

ROADMAP^{TO}

**EDUCATION
REFORM FOR**

MANUFACTURING

Results from the National Manufacturing
Talent Development Roundtable

I WANT TO BET ON AMERICA

About the Manufacturing Talent Development Roadmap

For the past two years, The Manufacturing Institute has led a strategic effort to develop the educated and skilled workforce required to drive innovation in the United States' advanced manufacturing sector.

This includes the creation of the NAM-Endorsed Manufacturing Skills Certification System and the establishment of an Education Council where leaders from K-12, community colleges, and universities advise The Manufacturing Institute on education strategy and provide test-beds for new innovations.

The Manufacturing Institute also participates in regional, national, and international partnerships and boards that drive innovation in education through the application of competency-based learning

in higher education; the infusion of technology and adoption of computer-based learning; the creation of industry, government, and academic partnerships to establish a renaissance in manufacturing; and the conversion of the General Educational Development (GED) to a gateway to employment.

Now, as manufacturing leads the United States out of the latest recession, there is an opportunity to reinvigorate manufacturing in this country not just during this economic cycle, but for generations to come.

National Manufacturing Talent Development Roundtable Participants

Manufacturing Executives

Ronald Bullock
Chairman
Bison Gear and Engineering Corp.

Emily Stover DeRocco
President
The Manufacturing Institute

Gov. John Engler
President & CEO
National Association of Manufacturers

Michael Gallo
President & CEO
Kelly Space & Technology, Inc.

Elliot Ginsberg
President & CEO
Connecticut Center for Advanced Technology

Beth Hying
Assistant Dean, Caterpillar University
Caterpillar, Inc.

Kellie Johnson
President
ACE Clearwater Enterprises

Joseph Loughrey
President, COO, Director (Retired)
Cummins, Inc.

Donald McCabe
Senior Vice President
Corning, Inc.

Blake Moret
Senior Vice President
Rockwell Automation

JoAnne Pritchard
Manager of Manufacturing Learning
General Motors

Lynn Scheitrum
Manager, Talent Management & Central Staffing
Air Products & Chemicals

Al Stimac
President
Metal Essence, Inc

Dan Swinney
Executive Director
Chicago Manufacturing Renaissance Council

John Taylor
Senior Manager
Lockheed Martin Aeronautics Co.

Education Officials

Bryan Albrecht
President
Gateway Technical College

Gregg Bethell
Senior Executive
New York City Department of Education



TALENT AND
INNOVATIVENESS
ARE HERE

To be successful, though, requires significant education reform.

On December 1, 2010, The Manufacturing Institute and the National Association of Manufacturers hosted a National Manufacturing Talent Development Roundtable where 36 manufacturing executives, education officials, and thought leaders gathered to provide input on a manufacturing education reform roadmap.

In preparation for the Roundtable, participants read and reviewed

some of the foremost research and writings on the subject of education reform. This includes the groundbreaking book on disruptive innovation in education, *Disrupting Class*, policy papers from think tanks like the American Enterprise Institute and the Center for American Progress, and foundation projects from the Bill & Melinda Gates Foundation and Lumina Foundation for Education.

There are quotes from many of the participants at the Roundtable throughout this Roadmap. This

is not an endorsement of the recommendations in this report from those individuals. The recommendations come solely from manufacturers as represented by The Manufacturing Institute and the National Association of Manufacturers.

To access the complete set of books and research papers, or view the webcast of the National Manufacturing Talent Development Roundtable, please visit The Manufacturing Institute website at <http://institute.nam.org>.

Dr. Roy Church
President
Lorain County Community College

Joseph D'Amico
President and Chief Operating Officer
Apollo Group, Inc.

Dr. Gary Green
President
Forsyth Technical Community College

Dr. Robert Mendenhall
President
Western Governors University

Roderick Nunn
Vice Chancellor
St. Louis Community College

Dr. Mohammad Qayoumi
President
California State University – East Bay

Dr. Thomas Samph
Chief Executive Officer
Post University

Dr. Mel Schiavelli
President
Harrisburg University of Science and Technology

Dr. Thomas Snyder
President
Ivy Tech Community College

Dr. Stewart Weinberg
Superintendent
Dallastown (PA) Area School District

Thought Leaders

Molly Broad
President
American Council on Education

William Eggers
Executive Director of the Public Leadership Institute
Deloitte, LLP

Michael Horn
Executive Director
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Dr. Parminder Jassal
Program Officer, Postsecondary Success
The Bill & Melinda Gates Foundation

Jamie Merisotis
President & CEO
Lumina Foundation for Education

Stephen Ruffa
President
Lean Dynamics Research LLC

Martin Scaglione
President, Workforce Division
ACT

Louis Soares
Director of the Postsecondary Education Program
Center for American Progress

WE HAVE TO PUT THE EFFORT IN AND

Why Manufacturing



OUR MANUFACTURING ECONOMY WILL

Manufacturing, and particularly the advanced manufacturing that now dominates the U.S. industrial sector, creates more wealth than any other industry.

- Manufacturing pays higher wages and provides greater benefits, on average, than other industries;
- Manufacturing creates the highest number of jobs to both support the industry and serve the surrounding communities; and
- Manufacturing contributes over 50 percent of the total U.S. exports.

If manufacturing is critical to our economic security, then it is essential to our national security. It is U.S. companies that provide the tools, armor, and machines that allow our military to control the battlefield while simultaneously protecting our servicemen

and women. Our defense and homeland security depend on a strong, vibrant, and innovative manufacturing base.

In response to competition from foreign countries, over the last two decades, the U.S. manufacturing industry has evolved from a labor-intensive production line to an advanced, technology-driven environment. Firms both large and small have applied lean principles to streamline operations and survive in this highly competitive marketplace. This has led to significant gains in productivity and enabled the United States to remain the world's largest manufacturer.

But in order to maintain and increase productivity, companies must improve the skills of existing employees to utilize advanced technologies while attracting the next generation of talented and skilled workers. This is the greatest challenge that manufacturers face.

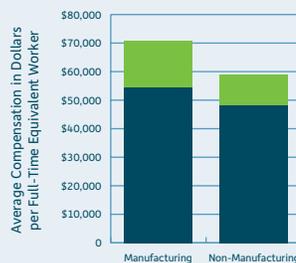
This is our call to action.

Manufacturing Dominates U.S. Exports



Source: U.S. Bureau of the Census, 2008

Manufacturing Pays Premium Compensation



Source: U.S. Bureau of Economic Analysis, 2007

Manufacturing's Multiplier Effect is Stronger than other Sectors



Source: U.S. Bureau of Economic Analysis, 2007 Annual Input-Output Tables

“ A skilled, educated workforce is the single most critical element of innovation success – and the hardest to acquire. ”

Emily Stover DeRocco,
President, The Manufacturing Institute

“ Talent isn't just what is developed to fill the jobs that are being created. Talent is actually what we use to create the jobs in the first place... Companies don't create jobs; the people do. ”

Jamie Merisotis,
President, Lumina Foundation for Education

Facts about the U.S. Education System & U.S. Manufacturing

Manufacturers in the United States have a talent problem. Just as manufacturing grows more complex and innovation drives the industry, companies can no longer find workers with the skills today's jobs demand. This deficit in talent available to manufacturers poses a direct threat to the future prosperity and security of the United States.

Though there are many reasons for this talent crisis, several facts about the state of education in the United States cannot be ignored.

- Over 31% of students drop out of high school. That is approximately 1.3 million students a year;
- Only 27.5% of students entering a two-year college earn an Associate Degree within three years and 55.9% of students entering a four-year college earn a Bachelor's Degree within six years;

- By the year 2018, 63% of all jobs will require some form of postsecondary education;
- The National Defense Industrial Association reports that between 5th and 12th grade, 74% of students do not have interest in or access to math and science courses required for technical careers.

These deficits in education are now impacting the ability of U.S. manufacturers to compete in the global economy.

- At the height of the recession, 32% of manufacturers reported that they had jobs going unfilled because they could not find workers with the right skills;
- 84% of manufacturers stated that the K-12 school system was doing an inadequate job of preparing students for the workplace;
- 2.7 million manufacturing employees are 55 years of age or older and likely to leave the labor force over the next 10 years. This will create additional and significant demand for a technically trained workforce.

BE
FOR A LONG TIME TO COME
STRONG





As institutions and policymakers begin to address these education deficits, they must recognize that the student population has changed. The traditional, 4-year, residential model of postsecondary and higher education no longer serves the needs of today's students.

- 73% of students in higher education today are “non-traditional;”
- Enrollment in community colleges has increased 17% within the past two years. This threatens to overwhelm the capacity of community colleges absent significant additional resources or the adoption of new methods of instruction;
- There are 75 million potential working learners in the United States. These “students” are balancing work, family,

and school and need to learn the skills required to advance their careers in the most efficient and effective means possible.

These facts demand a completely new and different approach to education in the United States. Incremental increases in funding to deliver more of the same courses and models will not provide manufacturers, or any sector of the economy, with the skilled workforce required to compete and succeed. And traditional education models will no longer give the majority of Americans the skills to find and keep good paying jobs. It is time for innovative solutions.

“ If you look at the 55-64-year-old age group in the United States in terms of postsecondary credentials, we are number one in the world. If you look at the 24-35-year-old age group in terms of postsecondary credentials, we are number 12 in the world. ”

*Joe Loughrey,
Retired President, Cummins, Inc.*

“ 20% of students that attend technical college already have a Bachelor's degree. ”

*Bryan Albrecht,
President, Gateway Technical College (Kenosha, WI)*

“Competency-based instruction is the future as we align education and workforce development with employers’ needs.”
*Gary Green,
President, Forsyth Technical Community College*

Application of Competency-Based Education

The U.S. education system is based almost exclusively on time. K-12 grades are a single school year. Postsecondary degrees are conferred after a set number of credit hours.

The rate at which students learn is immaterial in today’s school system. If a student cannot master a subject in the time allotted, then he or she either fails or falls behind. Over time, as subjects grow more complex and interdependent, this pattern escalates to where students can never catch up and dropping out becomes an attractive and sometimes only option.

In a competency-based education system though, each student progresses as he or she demonstrates mastery of the curriculum. They proceed at their own pace and teachers, with the use and aid of technology, continuously assess progress and adapt instruction.

This type of education system promises several benefits. First, by continuously assessing a student’s progress, teachers will

have a better understanding of the specific subjects and topics that are challenging the student. This will allow them to better customize and personalize instruction so more students achieve proficiency. This frees teachers from providing the average method at the average pace. Second, students will be able to proceed at their own natural learning pace, rather than the current arbitrary pace set by the teacher and the school calendar. Focusing additional time on the curriculum components in which individual students struggle gives them the time to overcome those struggles before proceeding to the next subject. In concert with technology, it does so in a way that does not disrupt or delay the rest of the class.

But perhaps most importantly, it will change the assumption about the length of schooling required to obtain skills and develop talent. Institutions at all levels of education are facing tremendous cost pressure. A system that enables the acceleration of learning and the compression of the traditional semester offers an opportunity to realize significant savings. This has already begun with dual enrollment and early college model programs in some areas, but it should be expanded and made available to all students.



SUCCESS
AND THE HARDEST
TO ACQUIRE

“ We’ve moved away from a traditional faculty model to bring people from industry with 10-15 years of experience as well as academic credentials to actually build courses, design courses and deliver courses. ”

*Dr. Thomas Samph,
CEO, Post University*



COMPETENCY-BASED INSTRUCTION IS THE Establish and Expand Industry- Education Partnerships

Part of the responsibility for creating an education system that graduates students prepared to work in today’s economy must rest with companies. This includes ensuring that schools are teaching the latest skills required by industry, partnering with education to provide internship opportunities for students to blend classroom learning and application, and providing an education option for current employees to obtain new skills needed to advance.

There is also an opportunity for industry associations to create partnerships that are nationwide. Most industry-education partnerships have occurred between individual companies and community colleges. This is a difficult and time-consuming process that benefits only a small number of companies and provides limited employment options for students.

Now, through The Manufacturing Institute, the manufacturing sector is engaged with leadership in 31 states to integrate a set of nationally portable, industry-recognized

skills certifications into their curriculum. This provides a framework for engagement between education and manufacturers that produces a consistent set of credentials and classes across the country.

The NAM-Endorsed Manufacturing Skills Certification System

The NAM-Endorsed Manufacturing Skills Certification System is an organized group of nationally portable, industry skills certifications applicable to entry-level jobs in advanced manufacturing. The attributes of the system are:

- The skills can be learned in programs of study beginning in high school and progressing through community college and university curriculum;
- The skills certifications are stackable, with the skills learned in chunks of curriculum and measured by gaining competencies, not through seat time or credit hours;
- The skills certifications are integrated into degree programs where educational pathways are aligned to career pathways for each certification;
- These pathways provide more “on” ramps to postsecondary education to learn high level skills, and more “off” ramps to employment with industry credentials that have value in the workplace.

FUTURE AS WE ALIGN EDUCATION

“ Standards have to be set by industry and be independent, valid, and proven. We have to be able to look at anybody anywhere in the world and say the quality of our education can compete anywhere. ”

*JoAnne Pritchard,
Manager of Manufacturing Learning, General Motors*

The key differences in this approach to education reform and educational success are:

- A competency-based curriculum that redefines “completion” and “success” in postsecondary education and college as the attainment of industry-recognized credentials; and
- Industry playing a critical role in defining and refining the learning standards and assessment, ensuring curriculum is industry- and employment-relevant.

Deploying these competency-based educational pathways helps address the systemic educational deficits and long-term costs of education by:

- Keeping young people engaged in relevant education and progressing

to credentials that have value in the workplace, reducing the high school dropout rate and the number of college students who leave prior to completion; and

- Achieving cost savings by compressing the last years of high school and first years of college allowing students to simultaneously earn a high school degree, National Career Readiness Certificate, and a substantial number of credits towards a college degree with industry certifications.

This approach helps ensure the employability of graduates and working learners by equipping them with the industry-recognized skills credentials with meaning in the workplace. It also provides the manufacturing sector with a framework to engage community colleges on a consistent, nationwide basis.

AND
DEVELOPMENT
WITH EMPLOYERS' NEEDS
WORKFORCE

“ As I thought about what we can do, the only place I really have influence is where I live and so I chose to start locally... In my area, we are at the point of influencing hundreds of young people, changing their potential future. But if I add that to the thousands that JoAnne Pritchard and the thousands that Ronald Bullock are influencing and the work that Emily DeRocco is doing, it's now growing to tens of thousands or even hundreds of thousands. ”

*Donald McCabe,
Senior Vice President, Corning, Inc.*



“ We’ve taken the kind of technology that you all experience everyday outside of education and we are bringing it inside education. So we can understand when a student in class is struggling and we can deliver personalized learning. That is what we are changing in our environment. ”

Joseph D’Amico,
President, Apollo Group



CHANGING TO DELIVER PERSONALIZED LEARNING WE ARE

Infusion of Technology in Education

The infusion of technology into the classroom is not simply the placement of computers at every desk; it is computer-based instruction, personalized for individual students and utilizing the full set of technology tools and applications now available to the rest of society. The possibilities that widespread technology infusion hold are revolutionary:

- The mass-customization of education through software programs that understand how students learn, adapt to each individual student’s strength in learning, and continually assess progress during instruction;
- Access to any course or instruction method developed anywhere in the world. Schools could pool resources to offer specialized or advanced classes over the web with students attending virtually from anywhere in the country;
- Through social media technology, students can find, learn from, and collaborate with other students with similar interests, learning styles, or aptitudes. This replicates the team-based approach now common in

manufacturing, and all businesses, and better prepares students for the workplace.

The integration of such technology has the potential to reverse the dropout epidemic in the United States. By customizing learning to individuals, students who do not excel through traditional textbook and blackboard instruction will have the opportunity to learn through methods that engage and excite them.

It also provides an opportunity to re-inject the technical-based classes that so many schools eliminated over the past decades. These are critical to engaging students in the applied science and engineering pathways that lead to jobs in advanced manufacturing. Students can design and build products and operate machines virtually to learn the necessary skills. Then, through industry partnerships, they can apply those skills in a company setting.

HAS CHANGED
PRODUCTIVITY
IN EVERY

“ We can begin to create a broader range of opportunities that really will excite not only our students but begin to excite society as a whole about manufacturing. Advanced manufacturing is our only future if we are going to have a sustainable society. ”

*Dan Swinney,
Executive Director, Chicago Manufacturing Renaissance Council*

Create Excitement for Manufacturing

Part of the challenge in today's education system is that students do not see how what they learn in class applies to the real world.

This is particularly important in the manufacturing sector because a defined set of technical skills is required for most positions. This means students must engage in science, technology, engineering, and mathematics curriculum as early as middle school in order to obtain the required foundational knowledge.

A clear, defined, and well-lit pathway from school to a career in manufacturing is needed to ensure students obtain the

necessary skills. Combined with industry partnerships and applied learning, this pathway can re-excite students about the opportunities present in advanced manufacturing.

The Manufacturing Institute leads a career awareness and recruitment strategy that is engaging manufacturers, educators, and economic developers to encourage students to pursue a career in manufacturing. Called Dream It! Do It!, this strategy provides students with the opportunity to learn about and engage with manufacturers while directing them to the education pathways that open career opportunities. It is underway in 20 regions around the U.S.

INDUSTRY
EXCEPT EDUCATION

“ Technology has changed productivity in every industry except education. In education, it's an add-on cost and it will be until we change the entire way we think about delivery, the way it has in manufacturing. ”

*Dr. Robert Mendenhall,
President, Western Governors University*



“ If you look at how community colleges are organized... developmental education sits in one silo while non-credit workforce training sits in another silo. To achieve real solutions, we have to be much more integrated in how we deploy these assets. ”

Roderick Nunn,
Vice Chancellor, St. Louis Community College



TO ACHIEVE
REAL
SOLUTIONS

Application of Manufacturing Principles

Manufacturers have been on the front lines of the global economic competition for over two decades. That experience has taught them how to cut costs and maximize their focus on customer value; in manufacturing terms, how to be “lean.”

While educational institutions do not face the same global competition, they are experiencing the same pressures to reduce costs.

This has caused some schools to begin a reevaluation of their customers. This includes specifically defining students as their customers and designing services

that maximize value to those customers. The next step in that process is to cut the services and costs that do not improve the value of education for students.

This is the application of the principle of lean dynamics from manufacturing into education and holds the promise of significantly reducing the costs associated with operating educational institutions while simultaneously improving the services and results for students.



“ A lean organization is one that really develops a mechanism to understand the customer- the specific needs of their customers... Students are obviously customers. What do they need? What does it take to excite them to get engaged in the fields they need to be, or we need them to be engaged in, and stick with it completely through to get their certification? Companies are moving in different directions and at different paces. There needs to be a linkage so educational organizations can respond well. ”

Stephen Ruffa,
President, Lean Dynamics Research LLC

“ One of the things we’ve looked to SkillsUSA for, and why it’s become such an important talent pipeline for us, is that we are seeing students coming through with the capacity to understand complex skills and innovate creatively to function in manufacturing. ”

*Lynn Scheitrum,
Manager, Talent Management & Central Staffing,
Air Products & Chemicals, Inc.*

Expand Successful Youth Development Programs

Solutions to many of the education challenges faced by manufacturers have already been found. These programs must be replicated and brought to scale if they are going to reach the number of students necessary to reinvigorate manufacturing in the United States. Some examples of these successful programs include:

- SkillsUSA, a partnership between students, teachers, and industry working to ensure that America has a skilled workforce. SkillsUSA provides students with hands-on instruction in the application of technology through manufacturing while developing the next generation of leaders and responsible citizens.
- For over three decades, Jobs for America’s Graduates achieved extraordinary outcomes, including: retaining at-risk youth in middle

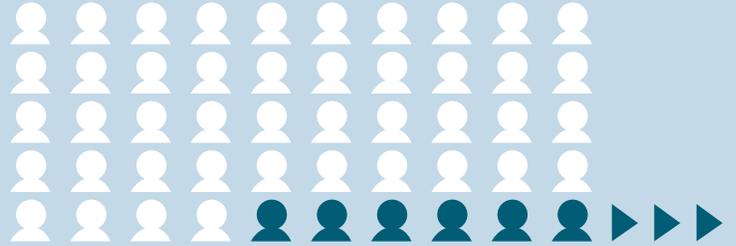
school and high school through graduation; assisting JAG graduates in securing an entry level job leading to career advancement opportunities; encouraging and helping JAG graduates pursue a postsecondary education; and providing program participants with competency-based classroom experiences.

- Austin Polytechnical Academy is a high school dedicated to educating the next generation of leaders in advanced manufacturing. Students learn about careers in all aspects of the industry, from skilled production and engineering to management and company ownership — plus related sectors like intellectual property law.

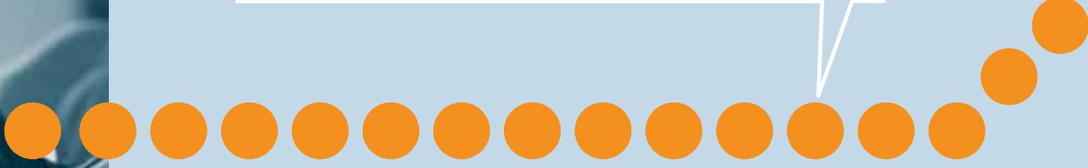
IN HOW
WE DEPLOY
OUR ASSETS



MANUFACTURERS SUPPORT Education



Of 50 children who can't read in 1st grade, 44 will still be behind in 4th grade



Manufacturers support:
Wise investment in early childhood education

“Let’s really infuse technology... so that we can educate children differently than we’ve ever done before. Change the role of the teacher. Change the role of technology and include a real working relationship with manufacturers and businesses to develop the curriculum that’s necessary for the future of America.”

*Dr. Stewart Weinberg
Superintendent, Dallastown (PA) Area School District*



We still have an education system aligned to a 19th century agricultural economy and 20th century industrial model – in the 21st century driven by technology and innovation.

15 million American adults today do not have a high school diploma

45%

By 5th grade, 45% of students are not excited about math and science

60%

By 8th grade, 60% are not pursuing math and science courses

31%

31% of students in 9th grade dropout of school before graduating

11th and 12th grades are often “lost years” of elective classes

Manufacturers support:

A new standards-based postsecondary education and career readiness credential for re-engaging adults without a high school diploma in our economy.

Manufacturers support:

- Competency-based learning pathways, allowing students to advance in their education as they gain mastery. These pathways should be standards-based, performance-based, and proficiency-based, not seat-time based.
 - Manufacturers understand the value of the national Common Core Standards to ensure every student gains a mastery of foundational academic skills.
 - Manufacturers call for the integration of industry-recognized skills credentials into programs of study.
 - Manufacturers believe providing an alternative “applied STEM” pathway to graduation will keep students engaged in science, engineering, technology, and math courses necessary to careers in advanced manufacturing.
- Blended learning, allowing students to learn, in part, through on-line delivery of education;
- Bringing evidence-based youth development programs like SkillsUSA to scale.

Manufacturing Skills Certification System

The NAM-Endorsed Manufacturing Skills Certification System will validate for employers that a student or entry-level worker has achieved core workforce readiness, academic, and manufacturing technical skills that enable individuals to swiftly enter careers across 14 sectors of advanced manufacturing. The Manufacturing Institute is now “building out” the Skills Certification System,

focusing on higher-level sector and occupation-specific industry-recognized credentials that will align to baccalaureate and graduate degree programs of study. The development of a highly skilled and educated 21st century workforce will help maintain U.S. leadership in innovation and productivity, which are essential to the viability of manufacturing in the global marketplace.

LEARN & EARN

COMMUNITY OR TECHNICAL COLLEGE

4-YEAR COLLEGE OR UNIVERSITY

Manufacturers support:

- More technology-infused postsecondary education alternatives, meeting students and working learners “where they are” and “when they can learn;”
- More competency-based postsecondary pathways with opportunities to earn interim credentials with value in the workplace;
- Compressed secondary-postsecondary learning via early college and dual enrollment models;
- Accelerated pathways to credentials and more “on and off” ramps to postsecondary education, to learn throughout their careers and improve advancement opportunities;
- More Learn & Earn programs of study that translate prior experience and learning into credits toward degrees;
- More internships and mentorships to align higher education with industry competency and skills requirements.

There are **75 million** potential working learners in America who must have access to higher education and employment concurrently.

“ In the United States, people do not see manufacturing as a desirable career path. The more we can drive young people to look at manufacturing as an exciting career, the more open they will be to continuous learning to advance their careers.”

*Beth Hying
Assistant Dean, Caterpillar University,
Caterpillar, Inc.*

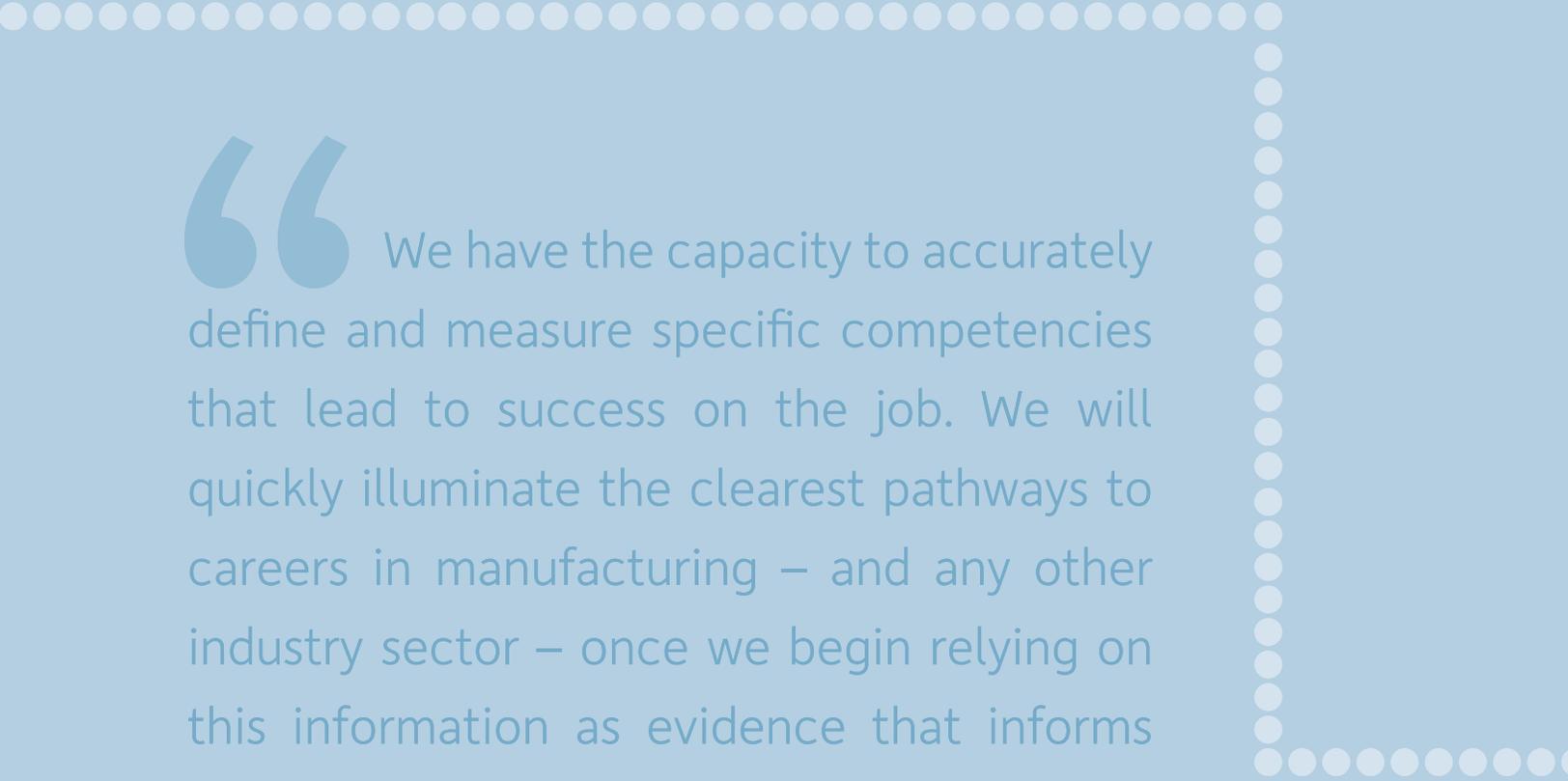


Manufacturers provide high quality jobs that:

- Pay higher wages and provide greater benefits than other industries;
- Create the highest number of jobs to both support the industry and serve the surrounding communities;
- Produce over half of all U.S. exports;
- Conduct nearly half of all research and development in the United States.

Manufacturers require the talented and skilled workforce that:

- Drives innovation in the industrial economy;
- Provides a competitive advantage in the global economy;
- Creates jobs in the U.S. economy.



“ We have the capacity to accurately define and measure specific competencies that lead to success on the job. We will quickly illuminate the clearest pathways to careers in manufacturing – and any other industry sector – once we begin relying on this information as evidence that informs teaching strategies and guides learners to knowledge and skills that will be directly associated with their success.”

*Martin Scaglione,
President, Workforce Division, ACT*

“ I want to bet on America. I believe we can win. I think talent is here and innovativeness is here... We have to put the effort in and make sure that the opportunities are ubiquitous so everybody can take advantage of them. If we do that, our manufacturing economy will be strong for a long time to come regardless of what’s going on in the rest of the world.”

*Governor John Engler,
President, Business Roundtable*



The National Manufacturing Talent Development Roundtable was sponsored by The Manufacturing Institute, the National Association of Manufacturers, and the Apollo Group. For more information, please visit The Manufacturing Institute website at <http://institute.nam.org>.