also been working with numerous community colleges across the country that want to emulate our partnership and research-sharing model in their technology-education efforts.

A key aspect of our partnership is what we term the "capstone semester." It is taught using the state-of-the-art facilities and expertise resources of Penn State's University Park campus. All students in the nanotechnology programs of the 21 partners must take this total, hands-on emersion into nanoscale fabrication, synthesis, and characterization. This six-course capstone semester experience is provided by Penn State three times a year as a service for the two-year-degree-granting schools engaged in the education of technicians.

The motivation for industry to play a role in advance technology education is well understood. The motivation for research-intensive universities to play a role in technology education is less clear. There is a well-established innovation path from research universities to industry, which turns ideas in the laboratory into products for American industry. It is considered prestigious to participate in that pathway. There needs to be an equivalent innovation pathway from universities to technology education which turns new ideas in the laboratory into skills and learning in the technology classroom. Being a participant on this pathway needs to be deemed equally prestigious.

If I were to distill my thoughts down to one idea, I would say innovation and cutting-edge technology has to move quickly to the community college classroom, just as quickly as it moves to industry, and I believe the best way to do this is to encourage partnership and research sharing among community colleges and research-intensive universities.

Thank you.

[The prepared statement of Dr. Fonash follows:]

PREPARED STATEMENT OF STEPHEN J. FONASH

Question 1: Please describe the evolution of your program—how it began in response to industry's stated needs and how the program has changed as the industry needs and focuses have changed. Please describe how the program adjusted after the drop-off in demand for semi-conductor manufacturing technicians that occurred around the year 2000. How do you prepare your students to be adaptable to the changing needs in high-tech manufacturing?

Our program originated from calls in 1998 from Lucent, Fairchild Semiconductor, and Air Products for increased technical education in Pennsylvania in the micro- and nano-scale fabrication and characterization techniques used in the semiconductor industry. To address this need, Penn State University, Pennsylvania community colleges, other two-year-degree granting institutions in Pennsylvania, and industry worked together to create a two-year degree program teaching micro- and nano-scale fabrication and characterization with an emphasis in semiconductor applications. Today, this effort has evolved into the Pennsylvania Nanofabrication Manufacturing Technology (NMT) Partnership. Today, its programs provide a broad micro- and nano-scale fabrication, synthesis, and characterization educational experience addressing the career needs of students and the technician needs of a spectrum of industries. The Partnership has received support from the Commonwealth of Pennsylvania since 1999, and in July 2001, was established as a NSF Advanced Technological Education (ATE) Center. As an NSF ATE center, the Partnership works with numerous institutions in other states to aid in replicating our educational programs and partnership approach.

At the inception of the Partnership, it was decided that each two-year-degree granting institution should formulate its own nanofabrication education program. However, each program was required to include a one semester hands-on immersion in micro- and nano-scale fabrication and characterization which we termed the "capstone semester." Curriculum development was done in concert with industry through an Industry Advisory Board which oversaw, and today continues to oversee, the program and course development. The key—and unique aspect—of the program was the development of this capstone semester. This capstone semester experience is provided by Penn State three times per year at its University Park campus (fall, spring, and summer) as a service for the two-year-degree granting schools engaged in the education of technicians and production workers.

The "capstone semester" is taught at Penn State's University Park campus and it is only there that a critical mass of students must converge. This is an important consideration for three reasons: (1) community colleges across the country find that technology training programs do not attract a large number of students, (2) community colleges cannot afford to have, and even more importantly, cannot afford to maintain the expensive equipment needed, and (3) community colleges do not have the resident expertise required to use this equipment to teach micro- and nano-scale manufacturing technology. With the approach taken in the NMT Partnership, each "home school" contributes students to the capstone semester at University Park and the individual home schools need not have a critical mass in order to offer this training. They do not have to create whole new curricula for students but only have to modify course content to prepare students for the capstone experience. With the approach taken, Penn State's broad facilities and the resident expertise were from the start, and are now, used to teach the defining, hands-on capstone semester exposure to advanced micro- and nano-scale fabrication and characterization. The approach was, and continues today to be, that the two-year degree granting institutions use the capstone semester courses in their programs as they see fit. These six courses are "on their books" as their courses and each home school's students pay their institution's tuition even while taking the capstone semester. The State of Pennsylvania enables this by paying the difference between the home school's tuition and the actual cost of the capstone semester experience.

With the drop-off in demand for semiconductor manufacturing technicians which occurred in the 2000–2001 time period and with the increasing hiring of the NMT Partnership students by chemical, information storage, and pharmaceutical companies, it became apparent that micro- and nano-scale fabrication and characterization training should not be focused only on semiconductor manufacturing but that there was a ubiquitous need. The dramatically changed fortunes of the semiconductor industry at that time also taught the Partnership that students must be prepared for a lifetime of changes and shifts. As a consequence, the capstone semester courses were refocused to provide even more general training in micro- and nano-scale fabrication, synthesis, and characterization. The community colleges of the Partnership responded by modifying additional curricula and thereby inserting the capstone semester into degree programs in fields such as chemistry, manufacturing, and life sciences. The on-set of these changes and their continuing evolution may be seen in Fig. 1. With this broadening of the Partnership, micro- and nano-scale fabrication, synthesis, and characterization education areas, companies such as Rohm and Haas, Merck, Johnson & Johnson, PPG, and Lockheed Martin joined the Industry Advisory Board. The current composition of that Board is seen in Table I. The broad spectrum of Pennsylvania companies that have hired NMT Partnership graduates is presented in Table II.

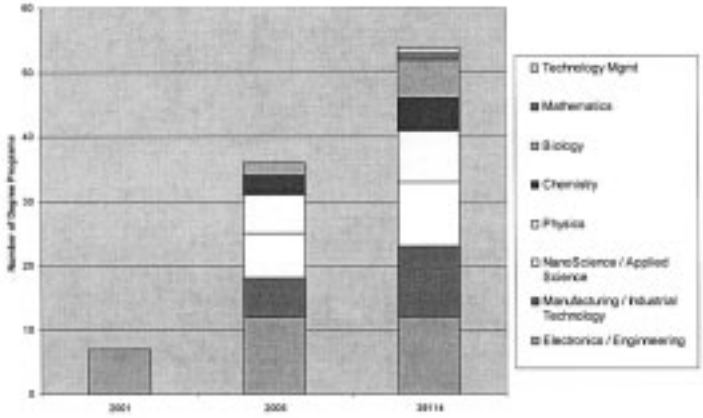

Figure 1 Evolution of the degree areas using the six-course, hands-on capstone semester immersion in micro- and nano-scale fabrication, synthesis, and Characterization

Table 1
PA NMT Industry Advisory Board Membership as of May 2007

Agere Systems
Airgas
Air Products and Chemicals
Bayer Materials Science
Boy Machines
CarboLex
Crystalplex
Diamonex
Edlon
Fairchild Semiconductor
Hanson Technologies
Imiplex
Johnson & Johnson
Kurt J. Lesker
Lockheed Martin
Merck
Minerals Technologies
PPG Industries
Plextronics
RJ Lee Group
Rohm & Haas
Saladax Biomedical
Schott Glass Technologies
Seagate Technology
Solid State Measurement
Tyco Electronics
US Steel
Veeco
Versilant Nanotechnologies

Being designated as an NSF ATE center has been absolutely critical to our being able to broaden our educational impact and to our success. It has enabled the program to go from a Partnership of seven community colleges and Penn State in 2001 to a Partnership of all 14 PA community colleges plus Penn State campuses and the Pennsylvania State System of Higher Education. Today the Partnership's mission can be summarized as the following: to educate a workforce that is skilled in micro- and nano-scale manufacturing concepts in which can be transferred from industry to industry as the economic winds wax and wane. In short, we want to provide students with an excellent, broad education and the ability to take advantage of career opportunities as they may occur across a wide spectrum of industries. We want to make industry cutting edge and competitive and to give it a cutting edge and competitive workforce that can adjust to rapid change. We also want to provide two-year degree students with clearly defined pathways to a variety of four year degree opportunities. With that latter objective in mind, the four-year degree State System of Higher Education schools have been added to the Partnership. Working with the two-year degree institutions, these schools have created pathways whereby two-year degree graduates can use the capstone semester credits to build four year degrees in chemistry with a concentration in nanotechnology, in biology with a concentration in nanotechnology, in physics with a concentration in nanotechnology, and in engineering technology with a concentration in nanotechnology.

Table II
PA Companies Who Have Hired NMT Capstone Semester Graduates for Micro- and Nanotechnology Jobs (As of December 2006)

II-IV Corporation
Agere
Allied Fueling
Alden Products
Amedeo
Apogee Photonics
Avail Technologies
BioElectroSpec
B. Braun
Cabot
Correg Sensors
Cosmos Technologies
Cyoptics
DRS Laurel Technologies
Dana Corporation
Doucette Industries
Ex One
Fairchild Semiconductors
Fincor Automation
First Energy
F.S. Elliott
Gas Technologies
GlaxoSmithKline
Hershey Medical Center
Johnson & Johnson
Johnson Matthey
Keystone Engineering
LCM Technologies
Lockheed Martin
Lucent Technologies
Lutron Electronics
Membrane Assays
Merck
NanoHorizons
Optellios
Philips Medical Systems
Plextronics
Probes Unlimited
PPL
Rhetech
Seagate Technologies
SI International
Spectrum Technologies
Textron Lycoming
Transene
Westfalia Technologies
Xactix

Question 2: What demographic profile does your program draw? How have you faced the challenge of recruiting more students to your program?

The demographic profile of the students at NMT Partnership schools is that of the 21 community colleges and other two-year-degree granting institutions in the Partnership from across Pennsylvania. Figure 2 gives the female and minority compositions of the students who take the capstone semester. The representations for females and minorities is close to that seen across the country for engineering. The Partnership has embarked on using three day Nanotech Camps, held in the summer at University Park for high school students, as a recruitment tool and a means to increase female and minority interest in nanotechnology-based manufacturing. Last summer a total of 206 high school students attended these Nanotech Camps at Penn State. Of these students, 50 percent were under-represented minorities and 56 percent were female. This summer, it is anticipated that 50 percent of the attendees will be female. Further, of the 10 Nanotech Camps scheduled, four will be exclusively for under-represented minorities.

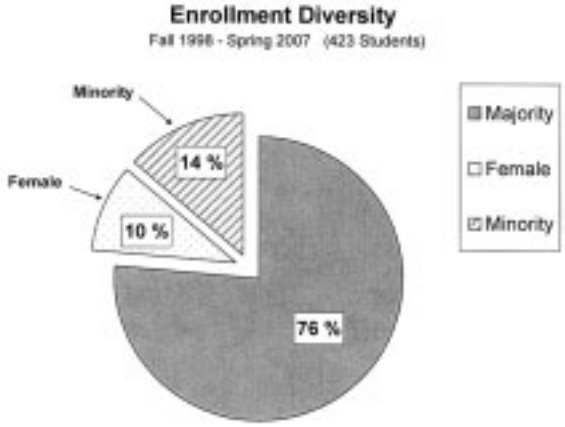

Figure 2 Enrollment diversity for 423 student attendees beginning winter semester 1999 through spring semester 2007

Community colleges find that recruiting students for technology programs is difficult whether addressing minority, female, or general populations. At least some of the reasons for this problem lie in (1) parental desire for students to attend a four-year degree school, (2) a perceived lack of clear paths to four-year degrees for students attending two-year degree schools, (3) a nation-wide aversion to science and technology, and (4) lack of aggressive marketing by the community colleges. In the NMT Partnership, the various schools recruit their students. Partnership participation arms them with distinct, advantageous points to convey to prospective students and their parents. These include: (1) students will have a hands-on opportunity to work with the latest equipment and learn the very latest technology from practitioners, (2) students will spend one semester in the environment of a research university, (3) students will get more hands-on experience than four-year engineering students, (4) pathways are in place for two-year students to continue to four-year degree programs with nanotechnology concentrations, and (5) two-year degree NMT graduates of Partnership schools have been receiving salaries in the $30,000 to $50,000 per year range. Even with these "sales-points," the marketing of the unique micro-and nanotechnology education opportunities provided in Pennsylvania to counselors, teachers, parents, and students has been hampered by (4) above; i.e., lack of aggressive marketing by the community colleges.

The Partnership has prepared materials and tools to assist in marketing efforts. Included are nanotechnology product bags showing some of the latest nanotechnology-based consumer products, web access to nanotechnology tools for remote operation, a movie on a day in the life of a student who is taking the capstone experience, testimonials from industry, testimonials from graduates, and a public service announcement from the PA Governor. Many of these may be seen on the Partnership web site *www.cneu.psu.edu.* In addition the Partnership holds nanotechnology workshops for middle school and high school teachers to work to create a cadre of teachers who understand the far reaching impact of this technology. To date over 500 teachers have taken these workshops. However, all these efforts are only useful when coupled with a strong marketing effort. Community college faculty do not seem to have the time to do the needed recruiting, community colleges do not seem to have adequate marketing capabilities, and administrators worry support for nanotechnology education programs such as the PA NMT partnership will evaporate.

Question 3: How do you determine your math/science curriculum? What steps do your partner community college institutions take to ensure students can meet the demands of your program?

With the added resources available since becoming an NSF ATE center, our Partnership has grown to 21 institutions offering 33 nanotechnology two-year degrees across Pennsylvania. Each school uses the capstone semester as an integral part of its two-year degree programs which are based on micro- and nano-scale fabrication, synthesis, and characterization. Each institution has tailored these degrees to meet the industry focus in its area. For example, the two-year degree programs in the Pittsburgh area tend to be materials processing oriented. Those in the Philadelphia area tend to be chemistry and biotechnology oriented. The two-year degrees offered by Partners run the gambit from nano-manufacturing to nano-biotechnology.

With this number of institutions and this variety of degree types feeding into the capstone semester hands-on experience, it is not feasible to even attempt to standardize the math/science courses and curriculum base for the Partnership. To try to do so would take years since each institution has its own course and curriculum committees and procedures. Rather than attempting this approach, we chose to standardize the skill set that must be provided by each math/science curriculum feeding into the capstone semester. Each institution must certify that this required skill set is met by each student it sends to the capstone semester. The capstone semester then builds on this entry skill set. Students emerge from the capstone semester with the technician skill set established by the Industry Advisory Board. This is shown in Table 3.

Table III

Skill Set Acquired from the Capstone Semester

Micro- and Nanotechnology Foundation Skills

- Basics of Chemical and Material Properties
- Chemical and Materials Handling
- Health, Safety, and Environmental Concerns
- Cleanroom Use, Design, and Maintenance
- Pumps, Flow Control Systems, Scrubbers, Sensors: Use and Maintenance
- Vacuum Systems: Use and Maintenance
- Plasma Generating Systems: Use and Maintenance
- Furnaces: Use and Maintenance
- Chemical Reaction Systems: Use and Maintenance
- Contamination Control
- Process Integration
- Introduction to Statistical Process Control
- Biocompatibility

Micro- and Nanotechnology Synthesis and Fabrication Skills

- Bottom-up
  - Pattern Generation
  - Chemical, Physical, and Biological Self-Assembly
  - Nanoparticles: Colloidal Chemistry
  - Nanoparticles: Plasma and Grinding/Milling Approaches
  - Nanoparticles: Chemical Vapor Deposition
- Top-down
  - Optical, E-beam, Stamping, and Imprinting Lithography
  - Etching and Deposition
  - Chemical Vapor and Physical Vapor Deposition
  - Materials Modification
- Hybrid

Micro- and Nanotechnology Characterization Skills

- Optical Microscopy

- Scanning Probe Microscopy
  - Atomic Force Microscopy
- Electron Microscopy
  - Scanning Electron Microscopy (SEM and Field Emission SEM)
  - Transmission Electron Microscopy (TEM and Field Emission TEM)
- Chemical Characterization
  - X-ray (Energy Dispersive Spectroscopy)
  - Secondary Ion Mass Spectroscopy
  - Auger Electron Spectroscopy
  - Fourier Transform Infrared Spectroscopy
- Electrical Characterization
  - Current-Voltage Measurements
  - Capacitance Measurements
  - Opto-electronic Device Measurements
- Physical Characterization
  - Spectrophotometer
  - Profilometer
  - X-ray Diffraction

Micro- and Nanotechnology Professional skills

- Team Building
- Problem Solving
- Project Organization and Planning
- Research Skills
- Assessing Cost of Ownership
- Presentation Skills
- Technical Reporting and Documentation
- Intellectual Property

Question 4: What is the ideal role for industry partners in developing and running a successful tech-training program? Please elaborate on industry's role in creating skill standards, developing curriculum, providing student development opportunities, defraying the cost of equipment, and hiring graduates.

For a meaningful advanced manufacturing and technology education program, industry must be involved from the inception. This was the situation for our Partnership—in 1998 companies such as Lucent, Fairchild, and Air Products went to the Pennsylvania government with Penn State representatives to argue for the semiconductor oriented micro- and nanofabrication education effort. This evolved into the 33 very broad micro- and nano-scale manufacturing technology two-year degree programs of today's NSF ATE center. From the very beginnings these companies, and the 26 additional companies that have joined them over the ensuing nine years, have constituted our program's Industry Advisory Board. We have worked to keep this group small enough to be active and interactive and yet broad enough to encompass representatives from all the various Pennsylvania industries now impacted by nanotechnology from pharmaceuticals to the alternative-energy companies and from information storage to measurement tools companies. Our current Industry Advisory Board (Table I) last met this past May 2007 in its Partnership guidance role.

An Industry Advisory Board plays an extremely crucial role in advanced manufacturing and technology education for the very basic reason that it tells you if what you are doing is meaningful, or not, to companies. One must temper its advice, however, with the understanding that in some cases an industry view can be a very "this quarter" perspective—after all, in the beginnings of our program, before the collapse of much of the semiconductor manufacturing in this country, we were being told to emphasize the semiconductor industry aspect of micro- and nano-scale manufacturing. Nonetheless, the Industry Advisory Board and its input to courses and curriculum has been the principal force in shaping our program. Every year the Board reviews the skill set responsibilities of the community colleges, the course content of the capstone semester courses taught for the community college by Penn

State, and the skill set to be developed in the capstone semester experience. The current capstone semester skill set that comes out of this industry input, just modified as a result of the May 2007 Board meeting, is seen in Table III.

The innovation and vision of research intensive universities is sought after by industry to aid in keeping their products on the cutting edge and competitive internationally. That same innovation and vision of research intensive universities is also needed to aid in keeping community colleges on the cutting edge of skilled technician and production worker education. The "this quarter" perspective that industry can sometimes bring in its assessment of workforce skill needs can be tempered by the "next decade" perspective of products and manufacturing that a research intensive university can bring. This perspective is critical to the students' well being and to the country's long term economic health. Students must be educated with an understanding of basic fabrication, synthesis, and characterization and imbued with the basic desire to continue to want to learn. It is only this approach that will allow the workforce—and ultimately the country—to adapt to the changing needs, which surely will come, in high-tech manufacturing.

A proposed list of the ideal roles industry can play in advanced technical education programs such as micro- and nano-scale fabrication, synthesis, and characterization is the following:

(1) Delineate the skills needed for workers and evolve these as the industries react to competition and market forces
(2) Monitor courses and curricula to insure these skills are taught
(3) Assist with student recruitment
(4) Provide student development opportunities such as internships
(5) Assist with equipment costs
(6) Hire graduates

Research intensive universities should have an equally important role in advanced technical education programs such as micro- and nano-scale fabrication, synthesis, and characterization. A proposed list of the ideal roles research intensive universities can play is the following:

(1) Balance the near-term perspective of industry with the longer-term perspective of a research university
(2) Provide the facilities and resident expertise as a service to allow community colleges to offer hands-on experiences in a broad variety of micro- and nano-scale manufacturing processes
(3) Provide the facilities and resident expertise to offer "teaching-the-teachers" education for keeping community college faculty current in manufacturing technology
(4) Assist community colleges with the development of student recruitment materials (e.g., provide brochures, web access to equipment, web available informational materials)

The motivation for industry to play these proposed roles in advanced technology education is well understood. The motivation for research intensive universities to play the roles proposed for them for advanced technology education is less clear. There is a well established innovation path from research universities to industry which turns new ideas in the laboratory into products. It is considered prestigious to participate in this pathway. There needs to be an equivalent innovation path from universities to technology education which turns new ideas in the laboratory into skills and learning in the technology classroom. Being a participant on this pathway needs to be deemed equally prestigious. Innovation has to move to industry rapidly to keep it competitive. Innovation has to move to the technology classroom equally rapidly to keep the country's workforce competitive and to provide a lifetime of opportunities for technical workers. Perhaps something like a Morrill Act for the 21st century is needed to insure that innovation and cutting edge developments are moved quickly into the teaching of the "branches of learning as are related to. . .(the) mechanic arts."

BIOGRAPHY FOR STEPHEN J. FONASH

Dr. Stephen Fonash holds the Bayard D. Kunkle Chair in Engineering Sciences, at the Pennsylvania State University. He is also the Chairman and Chief Technology Officer of NanoHorizons, a nanoscale-materials engineering company. Dr. Fonash's activities at Penn State include serving as the Director of Penn State's

Center for Nanotechnology Education and Utilization (CNEU) and as the Director of the National Science Foundation Advanced Technology Education Center.

Prof. Fonash's education contributions focus on nanotechnology workforce development and on nanotechnology secondary and post-secondary education. His research activities encompass the processing and device physics of micro- and nanostructures including solar cells, sensors, and transistors. Current research activities include studies of the effects of nanoparticle plasmon-related enhancement of optical characterization techniques, electrical sensing based on nanowires, and nanowire transistors. He has published over 300 refereed papers in the areas of education, nanotechnology, photovoltaics, microelectronics devices and processing, sensors, and TFTs. His book *"Solar Cell Device Physics"* has been termed the "bible of solar cell physics" and his solar cell computer modeling code AMPS is used by over 600 groups around the world. Dr. Fonash holds 23 patents in his research areas, many of which are licensed to industry. He has founded two companies, serves on the boards of several companies and journals, and is also a consultant to a variety of firms. Prof. Fonash received his Ph.D. from the University of Pennsylvania. He is a Fellow of the Institute of Electrical and Electronics Engineers and of the Electrochemical Society.

Chairman BAIRD. Thank you very much, Dr. Fonash.

Mr. Mittelstadt, please.

STATEMENT OF MR. ERIC MITTELSTADT, CEO, NATIONAL COUNCIL FOR ADVANCE MANUFACTURING

Mr. MITTELSTADT. Thank you, Chairman Baird and Ranking Member Ehlers, and Members of the Subcommittee. I very much appreciate and am honored to testify today on what NACFAM believes is a critical issue in the 21st century, and that is the need for a more highly skilled and lifelong-learning workforce. I commend you for this hearing, and I hope that I can add to our collective understanding of the issues and what community colleges and industries are doing to meet the demand.

Let me briefly set the stage for why higher skill levels are required of production workers and technicians now and in the future and why innovative and collaborative approaches to training them are essential. Manufacturing has led the U.S. economy in productivity gains in recent years, but that productivity must continue to increase for a number of reasons: these include demographics, increasing customer demands, the hypercompetitive global economy, inevitable fluctuations in our economy, and finally because we have fewer people than China and India have, for example, we have got to remain more productive and innovative if we are going to remain a world power.

To achieve the dramatic increases in manufacturing productivity of the past 20 years or so has required increasing use of the technologies of automation, information technology, statistical quality control, and on and on. To utilize these effectively, production workers continuously need more skills. This added sophistication of production jobs is magnified by the coming dramatic reduction in the size of the U.S. workforce as millions more baby-boomers retire in the next decade than the number of new, young workers entering our workforce. Obviously, this demographic fact of life affects all sectors, from stockbrokers to teachers, from retail salespeople to healthcare workers, and it certainly affects manufacturing. Thus, the current and near-future outlook for graduates of technical training programs is excellent, even as the reality of increasing productivity continues to reduce the number of traditional manufacturing jobs, similar to agriculture in the previous century.

Data from a number of industries show shortages already of qualified workers, and this will only get worse as the demographics play out. Faced with this reality, many companies, their associations and educational institutions are all taking multiple and collaborative approaches to attract more students to these careers. In addition, companies must pay higher wages and benefits to those positions. They have got to increase their training efforts. They need to utilize objective-skill standards and certifications. Companies are also realizing that they cannot solve this problem by themselves. They are partnering with community colleges to guide tech-prep programs to address the required skilled upgrades and working through their associations to attract more students to those skilled careers. For example, the Business Champions Program of the Manufacturing Institute Center for Workforce Success encourages manufacturing executives "to engage the business community, elected officials, foundation leaders and State policy-makers about the importance of community colleges in developing a skilled workforce." Further, their "Dream It Do It" program works to raise the perception of manufacturing careers among current and potential students.

The necessary skills for even production workers now includes STEM education to enable them to most effectively use the advanced equipment and techniques so essential to U.S. manufacturing competitiveness. STEM skills are, for example, included in the advance-manufacturing competency model sponsored by the Department of Labor, in whose development, we at NACFAM and other industry associations participated. STEM skills are also included in the manufacturing-skills standards council work of NACFAM with the American Federation of Laborers Working for America Institute.

In conclusion, today there is great progress being made, but the challenges are even greater. The required 21st century workforce skills are not only important to every individual worker, they are increasingly becoming essential for continued American innovation, and therefore, prosperity. Moreover, as daunting as these workforce challenges are, they are only one of many facing U.S. manufacturers. In the new paradigm of network-centric manufacturing, a new level of what we call intense collaboration is required among OEMs and suppliers, but also with labor education and government. The future competitiveness of our nation depends on the success on the intense collaboration, including as it applies to the critical issues being discussed here today.

NACFAM is looking forward to working with you to make it all happen. Thank you very much.

[The prepared statement of Mr. Mittelstadt follows:]

PREPARED STATEMENT OF ERIC MITTELSTADT

A key issue facing our great nation in the 21st century is the need for a more highly trained work force to maintain the U.S. position as a world power. NACFAM commends the Subcommittee for this hearing, and hopes it can add to the collective understanding of the issues and what community colleges and industry are doing to meet the demand.

While today's focus is on production workers and technicians, many of the points herein apply to most sectors of the U.S. economy. It is helpful to set the stage for why higher skill levels are required of these workers now and even more so in the

future, and why innovative and collaborative approaches to training for them are essential.

Manufacturing has led the U.S. economy in productivity gains in recent years. Overall the concerns of the 80's and into the 90's that Japan would surpass our productivity have been put to rest. Today however, there are new challenges from China and India especially, and in the remainder of this new century others will arise as other nations in Southeast Asia, Latin America, Africa and even the Middle East, seek to improve their economies and the standard of life of their citizens. Therefore, manufacturing productivity must *continue* to increase for a number of reasons:

- Demographics—tens of millions fewer workers (input) by 2018, but a growing population and increasing demand (output).
- Consumer pressures for higher quality, content and customization at ever lower prices.
- An increasingly "hyper-competitive" global economy as more and more nations seek to improve their economies to become more like America.
- The inevitable fluctuations in the economy—when times are tough, companies must squeeze every penny they can out of costs just to survive.
- And finally, because the U.S. has fewer people than China and India for example, we must be more productive, and innovative, for the America to remain a world power.

This need for increased productivity generates some inescapable trends:

- The need for increased productivity means producing more (output) with fewer workers (input).
- Thus, there will be an inevitable *reduction* in the number of traditional manufacturing jobs.
    - Similar to agriculture in the previous century, but hopefully not as severe, and also necessary because of the shrinking workforce.
- The experience lost by the retirement of the "baby-boomers" along with the increasing use of technology on the factory floor requires well-trained workers and lifelong learning to keep those skills current.
    - Another way of looking at this is that the *experience* of the retirees *will be replaced by* the increased *skills* of younger workers because the latter can't possibly enter the workforce with the experience of those retiring from it.
- All of this requires innovation in both product and process development & deployment, and also in *labor-market policies* by businesses as well as in the education and training practices of the institutions preparing workers for the future.

Achieving the dramatic increases in manufacturing productivity over the past 20 years or so has required increasing use of the technologies of automation, information technology, statistical quality control, lean, just-in-time delivery, etc. To utilize these technologies effectively means manufacturing production jobs require more skills, including STEM capabilities even on the factory floor. This added sophistication of production jobs is magnified by the coming dramatic reduction in the size of the U.S. workforce because the "baby-boomers" retiring over the next decade will be millions more than the number of new young workers entering the workforce.

Obviously this demographic fact of life affects all sectors—from stock brokers to teachers, from retail sales people to health care workers, and certainly includes manufacturing. Thus the current and near-future outlook for graduates of technical training programs is excellent even as the reality of increasing productivity continues to reduce the number of traditional manufacturing jobs just as happened in agriculture the previous century. Data from a number of industries already show shortages of technicians with the necessary qualifications. For example, the National Association of Manufacturers (NAM) *2005 Skills Gap* survey said that "over 80 percent of respondents stated they face, right now, shortages of qualified employees including skilled production employees, scientists and engineers." This will only get worse as the demographics play out.

Faced with the current and growing shortage of qualified technicians, many companies, their associations, and educational institutions are all taking multiple and collaborative steps to attract more students to careers as "skilled technicians" required for both engineering and production work in the 21st century. For example, successful companies must pay higher wages and benefits for many of these posi-

tions to attract the scarce talent they need to effectively utilize their production technologies and to continue to increase their productivity and competitiveness. They are also increasing their training efforts, utilizing skill standards and certifications to assure that the people they hire and train have the necessary skills, and improving their retention practices. All of this leads to more students seeing the advantages of "skilled technician" careers with companies that care about them as skilled individuals.

Perhaps most importantly, companies are realizing that they cannot solve this problem by themselves or just by complaining to educational and training entities. They are increasingly partnering with community colleges to guide their tech-prep programs to address the required skill upgrades, and working through their associations to attract more students to careers as skilled technicians and skilled production workers.

One significant example of this is the *Dream It Do It* program of the NAM Manufacturing Institute's Center for Work Force Success. This program aims at raising the perception of manufacturing careers among current and potential students. It is a regional approach to "Manufacturing Careers Campaign(s). . .providing youth-oriented awareness and education initiatives designed to captivate and prepare the next generation of skilled American manufacturing talent."

Another example is their *Business Champions* program to encourage manufacturing executives "to engage the business community, elected officials, foundation leaders and State policy-makers to learn more about community colleges including their strengths and challenges in developing a skilled workforce." With "45 percent of all undergraduate students enrolled in community colleges," this program recognizes the necessity for business to partner with those institutions to advise them on what is required to prepare students for the more demanding jobs of the future.

The necessary skills needed by even production workers today include the knowledge derived from STEM education. With this knowledge they can more effectively use the automation, IT, and advanced production techniques so essential to U.S. manufacturing competitiveness. This can be seen in the Advanced Manufacturing Competency Model developed by the Department of Labor (DOL) with help from NACFAM, the National Association of Manufacturers (NAM), the National Institute for Metalworking Standards (NIMS), the Society of Manufacturing Engineers, et al. The foundation for the Competency Model is derived from research done by the Manufacturing Skill Standards Council (MSSC) as part of a project co-managed by NACFAM and the American Federation of Labor's Working for America Institute. Key elements of the Model include STEM skills, collaboration, problem identification, communication, team and various other skills requirements for production workers and first line supervisors in the MSSC and other skill standards mentioned above.

Expanding on the latter two examples, and adding others:

- Advanced Manufacturing Competency Model (DOL)
  - Led by industry and government
  - Tied to existing manufacturing standards, including: AWS (welding), NIMS (metalworking), MSSC, etc.
  - Used to describe needed competencies and as one basis for DOL grants
- Manufacturing Skill Standards Council (MSSC)
  - Led by industry and labor, with input from education and government
  - Focused on production workers and first-line supervisors
  - Covers all manufacturing industries
  - Validated standards, assessments, certification process
  - Uses textbook and curriculum to prepare workers for testing
- Career Cluster Initiative (Department of Education—DOE)
  - Led by industry, education and government including the states
  - Aimed at providing career paths for all sectors and curriculum for them
  - NACFAM leads the Advanced Manufacturing effort in this initiative
- STEM Talent Development Regional Conferences
  - Led by MEP centers so far, with NACFAM assistance and national perspective
  - With industry, labor, education, government in a regional economic area
  - For example, Philadelphia regional conference

- 170 attendees paid fees to attend
- Determined what needed to be done by whom and with whom at regional, State and national levels
- Within two weeks of the event set up a "Regional Compact" to drive action in detail
- Conducted the project without taxpayer money!

These examples only scratch the surface, but they show there is great progress being made. Nevertheless, the challenges are even greater.

As daunting as the workforce issues are, they are only one of many challenges facing U.S. manufacturers. Based on NACFAM's research with a number of companies in various industries, the biggest trend in the future shape of manufacturing is toward *"network-centric manufacturing"*; that is, OEMs are increasingly becoming assemblers or integrators. They purchase systems, subsystems and components not only manufactured, but increasingly also engineered, developed, and often invented by their supply chain; i.e., by the "network."

This requires significantly more capability throughout the supply chain, including over 300,000 smaller manufacturers (SMMs). These SMMs face the same challenges as the OEMs, but without the resources of big companies to cope with them. This puts significant strain on the smaller companies and on the infrastructure supporting them. It is especially critical in Defense procurement because the large defense OEMs are in many cases dependent on SMMs for mission critical components and/or systems.

This new paradigm requires *"intense collaboration"* among people and among organizations including not only OEMs and their suppliers (often smaller SMMs), but also in many cases with education and government entities. It also requires better *"connectivity"* for the exchange of data and information to improve real time performance for global competitiveness.

Concerning the infrastructure, these increasing requirements for especially SMMs demand more efficient and effective *alignment* of Federal Government programs with the real needs of those extended enterprises; i.e., the "networks". Also required is more alignment of programs across federal agencies, not only for economic efficiency, but also because SMMs simply do not have the resources to sort out which programs will help solve their problems. Thus, another requirement is *easier access* to the multiplicity of government programs so they can do the job they were intended to do for SMMs.

Advanced manufacturing *"intense collaboration"* means OEMs and their suppliers, often SMMs, must work together among themselves, and with government, labor, educators, and others in the community to address problems industry cannot handle on its own. Chief among such problems is the issue of *increasing skill levels in American manufacturing workers,* the subject of this hearing. NACFAM's role is often to broker the required *"intense collaboration"* among the different sectors of industry, labor, education and government because it has members in most of these sectors.

Business implications of *"network-centric manufacturing"*:

- For OEMs and SMMs, competitiveness comes from:
  - Innovation—new technologies, products, processes
  - Faster times to market with the resulting products
  - The help of the entire *network,* including skilled employees, educators and government at all levels
- This requires robust capabilities at all manufacturing tiers in:
  - Innovative product and *process* design and development
  - Supply chain collaboration and connectivity
  - Increasingly in corporate citizenship, including sustainability, green manufacturing, etc.
  - Creative labor-market policies for the above needs

Worker implications of *"network-centric manufacturing"*:

- Because of the demands on businesses, workers of the future at all levels must be enabled to work in a more *"network-centric"* way with:
  - More skills in science, technology, engineering & math (STEM)
  - Collaboration skills for teamwork, inside and outside of their companies

- Creativity, analytic and problem solving skills for greater innovation in product and process
- Continuous updating of all these skills to be:
  - The best they can be for their current positions and employers
  - Easily mobile to other jobs in new industries

To respond to these needs *educators* must:

- Collaborate with industry to understand its needs, both current and future
- Collaborate with government to innovatively optimize the return on public dollars they spend

Government implications:

- In today's constrained budget environment, focus must be not only on funding levels (input), but more importantly return on public dollars (output), e.g., for:
  - R&D—new industries and jobs from new technologies, products and processes we cannot imagine today, just as in past decades we could not imagine much of what we take for granted today
  - Workforce investment, including economies of use with regional & economic development activities
- Government at best will take time to achieve its strategy for U.S. manufacturing; at worst it will not get much done

What *progressive companies* must do:

- Manufacturers must hedge by doing all they can for themselves and their employees, including *more creatively*:
  - — Recruiting new workers, both entering and displaced
  - — Retaining existing workers through empowerment to accomplish meaningful goals, competitive compensation policies, and trust that they truly want to contribute
  - — Training incumbent workers to continuously upgrade their skills as well as experience
  - — Utilizing employees past their traditional retirement age
  - — Leveraging foreign labor without losing U.S. competitiveness
    - — Companies that succeed in all of this will prosper

All of this suggests that metrics for strengthening U.S. manufacturing should be:

- Not just how many manufacturing jobs there are, although this is obviously:
  - Critical to the people involved, but it measures only *input*
  - Especially with a shrinking workforce, *output* is also essential
- Similarly, percent of GDP is misleading; for example:
  - New components of GDP (telecom, homeland security, disaster reconstruction, etc.)
  - Mean lower percent of GDP for manufacturing even if absolute manufacturing output grows, as it has.
- More important is the manufacturing *output* increase from:
  - Unimaginable new industries with new jobs as a result of R&D, both public and private
  - Automation, Lean, 6-Sigma, Just-in-Time, etc.

Because we all want to help the American worker, government needs to creatively:

- Encourage and enable workers to continuously learn to:
  - Prepare themselves to be the best they can be today, and
  - Be ready for new jobs not now imagined
- *Not* just try to preserve old jobs, but rather:
  - Devise innovative ways to minimize unemployment

- Creatively mitigate inevitable short-term displacements in a growing economy; e.g., worker retraining, health care assistance, transferable pensions, etc.
- Make its policies and programs for manufacturing the most competitive and accessible, vis-á-vis other countries

Key points to leave with you today:

- *Leadership* is essential in today's "flat world"
- Importance of *output rather than only input*
  - In everything we do, whether for our company or our country
- Trend to *"network-centric manufacturing"* demands:
  - *"Intense collaboration"* and connectivity among business, labor, education and government
  - *Innovation* especially in *labor-market policies* such as:
    - Greater recognition of the criticality of skilled production workers and technicians to American economic prosperity
    - More recognition of and support for the important role of community colleges in educating those workers and technicians
    - Encouragement and support for lifelong learning to both workers and employers
    - Policies for health care, pensions, etc., that recognize the realities of the 21st century concerning multiple jobs and employers over the span of almost everybody's working lifetime

BIOGRAPHY FOR ERIC MITTELSTADT

Eric Mittelstadt since January 2005 is the Chief Executive Officer of the National Council for Advanced Manufacturing (NACFAM), a leading industry think-tank based in Washington, DC, focused on advancing policies to help make U.S.-based manufacturers more productive and globally competitive.

Mr. Mittelstadt is also chairman emeritus of FANUC Robotics America, the leading robotics company in the USA since 1984, and named one of "Michigan's 11 best companies to work for" in 1999. He headed that organization from it's startup as a joint venture between General Motors Corporation and FANUC LTD of Japan in 1982, first as President and Chief Executive Officer through August, 1997, and then as Chairman and CEO through December 1998, leading it to $370 million in revenue. Before that, his GM positions included Managing Director in Uruguay, Product Planning Director in both Germany and Chevrolet, and engineering and management positions at GM engineering staff.

Separately, Mr. Mittelstadt heads his own firm, Mittelstadt Associates, Inc., specializing in top management strategy and implementation consulting, especially concerning customer and employee satisfaction, team building and financial performance. He is a past member of the board of Ellison Technologies, Inc., a leading machine tool distributor and, through its Automated Concepts, Inc. subsidiary, a long time successful integrator of robotic systems for various industries.

Born in Detroit, Mr. Mittelstadt received a BME from General Motors Institute (now Kettering University) in 1958, an MBA from Wayne State University in 1965, and completed the Tuck Executive Program at Dartmouth College in 1980.

Mr. Mittelstadt has served a number of volunteer organizations. He is a past Chairman of the NACFAM Board, and has been a member of the Board and chair of its Advanced Manufacturing Leadership Forum (AMLF). He has been a member of the Board of Directors of the Manufacturing Skill Standards Council (MSSC).

Mr. Mittelstadt is listed in *Who's Who in Manufacturing* and *Who's Who in Entrepreneurs.* In 1992 he won the Joseph F. Engelberger Award for Robotic Industry Leadership. He is past Chair of the USA Robotics Industries Association (RIA), the International Federation of Robotics (IFR), the Board of Control of Michigan Technological University, the Board of Trustees of St. Luke's Episcopal Health Ministries, and the South Oakland County Chamber of Commerce. He is a past member of the Detroit Regional Chamber of Commerce Board of Directors, the Oakland County Executive's Business Roundtable, Bloomfield Hills City Planning Commission, Cranbrook Schools Board of Governors, the Vestry of Christ Church Cranbrook, and Past President and member of the board of the Bloomfield Open Hunt.

Mr. Mittelstadt resides in Davidson, North Carolina with his wife, Susanne, a retired freelance writer and professional volunteer. The Mittelstadt's have seven children and fourteen grandchildren.

Chairman BAIRD. Thank you very much, Mr. Mittelstadt.

Ms. Poindexter.

STATEMENT OF MS. MONICA L. POINDEXTER, ASSOCIATE DIRECTOR, CORPORATE DIVERSITY, GENENTECH, INCORPORATED

Ms. POINDEXTER. Thank you, Mr. Chairman and Members of the Subcommittee for inviting me to testify before you today. One of my responsibilities has been to partner with local community colleges to develop programs to train students to work in the biotechnology industry.

Genentech was founded in south San Francisco, California, 31 years ago with the goal of using human genetic information to develop novel medicine for serious and life-threatening diseases. We are among the world's leading biotechnology company with 14 products on the market and over 50 products in the pipeline and more than 10,000 employees. The key to our success has been our commitment to hiring the most qualified workers available and to provide an environment for them to succeed. Our goal is to recruit and retain people who are the best at what they do, people who are motivated, who have high standards of quality and integrity and possess a flexible, entrepreneurial spirit and are committed to improving human health.

A particular focus of hiring in recent years has been in the area of product manufacturing. When the Food and Drug Administration approves a new drug, we face the task of creating up a technical workforce capable of manufacturing the product to the precise standards of the FDA. Traditionally, we have sought to hire these employees from four-year college institutions, but increasing we have seen the benefit of working with local community colleges to develop graduates of two-year programs who have the skills necessary to succeed in our industry.

Our experience with two-year community colleges has proven they can be an important source of highly-motivated, well-trained technical workers. Often, these students have some workplace experience before they enroll in community college. Their motivation for attending school is to develop the skills they need to qualify for the types of jobs we offer.

In the mid-1990s, Genentech began to work with Solano Community College, located in Vacaville, California, to develop a biotechnology certificate program to provide technical education to students who had an interest in a career in biotechnology.

The program began with a professor on sabbatical from Solano Community College who spent six months, working full time at Genentech to gain an understanding of our manufacturing processes. He spent an additional six months working with 60 Genentech employees to develop a bio-manufacturing curriculum to train students. At the time, no school in the country was providing bio-manufacturing training, so the development of this program was the creation of a new academic discipline.

The program teaches students the basics of chemistry and biology through a combination of lectures and laboratory work. In addition to the science of biotechnology, students learn about the regulatory environment in which we work. One of the best aspects of the program is that students experience working in a laboratory environment. The students must wear protective gowns, work in teams, prepare batch records, and perform other tasks that they would in a real manufacturing setting. They participate in an exercise in which they keep the lab running around the clock for four straight days by working in shifts. Much of their work is done with equipment donated by Genentech.

In 2002, we launched a similar program. That program was inspired in part by the events of 9/11. The airline industry struggled following this tragedy, and many of the United Airlines mechanics from the San Francisco Airport were forced to seek new employment. We recognized that mechanics possessed skills that, with some training, could be transferable to the biotechnology industry. We partnered with the Center of Workforce Development at Skyline Community College, the San Mateo County Workforce investment and labor Council to develop a 12- to 14-week curriculum for a bio-manufacturing certificate program. Course instruction includes basic skills in biology, bio-manufacturing, chemistry and an introduction to biotechnology careers.

Through the programs in which we are involved, we are able to help shape the curriculum to ensure that graduates have the skills we value in an employee. We have seen more than 500 students graduate from the various programs with which we are involved, and many have been hired by Genentech and other biotechnology companies.

Biotechnology is a high-growth, high-wage industry that provides an opportunity for people to build good, longstanding careers. It is a dynamic industry that is constantly in need of workers trained in specific technical skills. Our experience has shown that community colleges can be an important pipeline for the development of these workers.

Thank you for the opportunity to testify before you today, and I look forward to answering your questions.

[The prepared statement of Ms. Poindexter follows:]

PREPARED STATEMENT OF MONICA L. POINDEXTER

Thank you, Mr. Chairman, and Members of the Subcommittee for inviting me to testify before you today. My name is Monica Poindexter and I am the Associate Director for Corporate Diversity at Genentech, Inc. One of my responsibilities at Genentech has been to coordinate our efforts with local community colleges to develop programs to train students to work in the biotechnology industry.

Genentech, which is based in south San Francisco, California, is considered the founder of the biotechnology industry. Genentech was founded 31 years ago with the goal of developing a new generation of therapeutics created from genetically engineered copies of naturally occurring molecules important in human health and disease. Within a few short years, Genentech scientists proved it was possible to make medicines by splicing genes into fast-growing bacteria that produced therapeutic proteins.

Today, Genentech continues to use genetic engineering techniques and advanced technologies to develop medicines that address significant unmet needs. Genentech is among the world's leading biotechnology companies, with 14 products on the market for serious or life-threatening medical conditions, over 50 projects in the pipeline and more than 10,000 employees.

The key to our success has been our commitment to hire the most qualified workers available and provide an environment for them to succeed. Our goal is to recruit and retain people who are the best at what they do—people who are motivated to achieve results, have high standards of quality and integrity, possess a flexible, entrepreneurial spirit, are committed to improving human health, and want to develop to their full potential.

A particular focus of our hiring in recent years has been in the area of product manufacturing. When the Food and Drug Administration approves a new drug we face the task of quickly scaling up a technical workforce capable of manufacturing the product to the precise standards of the FDA. Traditionally we have sought to hire these employees from four-year college institutions, but increasingly we have seen the benefit of working with local community colleges to develop graduates of two-year programs who have the skills necessary to succeed in our industry.

Our experience with two-year colleges has proven they can be an important source for highly-motivated, well-trained technical workers. Often these students have some workplace experience before they enroll in a community college. Their motivation for attending school is to develop the skills they need to qualify for the types of jobs we offer. And the community college setting is ideally suited to teach these students how to work in a highly regulated technical environment like the biotechnology industry.

In the mid-1990's, Genentech began to work with Solano Community College, located in Vacaville, California, to design a biotechnology certificate program to provide technical education to students interested in careers in biotechnology. At the time, we had just committed to build the largest biotech manufacturing facility for the large-scale production of pharmaceutical proteins in the world. We knew we were going to need to hire hundreds of qualified individuals to operate our new facility.

The program began when a professor on sabbatical from Solano Community College spent six months working full-time at Genentech to gain an understanding of our manufacturing processes. He then spent part of the next six months working with more than 60 Genentech employees to design a bio-manufacturing curriculum to train students to work at Genentech and other biotechnology manufacturing facilities in the area.

At the time, no school in the country was providing bio-manufacturing training so the development of this program was the creation of a new academic discipline. The program teaches students the basics of chemistry and biology through a combination of lectures and laboratory work. In addition to the science of biotechnology, students learn about the regulatory environment in which we work. They learn about the structure and authority of the Food and Drug Administration, this history of key FDA laws, and how those laws led to the development of good manufacturing processes.

One of the best aspects of this program is that students experience what it is really like to work in a bio-manufacturing facility. Working in a laboratory environment, students must wear protective gowns, work in teams, batch records, and perform other tasks just as they would in a real manufacturing setting. They even participate in an exercise in which they keep the lab running around the clock for four straight days by working in shifts. Much of their work is done with equipment donated by Genentech.

By the end of this program, students know whether they have the interest and the skills to seek a career in biotech manufacturing. Roughly 60 of the 250 students who have completed the program at Solano Community College have been hired by Genentech and many others are now employed by other biotech companies in the area.

The success of this program led to the creation of a similar effort at Miri Costa Community College in Oceanside, California, where we have another manufacturing facility. The curriculum has also been replicated at other community colleges across the country.

In 2002 we began a similar effort with a community college near our headquarters in San Mateo County, California. This program was inspired in part by the tragedy of September 11, 2001. The airline industry struggled following 9/11 and many of the United Airlines mechanics at San Francisco Airport were forced to seek new employment. We recognized that the mechanics possessed skills that with some training could be transferable to the biotechnology industry.

We partnered with the Center for Workforce Development at Skyline Community College, the San Mateo County Workforce Investment Board, and the San Mateo County Labor Council to develop curriculum for a bio-manufacturing certificate program.

The program was designed to prepare students who possess transferable skills from other occupations for entry-level positions in the biotech industry. Course instruction includes basic skills in biology, bio-manufacturing, chemistry, and an introduction to biotechnology careers. The course was designed through a joint effort by Skyline College, San Mateo Workforce and Development, and Genentech.

The bio-manufacturing career pathway has five key phases leading to employment at wages of $35,000 per year and above:

1. The program begins with an outreach and assessment effort to introduce industry opportunities to the students, gauge the student's level of interest, screen for basic English and math skills, and determine the candidates ability to succeed in the program.
2. Phase 2 is a three-month bridge program to introduce students to the industry, provide intensive training in English, math and computer skills, and offer needed counseling and support.
3. Next is a three-month college credited course providing needed skills training including an introduction to applied chemistry and biology, applied math, and lab skills.
4. Program graduates then have the opportunity to interview for a 90-day paid try-out employment period at wages of $12–$15 per hour.
5. Finally, participants are assisted in finding full time employment.

In addition to providing training to the students, the program provides opportunities for continuing education for the faculty. The Faculty Rotation Program allows professors to gain an industry understanding of the core Product Operations functions that are critical to the manufacturing of Genentech products. It also provides them the opportunity to update their skills, curriculum and teaching styles to meet the real-time demands of industry in the classroom.

The faculty program takes place over a six to eight month period and involves five rotation assignments within our Products Operations organization, including fermentation, recovery, lab services, media prep and filling. The rotations provide hands on experience and interaction with team members and management.

Following the success of the program at Skyline Community College, we worked with another local school, Ohlone Community College in Fremont, California, to design a similar program. That program has been in operation since 2004.

Since creation of the bio-manufacturing certificate program at Skyline College, and the addition of the program at Ohlone College, 350 students have successfully completed the program and received a certificate. More than 90 percent of the students applied for internships at Genentech and 121 were hired as interns. In addition, six graduates were directly hired as full-time employees at Genentech and 46 of the interns have been converted to full-time employees.

Through the programs in which we are involved, we are able to help shape the curriculum to ensure that graduates have the skills we value in an employee. These programs not only set students on a successful career path but they allow companies like ours to increase the base of qualified workers from which we can hire.

The education of these students does not end when they are hired at Genentech. As with all employees of our company, we provide opportunities for these workers to grow their skills and develop their careers. Each year during our annual manufacturing shut-down we encourage our workers to take courses to refresh their technical skills and build their professional development. We also offer cross-training opportunities, where manufacturing employees do rotations in different jobs to become more well-rounded and gain greater understanding of entire manufacturing process.

Biotechnology is a high-growth, high-wage industry that provides opportunity for people to build good, long-lasting careers. It is a dynamic industry that is constantly in need of workers trained in specific technical skills. Our experience has shown that community colleges can be an important pipeline for the development of those workers.

Thank you for the opportunity to testify before you today. I look forward to answering any questions you may have.

BIOGRAPHY FOR MONICA L. POINDEXTER

Monica L. Poindexter is the Associate Director of Corporate Diversity at Genentech, the founder of the biotechnology industry with a quarter-century track record of delivering on the promise of biotechnology. Today, Genentech is among the worlds leading biotech companies, who manufactures and commercializes multiple protein-based biotherapeutics for serious or life-threatening medical conditions—giving Genentech one of the leading product portfolios in the biotech industry.

Monica has worked at Genentech for seven years; during her tenure at Genentech Monica has held positions as Sr. College Programs Manager & Sr. Staffing Manager. In these roles her responsibilities included overseeing the recruitment for New Grad Talent, and Internship/Co-op Program Management at the Community College, Undergraduate and Graduate MBA, MD, JD, Ph.D. educational levels recruiting across Genentech. Monica actively participates in filling the pipeline of diverse talent by tapping into professional diverse organizations such as NSBE (National Society of Black Engineers) NOBCHE (National Organization of Black Chemical Engineers), Black MBA & Hispanic MBA organizations. Monica was instrumental in developing Genentech's first formal Operations Rotation Development Program and is a member of ORDP Steering Committee. ORDP gives recent undergraduates and MBA graduates the opportunity to gain a broad perspective of the core Product Operations and Quality functions that are critical to the manufacture of Genentech products. In her current role as Associate Director for Diversity, Monica is responsible for developing comprehensive recruitment, retention and development programs that create a culture of inclusion at Genentech where Diversity of thought, style and cultures are valued within the company.

Monica's work in the area of Workforce Development for Genentech has led to the development of signature programs such as the Biotechnology Certificate Program. From this partnership the Department of Labor awarded a $2 million grant to a group of local work force investment boards and community colleges, to continue work on programs designed to train local workers for jobs in biotechnology. Genentech has already developed a program in partnership Skyline Community College to retrain laid-off airline workers in the Bay Area and has launched the same program at Ohlone Community College (Fremont, CA). These programs have been expanded to include other sectors that have experienced significant reductions in work force. Genentech helped to develop the curriculum for the three-month training program, which is designed to prepare students who possess transferable skills from other occupations for entry-level positions in the biotech industry. Course instruction included basic skills in biology, biomanufacturing, chemistry, and an introduction to biotechnology careers. The course and internships prepare trainees specifically for positions as Bioprocessing Technicians, Media Prep Specialists and Pharmaceutical Packaging and Materials Specialists. Graduates have an opportunity to interview and many have joined Genentech for both 12-week, paid industry internship positions and regular full-time positions.

In addition, Monica is the co-founder of the Genentech Scholars Program. The goal of this program is to provide an inroad for diverse students to gain access to the biotech industry by providing, a paid internship, a scholarship and potential job placement upon graduation. The Scholarship Program is beginning its sixth year of service awarding 22 Scholarships to targeted Bay Area & San Diego High Schools, Community Colleges and Undergraduate Institutions. To date, the Genentech Scholars Program has awarded $509,000.00 in Scholarships and provided over 75 internships to the Genentech Scholars throughout the Bay Area.

In Monica's spare time she is involved in developing and delivering Business & Professional Etiquette workshops to Bay Area community organizations. She serves as an Advisory Board Member for the UC–Berkeley SAGE Scholars Program and serves on the State of CA Workforce Investment Board Life Long Learning Committee.

Monica holds a BA in Sociology & Law and Society from University of California at Davis and a Master's Degree in Human Resources Organizational Development from the University of San Francisco. Monica is an INROADS Alumna.

DISCUSSION

Chairman BAIRD. Thank you very much, and I appreciate the witnesses' perspectives, and particularly, it is nice to hear that we have got some success models out there.

So the process, now, is we will exchange a series of questions, and in this particular committee, we actually enjoy a good dialogue. We are not here to put you on the spot or you are not taking an oath in this case. We have occasionally done that, but not in this kind of hearing. So this is really our chance—if there are things that you feel that we are not asking about, feel free to pitch those in as well.

One of the puzzles, as we have prepared for this hearing, is that we hear a lot of concern about the out-sourcing of jobs. We hear, at the same time, concern by manufacturers that they can't get employees domestically. And then we hear that sometimes when these programs are created at community colleges, there is a problem keeping enrollment.

And one of the challenges must be—and I will ask Dr. Pumphrey this—if you are trying to decide whether or not to initiate a program like this, you have got to decide what the costs are, what the numbers are, what the demand is out there, where we are going to get it. Exactly how does this issue of marketing play into this in terms of assessing the probability that you will get the demand from the students to actually take the courses if you make the investment? How does that play in?

Dr. PUMPHREY. If you have to evaluate whether we are going to have students and what the likelihood of having students would be, I would tell you that I haven't worked for a single college that had a line-item funding for marketing from any of its funding sources, so it tends to be an underdeveloped arm, at least in the community colleges I have worked for.

I think you have some challenges around marketing manufacturing programs, unless there is a high-visibility corporation in the community. One of those challenges has to do with all of the publicity around things like outsourcing which has gotten way more marketing than it has substance in truth. Then many of the young people growing up now have been in households that have been through dislocation in the manufacturing workforce, so that is something that we have to deal with as well, so it can be a real challenge.

Certainly, the work is fascinating at this point, very clean, very sophisticated. It involves a lot more discretion by the individual worker, even at the operator level, than what was true in the past. These are good careers. Their wages are above average. There are promotional opportunities. It is not a difficult story to tell, but I don't think either the college or industry have done enough, as much as they could have, to be wholly effective at marketing these programs.

Chairman BAIRD. That issue that you need an anchor-tenant, so to speak, almost. It seems critical, and Ms. Poindexter, in your case, you have that with Genentech. How has Genentech reached out to the community and to the potential pool of students and applicants to get the message out to parents and student and school counselor, et cetera, here is a potential career path? What have you done on that front?

Ms. POINDEXTER. So I would say, number one, is partnership between the three entities of industry, academia, and government. The other aspect is co-creation. And when we look at how do we attract, I guess, the future-talent pipeline, biotechnology is innovative. It is fun, and it is something that is new. And I think students that have come through the program, it is word of mouth. When they have successes, as far as their experience being in the biotechnology industry, experiencing what it is like to work in a manufacturing environment, being responsible for multimillion dollars

of product, that is something to celebrate, something that is exciting and something that is new.

So when students have good experiences, they talk about it. When you have professors that are also working in industry but also working at the college/academy, it is very easy to generate a buzz. So I would say it is definitely the possibility of placement that has helped us as well.

In Genentech, we are definitely in accordance within the South San Francisco area and we have had a lot of success with being able to hire students into entry-level positions, so it is something good to talk about.

Chairman BAIRD. Dr. Fonash, does Ms. Poindexter's comments sound similar to your experience, or are there other issues you would like to raise on that topic?

Dr. FONASH. Well, I have heard a number of things here that sound very similar to my experience.

Number one, I do, definitely, think community colleges need more marketing. From what I have seen, they don't have the marketing experience; they don't do it. But more marketing is needed. Parents, generally, are interested in sending their child to a four-year institution, and they don't think of two-year institutions. People can go to two-year institutions, and there can be very nice pathways to four-year institutions, but that doesn't seem to get sold.

And then, some of these programs, the students can go to a two-year institution and actually have better hands-on experience and learn more than they would in a four-year program. For example, in engineering—I am an engineering professor—in four years, your students very infrequently see actual equipment and get to work with equipment. Most of the training is theoretical. In a two-year program, they can have hands-on with the very latest equipment.

More needs to be done in that marketing. More needs to be done to get that idea across to the parents and to the students, so I certainly echo that comment of marketing.

The other comment about jobs, I think jobs are definitely moving out of the U.S., but what is happening is it is sort of a filtering process. What you are left with are the more demanding jobs, and industry is trying to fill those more demanding jobs, and that requires the higher-education standards, and therein lies the problem. If we are going to keep those jobs in the U.S., we have to meet those more demanding requirements of the education.

My comments on what I have just heard, I think that industry is a very vital part of this. Obviously, I, coming from a research university, I think research universities are a very vital part of this also, and obviously, the community college community. My mantra, if I will, for today is that research universities do so much in their involvement with industry, creating those new opportunities, those new manufacturing possibilities. They need to do more with education at the technician level, also, and helping the community college.

Chairman BAIRD. I appreciate that. Mr. Mittelstadt, we will get to you in just a second. I would like to acknowledge my colleague, Dr. Ehlers, for five minutes, but I am sure you have got something to add, so we will get back to you.

Mr. MITTELSTADT. Sure.

Mr. EHLERS. Thank you, Mr. Chairman.

It seems to me that there are three potential sources of good technical workers. One would be students who have dropped out of high school and have desire to get a good job and obviously need some training, those who have gone to high school and have opted not to go on further than that, and those who have been employed in some jobs, perhaps technical jobs, and find themselves unemployed for whatever reason.

Can you give me—and this is general for any one of you who wish to comment—can you give me roughly what percentage would be in each of those three categories. Are there any high school dropouts that fit neatly into your programs, or do they have to go back and get a GED or go back to high school?

Dr. Pumphrey.

Dr. PUMPHREY. Well, I have had experience with that. I would tell you that it is few and far between. I had a rather remarkable instance of a fellow who is about 40 years old, who came to our college functioning at the fourth- or fifth-grade level. He hadn't finished high school. He had a history of substance abuse and problems with the law, and he persisted all of the way through getting a GED, had to take a couple of more courses before staring a program in instrumentation and process control, and today he works as an engineering technician for a very prominent company in their research facility. Those things can happen. It is not a normal pathway and would not be a high percentage.

At the other end of that continuum would be dislocated workers, who have already worked in a manufacturing location and understand the culture of manufacturing and need a slightly different set of skills to move into new and developing job opportunities. We have had a lot of success with those.

And in the middle would be recent high school graduates, who have thought about a lot of things, but manufacturing careers are not necessary one of them. One of the conundrums that I do not wholly understand is why we have waiting lists for allied health and nursing programs, and one could talk about the working conditions and wages in those careers in similar terms that one might discuss manufacturing, but they have a drawing power in the public imagination that we haven't been able to achieve, in most cases, with manufacturing technicians.

Mr. EHLERS. Well, I think a good part of that is you read many stories about the coming shortage of nurses and that there will be lots of jobs. At the same time, you read stories about Michigan—pardon me—U.S. manufacturing losing jobs, going offshore and so forth, so I can easily see where that would be a perception.

But just again, roughly what percentage would be the high school graduates? What percentage would be displaced workers? Any of you?

Dr. PUMPHREY. I will give you a statistic that may help in thinking about that. The average age of our student at our college parallel or college transfer programs is around 20, and the average age of the students in our technical programs is around 29.

Mr. EHLERS. Okay. That is helpful. Any other comments on that?

Okay, Ms. Poindexter, you took some people who had worked in manufacturing and converted them to the biotech industry. Were

there any particular problems in that, and how specific did the training have to be, or did you give them rather broad-based, general training so they could have gone to work for any company, not just to Genentech.

Ms. POINDEXTER. Right. We were fortunate to have one of our very own Genentech employees who was an adjunct professor at Skyline Community College, who helped develop their biotechnology curriculum, based off of Genentech's manufacturing processes and procedure. So therefore, the students, in addition, from that same school—from Skyline College, we had the professor of the biotechnology program spend almost a year, on and off, working through five different rotations throughout our manufacturing facilities, and so he was then able to experience—his mantra was I want to know what my students are learning so that when they are in the classroom, I can translate that into a curriculum that is going to be meaningful, that will lead to an exact position for either Genentech or for the broader biotechnology industry. So once again, it is that co-creation and that partnership where we are there in the classroom as well as when the faculty comes to Genentech to learn.

Challenges, I would say, and I think it was actually mentioned in one of the previous testimonies, was really just around the speed, for a just-in-time workforce, and so when you have the pressures of getting a product out the door, it is ensuring that you have a workforce that understands what it takes to get it out the door. And so I think one of the pressures has been to ensure that we have a viable pool, just in time to meet our demand for hiring individuals for those important positions in manufacturing.

Mr. EHLERS. Thank you. My time has expired.

Chairman BAIRD. Mr. McNerney is recognized for five minutes.

Mr. MCNERNEY. Thank you, Mr. Chairman. I thank the panelists for coming out here today.

Dr. Fonash, one thing you said was that matured manufactures typically go overseas, and so in order to maintain our sort of eminence, we have to have cutting-edge and innovative business that keep us in the lead, that keep manufacturing going. That is a fairly stiff thing to do year after year, decade after decade. Surely, maintaining American university preeminence in the world is key to that, but also the need to produce highly skilled and innovative technical workers.

Now, in my district, the largest city is Stockton, California. It has a high school that has been very successful in turning problem students into very motivated people through their vo-tech program. It is strictly a vo-tech school. They have the higher rate of students going onto college than do the academic high school, and that tells me that there is a huge symbionce between vo-tech and academic training.

Would you comment on that?

Dr. FONASH. Well, one of the things that we have done in our partnership in Pennsylvania is to try to create a pathway from the vo-techs and the academic high schools to the community colleges. We call it the two-plus-two program. And then we also work to create clear pathways from the community colleges into the four-year degrees, and we call that a two-plus-two-plus-two program.

But I was amazed when I first became active in this aspect of education that these kinds of pathways were not defined at all. At least in Pennsylvania, they hardly existed, and in Pennsylvania, there were very few clear pathways from a community college to a university, just about no pathways from vo-tech, that is non-academic high schools, into community colleges.

I can proudly say that since our partnership as an ATE center has been functioning, creating such pathways has been one of our objectives, and I can say one of our achievements is establishing these kinds of pathways, and so we now have them in Pennsylvania, and in fact, the Pennsylvania Department of Education now uses our model for pathways from vo-tech and academic schools into community colleges.

So what is needed? I think it is always motivated faculty, but I also think there has to be administration who have to make sure there are clearly defined pathways in place. Appropriate State agencies have to take a look at this. These sort of pathways have to be in place. I think they are very important.

Mr. MCNERNEY. Well, one of the things that Ms. Poindexter pointed out was that these students are exposed to very high levels of responsibility and reward for the kind of work, and I think that motivates the students to understand the need for academic achievement as well so that they can enhance those skills.

And concerning that program that Genentech has, one of the questions I have is you worked with Skyline College in that you opened up an office in Vacaville. I don't know if it is still open or not. How likely is it that you will open an office in a location that has a community college that does put out good, well-trained students?

Ms. POINDEXTER. I would say that one of the assessments whenever Genentech is looking at a future site is around the academic surroundings because we do recognize that that is where a portion of the workforce would come from. I would just kind of respond to a portion of your answer with one our area of focus is also to ensure that those who may not be quite at that point for the two-year degree programs, we also have a partnership for a bridge for the purpose of being able to expose students to the two-year degree program before they actually go into a biotechnology certificate program. And that kind of addresses looking at how we are reaching down to students who are at the at-risk level.

So I would say that, you know, that when we are looking at future manufacturing sites, one of the factors is looking at the education system, both at a two-year, advance level, as well as with research institutions in the area.

Mr. MCNERNEY. Thank you.

Ms. POINDEXTER. You are welcome.

Mr. MCNERNEY. I yield back.

Chairman BAIRD. I thank the gentleman. Mr. Miller, five minutes.

Mr. MILLER. Thank you, Mr. Chairman. Undoubtedly, I am not a Member of the Subcommittee, but this is a topic of great interest to me. Community colleges, nationally, are hugely important to the American worker: 11 or 12 million Americans a year enroll in com-

munity college courses. But it is even more important in North Carolina. I am sure you know that, Dr. Pumphrey.

Eight-hundred thousand students are enrolled in community college courses in any given year. It is one in eight adult North Carolinians. And it is sometimes very specifically tailored to job needs. I know that Dr. Pumphrey and Dr. Fonash have cautioned against programs that are too neatly tailored to job need, but Waite Technical Community College has an extrusion campus to teach skills used in the extrusion industry—extrusion is a process of pulling soft plastic and letting it harden in different shapes—in an area where there are 30 or 40 manufacturers using that technology within a 20-mile radius. Alamance Community College had a biotechnology degree program, and the great majority are placed with one employer, Labcorp, which is one of the leading medical testing companies in the Nation. And students go directly to work from that program.

And I could go on. There are lots and lots of curricula that are specific to a particular community college in North Carolina that are tailored to a specific industry that is concentrated there, either a single employer or concentration industry, and it becomes kind of a mutual draw of industry to the area because of the community college programs and the prevalence of jobs, the availability of jobs in that area.

Ms. Poindexter, from the employer's standpoint, how should that balance be struck? How important is it that the skills of the employee come almost to the point of being ready to go to work the first day, and how much of it should really be taught at the workplace by the employer, based upon a more general-understanding education or job-skills training provided at the community college.

Ms. POINDEXTER. Right. I think more importantly, as far as for the focus for the specific skills that are needed, I think that is just to get the students into the door, to start off a career path. And once they get into a company like a Genentech, that is where we would provide them with the necessary skills to take them to the next level. But when we are looking at the specific technical skills, that's what is lacking, so in order for the students to even have an opportunity to get into the manufacturing industry, it is the baseline exposure of what it is like to be working in a highly-regulated FDA environment, and so that is something that I think it does need to be specific to a point that in certain aspects you do want creativity, but in other aspects of manufacturing, you don't want to have the creativity. So to have the full knowledge and understanding of what this environment and what this career path leads to, I think the more specific that we can be for certain niche-specific areas like manufacturing lab ware, glassware, where it requires technical capacity, I think that is very important. But once they get into industry, that is where industry will actually provide them the upgraded skills training so that we can then open up broader opportunities for promotion as well for future leadership positions within the company, because I do think it is important to have some technical level foundation on beginning and then to broaden out the horizons once they are in the industry.

Mr. MILLER. Thank you.

Mr. Mittelstadt, you also, from the employer's perspective, what is your perspective on that?

Mr. MITTELSTADT. Well, I come from a somewhat different perspective because I went to a small, private school in Flint, Michigan called General Motors Institute for my undergraduate degree, so I fully agree with Dr. Fonash's comments about the advantage of having people who are working almost at the same time as they are learning. I also agree it is really helpful to have as much technical background as you can from the school as possible, so you can be the best employee you can be once you do start.

But all individuals are coming from different points of view, and all programs are coming from different points of view. So I guess my answer is in a sense all of the above. It works very well in Alamance where you have got a particular employer who has got a certain set of requirements and probably will have for a few years, but maybe not for decades. Maybe the community colleges have got to be looking at what is coming next in terms of the future.

But I think all of those things are important having those kinds of skills, and I think that is where the community college really shines. By definition, as indicated by Dr. Pumphrey, their demographics are more experienced people, people that have been out there that understand a little bit about what is going on in the real world and see why they are doing what they are doing in the classroom and where it is going to apply. And I think ultimately, you are going to get better students as a result of that, and that is why a lot of our member companies really do partner extensively with community colleges because on average, those students in those institutions are motivated to really get some knowledge that they can use for a career.

Chairman BAIRD. I thank the gentleman. Dr. Bartlett is recognized. He will fill in the chair while Mr. Ehlers has a meeting with some constituents. Thank you for rejoining us, and you are recognized for five minutes if you have some questions.

Mr. BARTLETT. Thank you very much. I am sorry I couldn't be here for all of your testimony. In a former life, I taught for 12 years at a community college, and so I am very familiar with community colleges and how well they work with the businesses in the area. At our community college, we would offer any course that was desired by the industrial business community as long as there were enough students to make it a defensible thing to do. And there were some times when we started small with the hope that it would grow so that next year we would have enough students to justify what we were doing this year.

The working relationship between our community colleges and the business around them is really exemplary. The community college right next to me in Washington County has a program to train truck drivers, and they partner with Volvo Power Train, which we used to call MAC truck, and they have provided all of the trucks and all of the courses for training these truck drivers. That is a pretty pedestrian kind of need, but it is one which is really needed, as you may see from the back of trucks. They are all giving a 1–800 number. Please call. We have a job for you if you are qualified. So there is a huge need there, and that probably is one of the most

pedestrian things that I can think of that community colleges are doing, but it is a really necessary thing. If you got it, it was probably brought by a truck, wasn't it? And without truck drivers, it is not going to get there.

But the big problem in this area is not the working relationship between our businesses and the community colleges, which is going very well. The big problem is finding enough students who are interested in this kind of work. And as you know, there are many industries that tell us that if we can't increase the number of immigrants who are coming in on temporary work visa to fill the needs that they have, that they are moving their company overseas where the workers are.

And at the same time, we have far too many of our people working at jobs that pay far less, far less rewarding than if they were in these areas. How can we inspire our young people to be more interested in this? It is a matter of perception; the average person in our society does not perceive of these jobs as being either well paying or rewarding. And another thing I did in a former life was I built homes, and I will tell you that in many respects what I did then is a lot more satisfying than what I do now. They will little know and long remember what we do here today, but if I built that house right, in 100 years from now, it will still be there. And there are a lot of rewards from this kind of work.

But in our society, we don't perceive these as being desirable or rewarding career paths. I suggest that what we need to do is to have people working in these areas come to the school and to the PTA meetings with their W–2. These jobs really pay very well, and they are very rewarding. And as you know, I am a farm boy and a hands-on kind of person, and I will tell you that these are very satisfying kinds of work.

And what can we do so that we have more of our young people and their parents as they sit around the dinner table talking about, Junior, what are you going to do? Why don't you look at one of these technical areas? There are huge needs and big rewards. But that is not what the average parent thinks. How can we change that?

A society gets what it appreciates, and we really don't appreciate those people like we should, do we?

Mr. MITTELSTADT. I don't think that there is any question that that is a major challenge, and it is a challenge that goes far beyond any industry's capacity to meet it. It is one of those challenges that requires what I call intense collaboration between industry, education, and yes, government. The media as well, but the media gets influenced by all three of those constituencies, and you folks have a major impact on the media. And when you go back on your campaign next time, talk again with your opponent about that. What are you going to do about this problem? Make sure they understand what Dr. Fonash indicated. That off-shoring, for the most part, are jobs that nobody wants to do anyway because they are those dumb, dirty, dangerous, dull, and disappearing—I would add a fifth one—jobs that people are talking about all the time. Those are the jobs—you don't want to protect those jobs. You want to get people interested in the new kinds of jobs that are out there, but it takes all of us working to really get that point across. Every time

we get a chance, we have to do it, no matter whom we are talking with.

But if you can help us in terms of that, then maybe, you know—we used to say in Chevrolet that you spilled that much in a day, right? When you got down to some program that somebody didn't want to do, well, gee, you know, you can spill that much in a day. Well, certainly that is true here in Washington. There must be some place somewhere somehow in this trillions-of-dollar-kind-of-federal-government situation where we can find a few million dollars to help get that message across. Maybe it is an academic research project that says how you do it, but give it to a school that is known for applying that stuff too.

There are a lot of challenges there, and there are things being done, but it is never enough. I mentioned that Dream It Do It Program. It is aimed at that. There are a half a dozen of them in regions around the country now, doing that kind of thing, trying to get that message across, but you can't stop there. It has got to keep going.

Mr. BARTLETT. Mr. Chairman, I was only half-joking when I said we ought to send them with their W–2. We have people in all of these skills that are very articulate. We need to search them out and we need to give them incentives, and your company needs to really pay them, give them some time off, some compensatory time to go out and pitch this because we have some very articulate people who are making very good money. Go with the W–2 and pitch this thing, and you will turn people on, but you have to do it early before they decide to become a lawyer or a political scientist. I tell young people these are two potentially destructive pursuits. We have enough of each of those. We need some people in these other areas, don't we?

Thank you all very much. Thank you, Mr. Chairman.

Chairman BAIRD. Thank you, Mr. Bartlett. I am going to take this—I will recognize Mr. Bilbray in just a second—an opportunity to respond to Mr. Mittelstadt and Dr. Bartlett's comments as well and make a shameless plug. As you know, in the Congress, when there are people of like minds, we form what is called a caucus, and there are a host of different caucuses. Myself and Phil English recently established the bipartisan career and technical education caucus. And I would welcome your input, and when I have a chance to ask some questions, I will ask about that. But it is a chance to do precisely what Dr. Bartlett and Mr. Mittelstadt are talking about. My goal of our caucus, one of them, would be that in the next presidential race, when presidential candidates are running for office, they don't simply talk about making a college education affordable, but they add the words career and technical education.

And by the way, I will share this with people on both sides of the aisle because I don't see it as a partisan issue. When you add those two words, you expand your reach by a minimum of 17.4 million people who are involved in career and tech education, and you can add to that all of the employers who recognize the need for these employees. So we will reach out to you and maybe you can help us spread the word.

Mr. MITTELSTADT. We look forward to working with you on that because a lot of these issues need to get in that campaign. They need to be talking about these things at the national level. That is how parents start thinking about it.

Chairman BAIRD. And if politicians start showing it respect and attention, it will expand that reach.

Mr. Bilbray is recognized for five minutes. Thank you for joining us.

Mr. BILBRAY. Thank you, Mr. Chairman. I appreciate it.

I almost have to look at my family where all three girls are college graduates and academic achievers, and the boys took after dad, and let us just say, are trying to fill the middle-class spectrum within the family. I guess that is what we are really talking about here is the preservation of the middle class and retooling what the middle class means, and sadly, it seems like the middle class is not only not embraced, it is almost ridiculed. So much of the media and TV shows we see is based on that.

My question, though, is—and Eric, you can jump into it—I say where do we go in government in our intervention? Do we send a bunch of government people out to talk about, you know—let us face it. I think that the Walton Foundation has probably done more than all of the governments in the country combined talking about, you know, keeping kids in school, getting them to learn basic skills, usable skills out in the real world, and I just wonder how much we can help. And maybe our emphasis needs to be stop hurting it so bad. I don't know how far we shall get into it, but we have almost created this illusion or this big lie that if you are not a white-collar worker, you might as well be on welfare because that is all that matters. You know, there is a level here and a level there.

I would ask you more not what does government do to move the agenda, but what government can do to get the hell out of the way and aide in other people moving the agenda, just as the Ranking Member was talking about actually having corporate spokesmen, not government spokesmen going out there.

And I will leave that open to any one of you to comment on.

Mr. MITTELSTADT. Well, let me start a little bit. I didn't mean to say we need multibillion dollar programs. We maybe need a little bit to help jumpstart some of the data behind this, but I do think that you have a bully pulpit that you need to use because you people are the ones that get people thinking about issues. That is what you do. When you get reelected, you go through a campaign, you talk about issues—at least you try to. Sometimes it goes into other things too, but you have the opportunity to get that message across, and I think it is important to do that because it then flows into the local K–12 system. You have got school board members that are responding to the parents. The parents have to begin to understand that. So there is a big communication problem here.

We will do it too. Industry certainly wants to do it, and most of my members exactly agree with you. Government stay away. We don't need your help, except when it is this or that or the other thing for us, of course, but that is the American way of life, I guess. But I think it is more than money. It is talking about it. It is getting the awareness of it because we are talking about an awareness problem.

Ms. POINDEXTER. I would like to add just a couple of comments to that. I sit on the State of California Lifelong Learning committee, and some of the issues that we talk about are opportunities where government can influence, pretty much, access to biotechnology or even access to innovative technologies. It is really education around how to develop scalable programs.

In some of the comments, we were looking at, and I think they were talking about the class sizes are maybe a small cohort, but if we have an industry that is high growth and high wage, and we may not have professors or teachers that even understand what the industry is, That is part of the area where we focus on educating our teachers.

I did a lot of college on-campus recruiting, and you would not believe when we go to the college campuses, the teachers and counselors are the influences around, sometimes, where students go for their next career or where they go for college and what majors they have in college. And if teachers do not even know about nanotechnology, if they don't know about biotechnology, then that limits the scope of where students can be tracked for a two-year or four-year degree area.

The challenge or opportunity that government can influence is helping to educate industry of how we can access some of the programs and how we can partner with workforce investment boards to be able to develop just-in-time workforce partnerships or programs. Sometimes it is really knowing the right people, but also knowing how to utilize certain dollars as well as have a leverage to partnerships within the county or local workforce investment boards that would help us develop this future talent pipeline.

So I think its education and the other piece of it is looking at Congress or the government to use the technology of how people of my generation learn of educational programs and learn how to access programs.

Mr. MITTELSTADT. I would echo that access issue, and that is probably administration more than Congress, but it is something that you might want to be talking to the respective agencies about. Smaller companies, particularly, and there are over 300,000 small and medium-sized manufacturers in this country. They don't have time to figure out what program they can go to. You got stuff out there that is not even being spent because people don't have the ability to understand and access it. So access to those programs is an important feature.

Mr. BILBRAY. Mr. Chairman, I know my time is expired. Let me just say as somebody who comes from one of the most plugged-in districts in the world, North San Diego County, that I will just tell you something. I think if you want to look around at educational institutions that can plug people in one way or the other, Fairfax is second to none. They start early. They start right as they get into high school and middle school, and it continues on through the community college process. And I have got to give very high grades to a little county in Northern Virginia. I think they are second to none, and maybe a lot of what we can get is just listening to our neighbors on the other side of the river.

It is almost—I hate to take the cheap shot, but it is almost like a yin and yang here between the District's structure and Fairfax

structure, and culturally, we are not that far apart. But educationally and institutionally, there are huge gaps there, and really, I think it would be beneficial for anybody who really wants to talk about a national prototype to take a look at where something works and where it doesn't work, right across the river from this little creek you call the Potomac.

Thank you very much, and I yield back.

Chairman BAIRD. Thank you, Mr. Bilbray.

We will do a second round of questioning, and this is a chance for us to follow up on some issues we haven't touched base on, but feel free, also, if there is something you feel is urgent that we haven't addressed.

One of the questions I have about this is, my understanding of some of the high technology and manufacturing—and Mr. Mittelstadt, maybe you can speak particularly to this—is that if we—that it sort of works like a bicycle pace line, if you ever watch those bicycle races. When you fall off that pace line, you are done. You can't get back on it because you are out of the slipstream, and once it goes, it just goes off without you.

And I have been talking to some our high-tech manufacturers back home. We have got a lot—Sharp Microelectronics, Hewlett Packard are in my district. Once this goes offshore or leaves our borders, you lose the workforce with the feel for the process. If you are not dealing with the 300 millimeter wafers somebody else is, and all of the things that go with that, you lose. If you are not dealing with the day-to-day process of producing a genetically engineered pharmaceutical or bio-ceutical, you lose that feel and you lost that feedback mechanism, plus you lost your personnel. People will go somewhere else. And the hard part is getting back on that. And I am particularly interested in knowing if that is of concern to you folks, because you can't just keep generating new pace lines. You have got to somehow stay in that. If you fall off the training loop, what happens? And how do we not have that happen?

Mr. MITTELSTADT. You are right. That is difficult for companies to come back under those circumstances. I am sure, there are examples of them having done it, however. We have seen some examples of people who have off-shored and then brought it back, and yes, had a difficult problem doing it but were able to because of lots of other factors. You can't give up just because it is a problem.

More importantly, we are trying to get more and more smaller companies to understand that there are lots of techniques that they use on a day-to-day basis that don't require all kinds of resources that allow them to compete. And we often use an example of a small company in North Aurora, Illinois that basically was supplying flywheels to a major construction equipment manufacturer. They were the sole-source. They got told by the major company, either meet the Chinese price, or you will lose the business. The father called the two sons in and said, look, I am going to retire in three or four year, if you don't figure out how to solve the problem, you don't have anything for your future, so they figured out how to solve it. And they did it. They made it happen. They looked at what they needed to do with automation, with 6 Sigma quality control, training their workers, doing all kinds of things. A hundred-person company, they wound up meeting the price, even though it

didn't include all of the other things that go along with it, it was just labor, material, and freight. It didn't include all of the other stuff about how the customer had to do all of the quality things and educate the Chinese workforce, et cetera, et cetera. They still met it. And they wound up expanding their business and qualifying for other work with other companies. And there are hundreds, if not thousands of examples like that, but it takes an awareness on the part of people to exercise that leadership.

And here again, that bully pulpit is important. It is important for folks that are in the public domain to be talking about that. And maybe I am overemphasizing that, but the media listens to politicians. They don't listen to companies. They don't listen to, maybe even educators, as much as we would like them to, but they cover your campaigns, and if you can talk about these kinds of things and get that kind of ability to influence the media, I think it will help. We will work with you in terms of anything we can do to help make it happen.

Chairman BAIRD. Are there others who want to comment on that issue?

Dr. Fonash.

Dr. FONASH. Yes, if I may comment, I think that once you fall of that pace, you are off the pace, and I think the only answer to is it to create a new line. And instead of making chips, for example, you should turn to something like self-assembly for transistors or the kinds of things that people are exploring with nanotechnology. That is what I believe. I believe that these races will go off, but you have to create a new game, a new race, and I think you have to do that all of the time, and you have to have the technology workforce that is capable of staying up with that kind of a pace.

I think the pace is there. I think it is only going to get faster.

Chairman BAIRD. That will carry certain problems with our colleges, I would imagine, to keep up.

Dr. Pumphrey.

Dr. PUMPHREY. Maybe I am not as sanguine about our prospects as my colleagues. I had an interesting personal experience. I attended a departmental graduation for my daughter at North Carolina State University in December of 2005. It was in the college of textiles and that is certainly a manufacturing industry that is employing high technology today. It was a December graduation, so it was fairly small, three dozen baccalaureate graduates. Probably 80 percent of the graduates from North Carolina and Virginia, 12 Master's degree candidates, half of them from the United States; seven Ph.D. candidates, one of them from the United States.

These folks are being educated, not just so they can manage production lines, but the work that gets designed in the United States. They are going to take the competition to a higher level, clearly, with the expertise they get in our research universities, so I think the race gets faster which makes it even more problematic if you fall out of line.

Chairman BAIRD. Ms. Poindexter, do you want to add a comment?

Ms. POINDEXTER. I would just say in relation to the two-year degree, when looking at international, we are really looking at our local pool to keep and maintain from the local community colleges

and our local communities where we have our manufacturing facilities. So that is where it makes sense for us to keep our workforce local, especially relating to the two-year-degree areas.

Chairman BAIRD. Back to Mr. Bilbray's comments: we sure want to make sure we incentivize you to stay there and don't disincentivize you in a way that would motivate you to locate offshore. We are glad that you are committed to keeping the local manufacturing and education base.

Mr. Miller.

Mr. MILLER. Yes, thank you. A couple things, first of all, Mr. Chairman, on the subject of Congressional caucuses that are pertinent to this committee hearing, I will trump your career and technical education caucus——

Chairman BAIRD. My switch that shuts off his mic, where is it?

Mr. MILLER. Three years ago, I started a community college caucus, and I will happily join your career and technical education caucus, and would welcome you in the community college caucus.

Dr. Pumphrey, does your daughter still live in Raleigh?

Dr. PUMPHREY. No, sir, she lives in Wilmington and works for a prominent textile corporation.

Mr. MILLER. Okay. I was going to ask that you mention my name to her.

I disagree with one of the points made, and that is the outsourcing of jobs, the jobs that we are losing, are jobs that Americans don't want, they are dark, dirty—whatever the alliteration was—and by reference, less skilled and poorly paid. Now, I agree that this country's economic future cannot be unskilled jobs in labor-intensive industries. But we are losing very sophisticated jobs.

Dr. Fonash, you said that at least the jobs were pausing in the United States, but once the industries became mature, they moved onto somewhere else. My observation is that more and more manufacturing processes or products are going, even those developed from American research, are going to other places from the outset. And I am not convinced, either, that American workers, although highly skilled, working hard to develop skill and we have had wave after wave of job loss. If you visit a textile factory now, it is not like the Sally Field movie. Those are very sophisticated operation with very sophisticated machinery, and we are still losing the jobs.

And North Carolina's experience is particularly intense. I think we are second only to Michigan in the percentage of manufacturing jobs that we have lost, per capita. And North Carolina workers work hard and will go back to community colleges and community colleges are not a secret. They know they are there. And still we are losing jobs, and the jobs we have are not paying anything like the value that those employees are adding through their skills.

I know that the typical answer to what we need to do about protecting American jobs is improve the jobs skills of our workforce. Our workers are working hard to try to maintain current skills, and we are still losing jobs, and the jobs we have are not being compensated, even in a way to keep up with inflation.

What else do we need to be doing?

Dr. FONASH. Well, I don't see any way of getting out of the game. The game is innovate or perish, and I see no way of getting out

of the game. We used to have terrible wars, and people would murder each other in the millions. Today, we have wars, but they are much more sophisticated. They are economic, and the only answer, the only defense is innovation, innovation, innovation. I think you have to do that in education also. I think the jobs will constantly get more sophisticated. I think the pressures on education will constantly get more severe, but I see no end to the game. That is the game. I prefer it to the game that we had before, but it is an extremely difficult game.

Mr. MILLER. And again, I am not suggesting that we are going to protect unskilled jobs or relatively unskilled jobs in labor-intensive industries.

Does anyone else have an answer to what else we can be doing other than we are simply stuck in a desperately competitive international marketplace, and we can't affect it?

Ms. POINDEXTER. I mean I would just submit the question or the statement that if we continue to do the same thing, we are going to get the same result. And if we look at where we are today, we have 21st technologies. Genentech is an example of technology in the 21st century.

The question I would ask you all is is our education system in the 21st century?

Mr. MITTELSTADT. I think that is a legitimate question as well, but I understand your concern. I happen to live in Allen Davidson, North Carolina, near Charlotte, so I am not quite in your district, I guess, but at least I am in the state, and there are some tremendous people there, and they are very capable of things, and what you are really saying is that they are upgrading their skills, but the jobs aren't there yet. But you are doing some other things, too, and unfortunately there is time lag. You have the research campus that is going in in Canopolis, for example, where you are really trying to do some things to invent new industries.

And I really share Dr. Fonash's comment that in the macrosense, that is what is required. You have got to keep changing the game.

I have a cousin who just passed away a little while ago at 104. When she was in high school in the 19-teens, she would never have imagined millions of people in an auto industry. In the 40s, she couldn't have imagined millions in a television industry; in the 50s, maybe millions in a computer industry; and in the 70s, biotech or whatever. We see nanotechnology and hydrogen now, but there are more, and there have got to be more, and we have got to keep moving in that direction.

The problem is that what happens is there is what I call an inevitable short-term displacement in a growing economy, and that is where, to me, government comes in. You have got to be really creative in terms of how you can handle those short-term displacements, how you can do the things you do. People don't want to move from where they are, but maybe that is where the jobs are. At the same time, as we have said recently, we have got a shortage of millions of engineers. Well, we have got engineers laid off all over the country, but the ones that are laid off don't want to go to where the jobs are, where the shortages are. And that is human nature. They have got that right, obviously.

So one of my experiences was to be the managing director of GM's smallest but best plant in Uruguay in South America. One of the things I learned—it was a very small country—it is a tough damn job to run a country. And that is the jobs you folks have got. And if there is anything we can do to help you figure out how to creatively get at these things, we sure want to do it. It is a tough job, because exactly what you are saying is going to happen until some of that research comes out of some of those universities you have got in North Carolina, the research institutes you have got, things that can provide local jobs that are going to start there for the people that are there and don't want to leave there.

Chairman BAIRD. Thank you, Mr. Mittelstadt.

Mr. Bilbray.

Mr. BILBRAY. Mr. Chairman, I want to apologize because we really are talking about a bigger picture. We are talking about how you can't separate the education institutions from the business institutions from the governmental institutions, and my colleagues here, I think are, you know, very much predisposed to bipartisan cooperation.

If I could just point out that one of the things that scares me to death, and I don't think we talk about enough here in Washington, is what can we do when it comes down to the type of benefits two-year institutions don't get, especially from endowments. You know, it is nonexistent for two-year institutions, and you get a lot of the stuff we talk about, huge resources coming out of the private sector, to go into the wealthiest of the wealthiest of the population and their educational institutions, but in the blue-collar neighborhoods, and the two-year institutions like where I went, it is no way in the world would you ever get any of that.

It is a challenge, and I am not saying we can correct it here, but Mr. Chairman, I would just like to remind all of us that when we talk about competitiveness, do you realize that the Federal Government is operating a tax structure 100 years old, based on the concept that our borders would be locked tight by tariffs, and we are still operating off of a system that creates a situation to where somebody in Australia or China can make a product, the product is not even taxed in their country, imported into the United States and sold tax-free, where if you make the same product in the United States, it is taxed on its labor and on its capital, and then it is supposed to be competitive.

My family emigrated out of two parts of the world, one out of North Carolina, with the Boone family in 1790, but also from Australia. My cousins come in from Australia, and they say, darn Brian, do you realize that a Miata in Australia is more expensive than a Miata in California or in the United States. I say, of course, because they put the tax on at the sales level, so they are able to sell their product, and their workers are able to compete in the world market, where we have almost tied this millstone around your neck, saying you have got to drag this around.

And I know this is off the subject, but I just think we need to really look at ourselves. When you say what can the Federal Government do, be brave enough to start thinking about redoing stuff. We destroyed one little industry that was a cottage industry, the manufacturing of quality arrows for archery. We put a 12 percent

tax on all of the components, and what we didn't realize is that we were making it tax-free to import assembled arrows into the United States, and it was 12 percent to produce an arrow in the United States. Guess how many businesses manufacture arrows, today, in the United States. Only one. Thirteen of them left the country, and we can't blame the industry for doing that. We can blame lack of trained personnel and everything else, but what we have got to do is blame ourselves here in Washington that we mandated that those jobs are exported.

So I just ask that when we talk about the educational challenges or whatever, we also look at what harm are we doing here in Washington. And I hope, openly, as a leader of the majority, there is a frank discussion about do we want to continue with this concept? Are we so obsessed with redistributing the wealth and shift and shaft and the taxation, or do we go the basis of let us look more at, like at other countries, the consumption tax so our products are not taxed just because they are made here in the United States, that they have equal competition, not just here in the United States, but overseas.

And I think when we talk about jobs, we can't separate it from, and—comments from the panel. I apologize for ranting on and on.

Ms. POINDEXTER. You bring up a very good point, and the one point that probably has not been discussed is sustainability for these programs. And I think the representatives from the colleges probably would agree that when we are looking at sustainability across the board it is when money comes into the programs, especially to the local community colleges, what is put in place after those quick-start dollars, those CTE dollars, go away?

The biotechnology industry was started 31 years ago. How much money is going to be able to sustain the biotechnology industry 30 years from now, if this quick-start money goes away or if continuing education dollars go away or if programs that were in existence five years ago to reach out to students that are tying to come into the two-year and go to the four-year—what are we looking at from a sustainability perspective?

And so I think if I were to bring anything forward, it would really be to look at, when you are looking at legislation, and when you are looking at funding certain programs, look at not just the here and now, but look at the entire industry, five to ten, 15, 20 years out, because what I hear from community college professors, everything is tied to enrollment of student and then how long their funding is going to last. When the funding is gone, the program goes away, and then that impacts industry.

Mr. BILBRAY. Mr. Chairman, may I ask for unanimous consent for one more question?

Chairman BAIRD. Certainly.

Mr. BILBRAY. The H1–B program has a program that brings in skilled technical people into the country. But what a lot of people don't know is it requires that there be a fee paid to go into a pool to help address the fact that when we need to import certain talents, it is a sign of deficiency, and this is where the Federal Government really has the responsibility to get involved in education, when we have to modify your immigration policy because of the deficiency.

Where is that money going? Do any of you know if it is being integrated into the educational institution effectively? Go ahead.

Dr. PUMPHREY. Yes, sir. When I was President of Bellingham Technical College, we shared $200,000 of an H1–B grant with Everett Community college in Everett, Washington for the express purpose of expanding the coverts of radiologic technologists that we were training in a consortium.

Mr. BILBRAY. And your opinion about the program expandability? Or any editorial note?

Dr. PUMPHREY. It clearly helped us expand the program, but it was not permanent money, so when that runs out, you are where you started, essentially.

Mr. BILBRAY. Thank you, Mr. Chairman.

Chairman BAIRD. Yes, I would just point out that the amount, if I am not mistaken, for H1–B is about $1,500 per application, and some recent studies have suggested that there is significant—in spite of the intended law, a significant pay differential between H1–B visa recipients and non-H1–B, in other words, U.S. employees. And one of the things I have tried to advocate is that my own belief is that we ought to tie H1–B number increases to evidence that the employer requesting the H1–B has demonstrated a commitment to local education. So in a case like Genentech, if they have developed the kind of programs that they have, they would get to go to the front of the queue, in terms of asking for more H1–Bs, because they have demonstrated a commitment to educating the U.S. workforce.

I have got a problem in my district. I have got some innovative companies putting their Ph.D. level MS level engineers into the schools, trying to create mentorship programs, and there are other companies sitting by the side doing nothing. They can't get them involved, and these are some reputable companies, and they have just said, look, that is somebody else's business. My belief is that businesses and industries that have made it their business to try to educate the workforce of tomorrow among the U.S. students should have priority in the queue. If they do need H1–Bs, I am a whole lot more sympathetic if they can say these are all of the things we have done to educate the U.S. workforce; we still need some outside workers, versus the company that said, we haven't done anything substantive except pay our little fee. Those folks go to the back of the queue.

Mr. BILBRAY. Well, I think we may want to look at that fee and how it is directed because, let us face it, in two to four days, all of the H1–B applications are taken up, so obviously the market can bear more burden—and I know I have got a lot of high-tech companies that will kill me for this—but anybody in the private sector would say that if you put something out to bid, and you have sold for the year within four days, they would tell you are selling your own feet.

Chairman BAIRD. I would agree with that entirely. And the way I would like to see that bid increase is not just monetarily but commitment to education, because just paying the money and then making schools grants is a little—I think that is one way to do it. I would like to see some skin in the game from the local manufacturers.

Mr. BILBRAY. And I would like to see how we are doing in oversight with the existing program, too.

Chairman BAIRD. Yes, that is a good point. Maybe we could discuss that in this committee, actually. It might be appropriate.

Dr. Bartlett.

Mr. BARTLETT. Thank you very much.

Today we have been focusing on the challenge of attracting more of our young people, I guess, generally, to go into these technical areas, but Dr. Pumphrey introduced us to a really more fundamental problem which shares some of the challenges we have been addressing today.

When you noted, sir, that out of eight Ph.D. candidates, one of them was a U.S. citizen, this year China will graduate more English-speaking engineers than we graduate and probably half of our English-speaking engineers are Chinese students or somewhere near that.

I worked eight years for IBM in another life, and we knew—and this was way back, I left in '75, so that puts it in a timeframe—we knew at IBM that unless something happened in our country that we were going to lose our superiority in computers to Japan, because then, Japan was turning out more, and at least as good, perhaps better, scientists, mathematicians, and engineers than we were, and there was no way that we could continue to best them unless we turned to and produced more high quality scientists, mathematicians, and engineers.

Today, of course, the challenge is China. I was stunned when I was told that India's equivalent to our MIT is probably superior to ours because they have 100 applicants for every student they accept. It is not that we aren't capable. We are the most creative, innovative society in the world. But a society gets what it appreciates, and we just do not, flat out, appreciate people in these technical, scientific, and engineering areas. If young men go into those areas, they are called geeks and nerds. If they make good grades, then pretty girls won't date them. And a really bright girl plays dumb so that she can get a date. You know, that tells you there is something really wrong with the society in which this kind of thing occurs.

And I suggest, panel, that we need a fundamental change in our society. Society gets what it appreciates. And you watch the people that are invited to the White House and slobbered all over. It is not academic achievers. It is people from Hollywood and people from the sports area. And I don't know how to get that fundamental change, but we are at serious risk. We cannot continue to be the world's premier economic power and the world's premier military power when other countries are turning out far more scientists, mathematicians, and engineers that are as well trained as ours are.

This is a huge, huge challenge, and our future as a premier nation depends upon how we address this. How do we change the culture so that pursuits in these areas are really appreciated because we are not going to get the scientists, mathematicians, and engineers, and there will be no new companies to which we need to attract these technical people we are talking about today if we don't

turn out enough scientists, mathematicians, and engineers. How do we change our society so that we really appreciate those people?

Dr. FONASH. If I may attempt an answer at that: I don't know how to change it, but I know that the mechanism is—I don't know how to actually carry out the mechanism, but the mechanism is marketing. I look at CSI, Crime Scene Investigation, these TV shows. Now all of the kids want to be forensic scientists.

The media has immense control over middle school and high school kids. It shapes their thinking. You know, they want this because they were told they should have it. They want to be forensic scientists because that looks pretty cool on television. Engineers don't look cool. Scientists don't look cool. The media doesn't depict us as being cool. We are, as you say, nerds, geeks. Something has to be done in the basic marketing. This whole culture runs on marketing, and that is the area that has to be addressed, I believe.

Mr. BARTLETT. Thank you very much, Mr. Chairman. This is a real challenge, and if we don't collectively address this and succeed in changing it, we face a pretty uphill role in the future.

Chairman BAIRD. Thank you, Dr. Bartlett.

I think one of the positive things about the high-tech revolution is that the nerds and geeks have done pretty well. And Dr. Bartlett often raises this issues of pretty girls won't date the guys with the doctorate degrees. My wife is right fetching, and out of fairness, she has got a Ph.D. as well.

But I want to thank our panelists here for their contributions today, for their insights. The record will remain open for a couple of weeks. If members of this panel, or if you folks, want to add something to it, by all means, let us know, and I think we have got good grist for the mill here now as we work for things, and I think, equally importantly, some very good models for how things are working.

And one of the things we have said, we need to market those models as well so that other community colleges, other industries, can follow the kinds of examples of Genentech and the folks Dr. Fonash and Dr. Pumphrey and spoke about, and Mr. Mittelstadt, helping your members hear the kinds of examples we have got here of successes where the manufacturers themselves and the industries themselves have worked with the community college. Frankly, that is a lot faster turnaround than the appropriations process. Stick around the next few days, and you will see what I mean by that.

Thank you very much. And with that, this committee is adjourned. Thank you to the panel.

[Whereupon, at 4:45 p.m., the Subcommittee was adjourned.]

Appendix:

Answers to Post-Hearing Questions

ANSWERS TO POST-HEARING QUESTIONS

Responses by Gerald Pumphrey, President, South Puget Sound Community College

Questions submitted by Chairman Brian Baird

Q1. How can industry assist community colleges to market their programs? You mentioned in your testimony that companies themselves are better than community colleges at selling their jobs to potential employees. Could industry be doing a better job at marketing to students?

A1. Workforce and labor market demand issues seem to be ones on which companies within an industry are usually willing to approach collaboratively. It is useful to jointly develop, fund, and implement campaigns to educate the public about career opportunities within an industry. Many colleges struggle with marketing costs, particularly at the level of individual programs. Funding for the development and publication of electronic and print media that is tailored to the local college and employment opportunities in the companies it serves would be beneficial. Potential students know that the college's product is education, and they know that it is the employers who have jobs to offer. It is more powerful when company representatives join college faculty and/or recruiters when they visit high schools and recruitment events.

There are many wonderful career opportunities in technical fields that have very little public visibility. Visibility matters. Colleges have experienced strong enrollment in culinary and forensic programs not due to any overwhelming expansion of job openings, but due in large part to the visibility conferred by television programming in recent years. Meanwhile, employment opportunities in servicing technically sophisticated equipment and in manufacturing are going begging for qualified applicants. Industry-wide approaches to elevating the visibility of these jobs and the rewards they provide is important; the colleges cannot do it alone.

Q2. Dr. Fonash talked about the benefits of a research university affiliation in his testimony. If a community college does not have access to such an institution, or the area of technical training is outside the purview of most universities, can the National Science Foundation Advanced Technology Education (ATE) centers provide local programs with similar guidance? In what aspect are program like ATEs most useful?

A2. The NSF ATE program has been very useful in aggregating technical expertise, developing and disseminating curriculum and instructional materials, and providing expert consulting services to the colleges with similar programs. In many cases, they have been instrumental in developing skill standards that bring consistency to and elevate the quality of training programs. In some cases, this has resulted in credentials that promote the geographic mobility of program graduates. No doubt their impact has been greatest in the colleges and communities where they are located, but there have also been significant regional and national impacts from their work with other colleges. There is no question the model has provided value.

The model shared by Dr. Fonash, based on his work with the Center for Nanotechnology Education and Utilization at Pennsylvania State University, includes an ATE Center. However, this model also has an explicit regional focus operationally defined as the State of Pennsylvania. It leverages the intellectual capital of a major research university and the advanced technology concentrated in the ATE Center by a formal articulation with all of the state's 14 community colleges. The students spend their first three semesters completing relatively inexpensive academic and fairly generic technical courses in their home communities. They spend the fourth semester in a deep immersion in the rich nanotechnology environment afforded by the center. This is a more powerful model than many of the ATE Centers for effecting a strong regional impact and for the intensity of involvement of students from outside the host institution. It will not be possible for all ATE Centers to develop along these lines, but it is well worth emulating where it is possible to do so.

Questions submitted by Representative Eddie Bernice Johnson

Q1. In your experience, has industry shown more interest in community colleges creating degree programs or certificate programs?

A1. In my experience, which I would characterize as being insufficient for understanding as entirely representative, industry has shown most interest in two types of programs. The first is a short-term, highly customized program, usually delivered

on site in conjunction with a start-up, relocation, expansion, or adoption of a new technology. These are typically directed at new hires or at an existing group of employees who need new skills. Most often, these programs do not result in academic credit.

The second type of program in which I have seen a lot of industry interest is a degree program, usually an Associate in Applied Science or equivalent degree. Companies have often initiated discussions about this option at the same time they have discussed their customized, short-term training with us. Interest in the degree programs is often related to the development of a sustainable source of new employees over the long-term or to support advancement and promotion of their current employees. A lot of this interest has paralleled the evolution of organizational models that devolve responsibility for decision-making and quality control processes to front-line workers and their immediate supervisors.

I have seen less interest in certificate programs, even in cases where they might be sufficient or even more appropriate. Some of this may have to do with the value employers may place on the ability to set and achieve longer-term goals rather than the occupationally relevant content.

Q2. How do the different programs affect the quality of opportunities for students?

A2. In general, the more relevant programs are in preparing students for specific and available employment positions, the better the opportunities will be for the student both in the quality of the education they receive and their employment prospects upon graduation. To keep programs relevant, colleges must at a minimum maintain an ongoing dialogue with the industries the programs support. That dialogue serves to keep curriculum current, define professional development objectives for the faculty, and apprise the college of the technology the students will encounter upon employment. If the college has an effective partnership with the industry, the industry will often contribute content knowledge to inform the curriculum, provide training or return-to-industry experiences for faculty, and assist with acquisition of current technology.

Graduates who have benefited from this participation are more likely to possess the skills expected by the sponsoring industry. As a result, their employment prospects are enhanced. Strong relationships between a college and the employers they serve benefit all concerned, including students and taxpayers. Individual companies, large and small, experience changes in fortunes. Over time, the most stable partnerships involve groups of similar companies within an industry sector. This is not to argue against strong partnerships with individual companies, but to acknowledge the inherent risks to sustainability for a program that depends on a single sponsor or partner.

ANSWERS TO POST-HEARING QUESTIONS

Responses by Stephen J. Fonash, Center for Nanotechnology Education and Utilization, Pennsylvania State University

Questions submitted by Chairman Brian Baird

Q1. In your testimony you note that community colleges are often not well equipped to aggressively market their program to potential students. Have you seen industry take an active role in marketing their technician and skilled production jobs to potential employees? Could the private sector companies you work with be doing more to attract students to vital training programs?

A1. In general, community colleges do not effectively package or market their technical programs. Those that have the ability to offer cutting edge technology taught by knowledgeable faculty with state-of-the-art facilities, and that have pathways in place to four-year degrees, offer potential students outstanding value and opportunity. Such two year programs offer much more hands-on access to "'real' equipment than four-year engineering and science degrees thereby giving students a meaningful taste of what it is like to work in a technology field and meaningful skills to do so after just two years of training. This immediate immersion and the chance for technical jobs after two years is very helpful to students who are not sure if they want a career in science and technology and are "trying to find themselves." They can immediately get a "feel" for what these careers are like and can make more informed decisions. The programs that have pathways in place to four-year degrees also offer potential students the opportunity, if they so choose, of a lifetime of learning possibilities. These advantages, opportunities, and possibilities could and should be packaged and marketed by community colleges as a "two-year degrees—doors to a lifetime of opportunities" package. To make it all even better, this whole package of opportunities comes with a tuition price tag that is generally much less than the tuition costs of the four-year institutions.

While community colleges do not market these opportunities well, industry cannot be expected to greatly help in two-year degree marketing—either by assisting the colleges or through direct industry efforts. There are some exceptions. For example, industry associations such as the Semiconductor Industry Association (SIA) and the National Association of Manufactures (NAM) do conduct marketing efforts. However, individual companies face enormous competitive pressures, cannot afford to aid in marketing two-year degree programs, and must focus on their immediate needs in order to stay in business. Industry understandably wants students with the skills required to meet today's immediate challenges, which means that they want students to learn today's job skills. Unfortunately, these jobs—and their requisite skills—may migrate out of the country by tomorrow. Educators need to compensate for this by making sure students are taught career skills and develop a realization for the need for a lifetime of learning. Students have to develop a broad knowledge base for their "economic survival" over the course of their careers and they must learn to be intellectually "fast on their feet" so they can evolve as technology evolves.

Although industries are focused on surviving in today's international markets, they can be a very vital partner in the "education for a career approach." They have a strong sense of what tomorrow will bring. Consequently, their help is needed by educators in making sure curricula for the "two-year degrees—doors to a lifetime of opportunities" package continuously develop and improve. Since the economic forces industry faces will not allow individual companies to play major roles in developing and promoting educational opportunities, that burden must fall to industry associations, State and Federal Government. Among these, only government can provide the stability, perspective, and resources needed to plan and educate beyond this quarter's needs.

Q2. In your testimony you state the benefits that accompany a tech-training program paired with a research university. For community colleges without access to a university, or for programs outside areas of interest to universities, can ATEs serve a similar role as research universities?

A2. The National Science Foundation's ATE program strives to make sure that there are diminishing numbers of community colleges without access to a research university. One of the key ways that the ATE program is doing this is by serving as a catalyst to bring together community colleges and research institutions to (1) share research university resources and expertise, (2) enable community college faculty enrichment, and (3) develop new two-year to four-year degree programs and

pathways. It is very important to point out that, for this type of leveraging to work, not every community college needs to be directly linked to a research university in its locale. New and effective educational programming developed by an ATE center or project is quickly disseminated across the country through the ATE network. As an illustration, the concepts developed at ATE Center for Nanofabrication Manufacturing Education at Penn State are being leveraged by community colleges in more than 20 states. In addition, the approaches of this PA ATE center are being extended beyond nanotechnology to include programs areas such as biotechnology, information science and technology, engineering technology, and others.

We would not suggest that ATE Centers can or should even try to provide community colleges with the kinds of resources that research universities can. However, ATE centers and projects around the country are playing a crucial role in promoting innovative approaches to technical education, including linkages between research universities and community colleges. We are also observing a growing interest among research universities in participating in these kinds of partnerships. Research intensive Land Grant universities are particularly engaged because these arrangements help them fulfill their three-part mission of education, research, and service. Research universities also recognize that by strengthening community college technical programs and creating student pathways from associate to baccalaureate degrees, the universities are helping to develop a pool of qualified future upper division undergraduate and graduate students for their own programs, including students from under-represented groups which community colleges often tend to disproportionately serve. This is a win-win-win arrangement for community colleges, research universities, and, most importantly, students—an arrangement that the ATE program is helping to seed and promote through its centers and projects.

Q3. Can you please describe in more detail the career pathway programs you mentioned in your testimony? How many high school students have participated in these programs for advanced manufacturing through the Center for Nanotechnology Education and Utilization affiliated community colleges and have you been able to track these students: What factors attract high school students to a two-plus-two program?

A3. The PA Nanofabrication Manufacturing Technology Partnership has had 423 students who have completed the capstone semester total immersion in nanotechnology fabrication, synthesis, and characterization. Those students in this group that passed through since the establishing of our ATE center have been able to utilize two types of education pathways: the two-year degree to four-year degree (2+2) pathway and the high school/vo-tech school to the two-year degree to four year degree (2+2+2) pathway. Before the efforts of our ATE center, there were, in most cases, no clear 2+2 pathways from two-year to four-year degree granting schools in PA. Today, using nanotechnology as a coalescing theme, there are 2+2 pathways that lead from all 22 nanotechnology two-year degrees available in PA to four-year degrees. These available four-year degrees are in engineering management, various areas of engineering technology, biology with a nanotechnology concentration, chemistry with a nanotechnology concentration, and physics with a nanotechnology concentration. One can go to our web site at *www.cneu.psu.edu*, click on a specific two-year degree site on the map provided, and immediately be given the available four-year degrees set up for that specific two-year degree site.

The high school/vo-tech school 2+2+2 nanotechnology-based pathways in PA that have resulted from the efforts of our ATE center currently number thirty-one. The factors that we find attract high school students to 2+2+2 nanotechnology-based pathways include: (1) the opportunity to take courses at a community college campus, (2) access to community college facilities (e.g., computers, sports facilities), (3) the ability to get community college credit for high school courses in cases where high school teachers are certified by the colleges, and (4) the ability to lighten their college credit load.

The 2+2 and 2+2+2 pathways have been set up recently as part of our ATE activities; consequently our tracking data are limited. In a first survey taken in 2005, we found that 36 percent of the students were continuing their degrees past the two-year level. However, this cohort is not entirely made up of students pursuing 2+2 programs since some were students who came from four-year degree programs. A survey aimed at more precise 2+2 data is currently underway.

ANSWERS TO POST-HEARING QUESTIONS

Responses by Eric Mittelstadt, CEO, National Council for Advance Manufacturing

Questions submitted by Chairman Brian Baird

Q1a. The National Association of Manufacturers' 2005 Skills Gap Report—A Survey of the American Manufacturing Workforce *stated that 80 percent of the respondents to the study's survey indicated moderate to severe difficulty in finding enough qualified personnel for their manufacturing business. The authors of the study state that the majority of those responding to this survey were small and medium sized businesses, with 500 or fewer employees. In your opinion, is the workforce shortage concentrated in this sector of the manufacturing industry?*

A1a. Today perhaps yes, but as more baby-boomers retire it is clear companies of all sizes face the problem. Since most jobs in the manufacturing sector are found in small and medium sized companies, this is where employers increasingly encounter problems in recruiting both production workers and technical workers. Both of these require increasingly technical knowledge and skills as manufacturers of all sizes use more advanced processes, equipment and methods to meet the challenges of the hyper-competitive global economy of the 21st century. And, in fact, this is true in all industries, not just manufacturing. For example, health care, banking, sales, and on and on, are all utilizing ever more advanced technology to become more productive in the competitive global economy in which we live. This says the shortage is or will be felt in all sectors and by all sizes of companies.

Q1b. What distinct challenges do small and mid-sized manufacturers face in workforce development and how do they address these?

A1b. Since many small and medium sized manufacturers lack the financial or professional resources to develop focused recruitment programs to attract new workers, they often must rely on "word of mouth" or newspaper advertising to find new workers. Since they also do not have resources to design and conduct in-house training programs, most newly-hired workers are only given job orientation and some on-the-job training by the company's older workers. Again due to lack of resources to even look at something new, only rarely do the small and medium sized companies seek help from One-Stops or WIBs, or other federal, State and local programs, preferring to "do it the way we have always done it."

This suggests the necessity for new approaches by government to make such programs easier to access and easier to use for companies too strapped for resources to have the time to sort them out, so they can leverage their efforts and satisfy their needs with the programs available.

Q2a. Dr. Pumphrey and Dr. Fonash stated in their testimony that community colleges typically lack the resources to effectively market their tech-training programs. Could the private sector take more of an active role attracting potential students to tech-training and ultimately jobs as technicians or skilled production workers?

A2a. In view of the "rate of change" in the manufacturing sector, there is an increasing need for manufacturers to assume a greater role in working with post-secondary educators. Many technology-oriented companies already work with local community/technical colleges to help their workers as well as future job candidates acquire the technical knowledge and skills the companies need to be productive, innovative, and competitive in the global marketplace. Where smaller manufacturers have established close working relationships with community and technical colleges, students hear about the more technical and better paying job openings and are more responsive to job postings or "word of mouth" information.

The "Dream It—Do It" campaign approach developed by the *National Association of Manufacturers (NAM)* is one successful approach whereby businesses of all sizes can work together with government and educators in an organized and accountable way to get the message across. More regions around the country should be using this approach.

But because of those serious resource constraints for the vast majority of manufacturers mentioned above, companies, even working with educators, cannot do it by themselves. This applies to community colleges as well. As I said in my testimony, Congressional and Presidential candidates, as well as State, regional and local candidates, also can all help by making clear the national need for qualified people in the promising technician and skilled production jobs of today and the future. This

needs to become a recognized national priority, and in our nation that requires government leaders of all parties to work hard to communicate the criticality of the need to us all. That includes doing so in political campaigns, where media pays attention to what candidates say, and reports on it to the public at large.

Q2b. What type of initiatives can industry take to professionalize or increase the prestige of these types of jobs?

A2b. Manufacturers seeking to attract students and/or new workers with "the right technical knowledge and skills" should develop continuing relationships with post-secondary institutions (community/technical colleges, colleges and universities with STEM-focused programs, and graduate level programs focusing on science and technology) and with deans, department heads, classroom instructors, counselors, and other staff in these institutions.

Small and medium sized manufacturers concerned about the availability of young, entry-level workers should develop similar working relationships with local high schools and secondary-level technical schools and their teachers and staff to educate students about the more technical and upwardly mobile career opportunities in their companies. Where NAM's "Dream It—Do It" campaigns are operating, manufacturers should work closely with local program sponsors to inform high school administrators, teachers and students of the job opportunities available in their companies for graduates having the increasingly technical knowledge and skills needed in 21st century manufacturing entities.

Q3. What would be the most effective measures industry could take to bridge the gap between industry's fast paced rate of change and the inability of most community college tech-training programs to respond at a similar rate?

A3. Manufacturers of every size must establish ongoing relationships with educators at all levels to make sure teachers, counselors, professors, and administrators are familiar with the rapid changes occurring in their companies, the skills required for success in this rapidly changing competitive environment, and the capabilities required to succeed in the challenging new jobs in manufacturing. Manufacturers must be willing to assign executives to work year-round on industry-education partnerships at the post-secondary and secondary levels. . .to designate team leaders and supervisors to help develop community/technical college curricula aimed at meeting the knowledge and skills needs of students preparing for jobs in the manufacturing sector. . .to ask skilled workers to participate in secondary classroom presentations about career opportunities in their companies.

Here again though, especially for small and medium sized companies, national policy needs to find creative ways to free up the very scarce resources and time those companies need to do this essential task. *Examples could be* targeted tax reductions for companies that participate in such activities, streamlined regulatory compliance requirements to free up scarce time for these more constructive things, etc. Innovation and creativity in government is as important as in industry and education, because our nation is competing internationally just as much as are our industries, our educational institutions and our workers.

Further, national policy requires that government at all levels be challenged to find creative ways to help companies of all sizes, educators at all levels, workers in all companies, understand the importance of the proper technical preparation to their own and their children's success. We live in a world where technology will be increasingly critical to success in all fields, including but not limited to manufacturing. Companies cannot do this by themselves. It must become a national priority for all sectors of our great nation, government, companies, educators, workers, parents, everyone, if we hope to get this vital message across. This is the only way we can continue to enjoy the highest standard of living in the world and to be a world power in this century and on into the future, given that we will never have as many people as some other nations, India and China being only the most visible now.

ANSWERS TO POST-HEARING QUESTIONS

Responses by Monica L. Poindexter, Associate Director, Corporate Diversity, Genentech, Incorporated

Questions submitted by Chairman Brian Baird

Q1. You stated in your testimony that one of the biggest challenges Genentech faced when developing its partnership training programs was meeting the company's "just-in-time" workforce needs. How did you address this challenge? How did your company balance Genentech's fast paced needs with the community colleges' more deliberative nature and structure, as well as with industry's growing desire for more versatile employees?

A1. During the early part of 2000, the Genentech College Programs department partnered with managers in our company's manufacturing department to assess what their future hiring needs were and determine how to secure skilled workers for those jobs. From those early meetings a Manufacturing Task Force was formed to address where and how we would create the necessary talent pool. We identified the number of positions we would need over the next 18–24 months and joined with our community college partners to develop a plan to market, screen, interview, enroll and graduate students out of the 14-week certificate program. Graduates of the program were then offered interviews for Paid Work Experience co-op slots at Genentech.

To meet our continuing need for skilled workers we worked with the participating schools to increase the number of students participating in these programs. As Genentech's hiring needs have periodically decreased we have worked with the schools to explore job opportunities for the students at other biotechnology companies in the area.

The nature of the program we developed with the schools produced workers with a versatile set of skills well-suited to biotech manufacturing. Since the program was developed in a cooperative manner between industry and academia, students receive not just academic training but also hands-on experience that prepares them to be useful employees.

Q2. In your testimony you talked about the need for long-term planning when developing tech-training programs, especially around issues of funding and sustainability. How can industry, government and academia best work together to develop and sustain tech-training programs?

A2. There is a great need for industries like biotechnology to have well-trained, highly skilled workers available to operate our manufacturing facilities. Programs like the ones we have developed with local community colleges are an important element of ensuring that a trained workforce is available. But we cannot depend on these programs alone to provide the workforce we will need in the 21st Century.

Too many of our students fail to receive the basic education necessary to prepare them for work in the leading 21st Century industries. A greater focus on math and science education, as well as more opportunities for specialized skill training, would help to provide students with usable skills. I also believe the Federal Government needs to provide long-term funding streams for career technical programs to develop the future skill sets needed to support high-wage and high-growth industries.

Congress should look at policies to create incentives for industry to co-create curriculum and paid work experience programs not just for students but for teachers as well. Skill and course upgrade programs are critical for the development of a future workforce. Finally, Congress should also identify the attributes employers seek in industries such as biotechnology and determine how well current career technical education programs train students to meet those needs.

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