

Modern Manufacturing

Legendary race car driver **Mario Andretti** explains how innovations in racing cars over the years have changed the auto manufacturing industry.

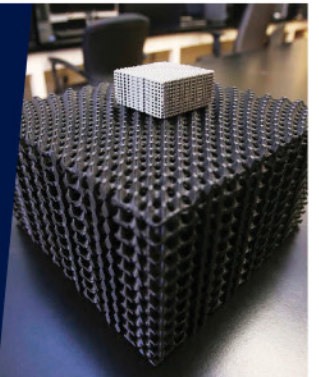


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The Dirty Truth

Host of "Dirty Jobs," Mike Rowe, discusses why more people should look to manufacturing for their career. [Page 10](#)



The Future Is Here

Women are underrepresented in manufacturing. The industry is trying to change that. [Page 15](#)



Concentration

HGTV host Matt Blashaw talks about the most important thing to remember about keeping workers safe. [Online](#)

How the Manufacturing Industry's Image Problem is Hurting the American Economy

The manufacturing industry's image problem means that millions could be missing out on a rewarding and well-paying job that would improve their standard of living.

The modern American manufacturing worker is often also a high-tech worker with a rewarding, hands-on, well-paying job. In fact, the average manufacturing worker earns \$81,289 annually in pay and benefits — well above the national average across all industries. Manufacturers are hiring, but the challenge is helping people get the skills they need to secure these jobs.

Help wanted for a thriving industry

Today, manufacturing contributes \$2.18 trillion to the United States economy. Manufacturing is a thriving, productive, dynamic industry. Robots and the Internet of Things improve our productivity, the power of data cuts waste, the advancement of 3D printing makes us more responsive to customers and digital modeling solves problems before they arise. But these advancements don't hap-

pen on their own. They require engineers, technicians, programmers and scientists. They require modern manufacturing workers. Without them, our progress could be in jeopardy.

Today, as many as 350,000 manufacturing jobs are unfilled. By 2025, manufacturers expect 3.5 million job openings but 2 million of them could sit unfilled — promising good wages and rewarding work but lacking candidates.

This is more than a manufacturing challenge. It is an American challenge. The strength of our economy hangs in the balance.

Leading the way

Manufacturing employers are working hard to close this skills gap, forging partnerships with community colleges as well as local and regional organizations. Many offer on-the-job training and apprenticeships so that workers can earn and learn at the same time. Apprentices take home a paycheck and, over time, a credential or a degree.



David Farr, Jay Timmons
Chairman and Chief Executive Officer, Emerson; CEO, National Association of Manufacturers

They gain valuable knowledge while the company gains a talented worker. Manufacturing companies see a person's potential whatever his or her age, experience or situation — regardless of whether a person is a recent graduate or looking for a midlife career change.

Manufacturers are working hard to bring people of all backgrounds onto shop floors and teams, including underrepresented groups such as women, young people, veterans, minorities and those who can benefit from new opportunities, such as people recently released from prison who have served their time and want to be productive members of society.

Taking action

Manufacturers alone can only do so much. Everyone, including parents, teachers and elected officials, has a role to play.

Our public officials must reject old models of education. The modern economy is changing too fast to stick to rigid,

outdated systems. We need flexibility and a focus on the STEM fields (science, technology, engineering and math).

Teachers and parents, who wield outsized influence with students regarding their career paths, need to recognize that modern manufacturing doesn't look like the manufacturing industry of the past.

Manufacturers are, however, making it easier for them to see the difference. The first Friday of October is Manufacturing Day, and manufacturers across the country will open their shop floors to welcome students, teachers, parents and the public to see what modern manufacturing really looks like. Every year, participants report gaining a better perspective of the industry and having a more positive view of the opportunities available. Students say they are more likely to see a future in manufacturing. By attending an event on Manufacturing Day you can help build a new generation of modern manufacturing workers. ■

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Improving Worker Safety One Robot at a Time

Automation in manufacturing is essential to preserving workers' safety. And it doesn't have to mean job loss.

Working in manufacturing can be dangerous. Although improvements have been made, manufacturing came in second for the industry with the most injuries and illnesses involving days away from work — totaling 125,990 cases in 2014. Leading causes of injury include overexertion (especially when lifting or lowering), coming into contact with objects, and slips, trips and falls.

Giving dangerous tasks to machines

Since manufacturing is such a dangerous industry, some of the

riskiest jobs have been replaced by robots, called automation in the industry. While initially some of this automation was meant to increase productivity, what is especially important is how it helps make workplaces safer.

For instance, robotic arms can now do work on assembly lines, keeping workers from being exposed to dangerous situations and repetitive tasks that wear on their muscles and joints.

As technology advances, automation is going to grow in the manufacturing industry and beyond, leaving some concerned about loss of jobs. But others believe that in today's workplaces, when automation is done correctly, it makes everyone safer and doesn't have to result in job loss. Even when work-

ers are removed from risky tasks, they can be still be involved in the work, such as in programming the new machines and operating and maintaining the new technology. There is still work, but now it can be done in a much safer environment.

Transitioning to new skills

Transitioning workers to these new job roles requires an investment in training and development. There are real benefits and real downsides to replacing workers with robots. Losing the knowledge of a worker that has been performing a task for years can be disastrous for both safety and productivity. After all, who knows better how things should work in a newly-automated process than the person who has been doing it since a facility opened?

Technology can also have a direct, proactive safety benefit beyond replacing or automating dangerous tasks. Three areas where exciting work is taking place are the Internet of Things (IoT) and sensors, cameras and wearables, and virtual reality.

The IoT, put simply, is communication between machines, objects and people. This has numerous safety benefits. For example, through automated safeguards and braking mechanisms, this technology can stop a fork lift that is coming too close to workers. Essentially, sensors on the forklift and workers are in constant communication about where they are in relation to one another, preventing unnecessary collisions.

Cameras are now small and high-resolution enough to be placed in visors, goggles and hard hats. This allows manufacturing safety professionals to see what workers are seeing and make adjustments to tasks that are causing too much of

a risk. It also allows them to better coach their workers about the best way to safely get a job done.

Finally, the size and cost of virtual reality equipment has decreased dramatically, making it more readily available in workplaces. There is a growing trend of virtual reality use in safety training, allowing for a more hands-on approach to experiencing dangers in a safe environment.

Technology and automation in manufacturing have the potential to keep workers safer than ever before. Every innovation takes time and comes with its own set of issues, but leading companies are embracing technology while facing these challenges head-on. If the growth of smart phones has been any indication, a decade from now these innovations will be the norm — and manufacturing workers will be safer for it. ■

By John A. Dony, Director, Campbell Institute

Managing the Response to Industrial Accidents

Accidents happen in the manufacturing industry, but with the right resources, companies can come out the other side a safer place to work and with reputation in tact.

United States manufacturers continue to experience high profile accidents that bring intense public scrutiny and the potential for reputational harm.

Whether it is a single fatality or a facility explosion, these incidents present a “perfect storm” of challenges that can overwhelm even the most sophisticated organizations. Criminal investigators are often among the first personnel at an incident scene

which raises stakes even higher. A prompt, effective response by attorneys experienced in crisis management is essential.

Investigating what happened

Multiple federal and state laws establish jurisdiction for investigations by government authorities. It is not unusual to have an alphabet soup of five or more independent agencies, each with its own statutory mandate, investigating an incident. The Occupational Safety and Health Administration and

the Environmental Protection Agency routinely initiate enforcement inspections after major accidents. Independent investigating agencies, such as the National Transportation Safety Board or the Chemical Safety Board may also respond. State and local authorities also are likely to respond to major events within their jurisdictions.

Although individual crises may vary, major accidents implicate similar legal issues and considerations including internal investigations, stakeholder engage-

ment, evidence preservation and government inspection response. Defending a client's legal interests is only part of effective crisis management. Safeguarding an organization's long-term reputation, demonstrating cooperation and promptly regaining site control are equally important.

Preparing for everything

To be prepared, companies should develop resources such as a major accident guidebook. Such guidebooks help establish general pro-

cedures that assist in-house attorneys and safety professionals in identifying and managing issues likely to arise within the first 96 hours after an event. The company and its legal counsel should then use these materials to conduct routine crisis response drills.

Only through thoughtful preparation and practice can an organization withstand and manage a crisis. ■

By Mark L. Farley, Co-head, Environmental and Workplace Safety Practice, Katten Muchin Rosenman LLP



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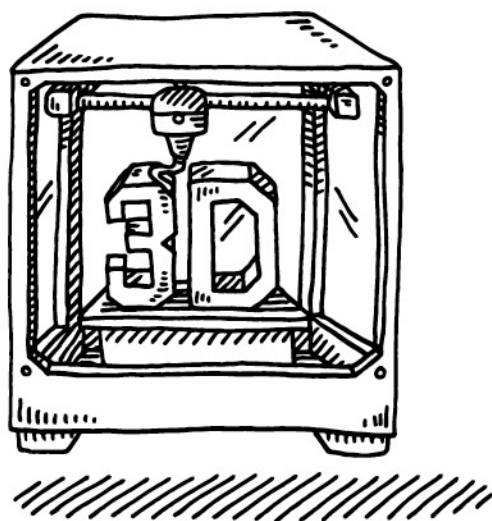
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5 Megatrends That Are Transforming Manufacturing in 2017

The manufacturing sector is evolving faster and more thoroughly than at any other time in history.

Manufacturing has seen recent, radical changes to its processes, technologies, markets, workforce and supply and distribution channels.

The key trends driving these changes will inevitably become more influential in the coming decade, and while the sector will continue to generate economic growth and transform lifestyles and living standards, by mid-century the manufacturing footprint will look dramatically different.

Five megatrends will alter the way manufacturers do business and further increase their value to society.

1. The new industrial revolution

The Industrial Internet will create smarter factory floors and integrated supply chains that improve productivity. More broadly speaking, the Internet of Everything will connect machines, people, and data across society, leading to such benefits as a self-correcting electrical grid, better traffic flows and reduced household energy consumption. 3D printing will enable smaller firms to mass-produce and customize

simultaneously. Nanotechnology is leading to more durable, safer products and is generating medical breakthroughs that were once the domain of sci-fi writers.

But with the rewards of technology come significant risks. Cyber security threats are a top concern for businesses and consumers. Unfortunately, as former CIA Director Michael Hayden has observed, private industry can't expect the government at this time to come to the rescue. Businesses must take responsibility for the safety and security of their systems and data.

2. Aging workers and automation

Demographics are reshaping global labor markets. Start with the fact that the manufacturing workforce is rapidly aging—overall, about 10,000 baby boomers are retiring each day. This loss of institutional knowledge is exacerbated by millennials' lack of interest in manufacturing careers (one survey shows only 37 percent of U.S. adults would encourage their children to enter the sector). Yet manufacturers' needs are changing as well: companies now rely on more automation and require fewer employees, and those they hire come with higher

science, technical and math skills.

Fortunately, the millennial generation—almost as large as the baby boomer generation—is more technologically sophisticated. Since women and minorities make up an increasingly large share of the general workforce, manufacturers are working to foster more inclusive environments. They are also collaborating with secondary schools and community and technical colleges to create curricula to equip a new generation of employees with the skills to succeed on the 21st century shop floor.

3. Data and you

The ability to collect and analyze large volumes of data in economic transactions has revolutionized customer care in the retail and finance sectors. In manufacturing, the concept of big data will accelerate the integration of IT, manufacturing, and operational systems on the shop floor, and lead to better forecasting and better understanding of plant performance. Customers are becoming more knowledgeable about the total cost of ownership and firms are responding with new forms of value and a more effective total customer experience. Big data, enabled by open platforms and crowdsourcing

that allow a quantity and quality of interaction never before possible, has the potential to radically alter how manufacturers design and distribute their products.

4. Global supply chains and marketplace

With the advent of advanced communications and more efficient transportation, the world has seen supply chains stretch across oceans and continents. While the United States remains the largest market, 95 percent of potential customers live outside our borders; 45 percent of U.S. manufacturing revenue is now generated overseas.

The rapidly growing markets and relatively inexpensive labor in Asia, Latin America and Eastern Europe have encouraged American manufacturers to build plants and expand customer bases abroad. Yet global businesses also find themselves exposed to political instability, volatile energy and commodity prices, supply chain disruptions, and regional economic uncertainty. Currency fluctuations also matter—the average U.S. manufacturer has currency exposure in four global regions or eight countries, and half of U.S. companies will enter two new markets by 2020.

5. Growth of new megacities

The migration of consumers to urban areas has global implications for manufacturers. Urbanization not only creates new opportunities for markets, but also affords a diversity of production-related resources, human and otherwise, whose value is reinforced by the synergies that arise from geographic clusters. At the same time, population concentration gives rise to complex spatial and mobility configurations, creating both increased supply chain efficiencies and logistical difficulties.

The United Nations estimates that the percentage of people living in urban areas will climb from 54 percent today to 66.4 percent by 2050—a migration of 2.4 billion people. Megacities (those with 10+ million inhabitants) will become key centers of economic growth in the coming years; the number of these markets is expected to rise from 29 today to 41 by 2030. While the proportion of megacities in Asia (58 percent) won't change, the number in Africa is expected to double, from 3 to 6. ■

By Stephen Gold, President and CEO, Manufacturers Alliance for Productivity and Innovation (MAPI)



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STUDENT TAKE

This Research Assistant Talks About the Future of Manufacturing

Lluvia Herrera, a student and research assistant at the University of Texas at El Paso gives Mediaplanet her take on 3D printing and what the future has in store for the manufacturing industry

How is your industry benefiting from the renewed focus on manufacturing in the United States?

Additive manufacturing is benefiting through the collaboration of major industries to improve the technology involved and uniting projects throughout the nation. By expanding the industry's networking systems, solutions to projects would be easier to access as well as resources.

What innovations in manufacturing are changing the industry?

The introduction of additive manufacturing in industry reduces the amount of time it can take to build a part (whether from a polymer, ceramic or metal, among many other materials) as well as the cost. This technology enables the user to have more freedom with the design of their part as they are able to experiment with complex geometries.

By Staff

Mario Andretti on Creativity, Competition and the Race Towards Progress

Renowned race car driver Mario Andretti sits down with Mediaplanet to shed some light on the auto manufacturing industry and explains why it's a great place for engineers to push the limits of their field.

As a professional race car driver, Mario Andretti appreciates the power of the competitive spirit. He believes it is what allows people to push the limits of what's possible in engineering. Take, for example, the vehicles he's driven for the 24-hour endurance races at Le Mans.

"You get out there in your pleasure car and go flat out, you'll probably blow up in about 40 miles," says Andretti. "That's the rigor that goes through a racing car. You have to manufacture a car than can last through that kind of punishment."

Racing towards progress

Andretti explains that it's this kind of challenge that inspires engineers by putting them in a unique environment to see what their minds



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The W.M. Keck Center for 3D Innovation (Keck Center) is equipped with more than 50 machines, ranging from desktop printers to some of the most forward-thinking custom hybrid approaches to polymer, ceramic, and metal additive manufacturing. Research focus areas include AM technology development; engineered, structured, and functional materials; 3D printed electronics and electromagnetic devices; and frontier applications in aerospace, defense, energy, and

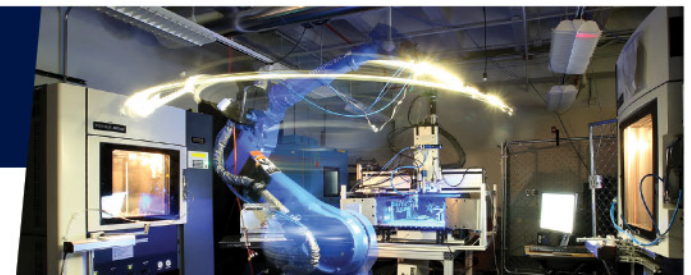
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are capable of. As a result, many of the developments in today's autos got their start in racing.

"Almost every aspect of the car," says Andretti, "the brakes, the transaxles, the suspension geometry, all these things that benefit today's road car — a lot of them were actually developed in our sport."

"The turbo-charged engine," he notes as an example "was developed through motor racing and found its way into production cars ... [Manufacturers] all have some development that they want to see through, and there's no better test than the world of auto racing."

A born gear-head, the 76-year-old racer has been blown away by the results when engineers are challenged to push the limits. "You talk about tire companies that I've worked with since the mid-60s — the progress that's been made there is just unbelievable, going from cross-ply to radial concepts [which increase fuel efficiency and offer better contact with the road]," Andretti says. "In those days you would not know how to dream of what we're in possession of today."

Engineering dreams

Andretti has seen firsthand the wide variety of specialized skills that go into auto manufac-



turing, as well as the opportunities the industry offers for engineers to work in a multitude of diverse specialties.

"There are so many specialized segments of an automobile," Andretti says. "Aerodynamics, suspension, design, engine, transmission ... each area is extremely specialized to one sector of engineering. It opens up infinite doors for

young prospects looking to join the industry." This extends to those who are looking to get creative with new modifications to soup up the cars that are already on the open market.

Building the future

With all the game-changing developments he's seen over his five-decade career, Andretti knows

the future will be here sooner than we think.

"I think the way things are progressing, [all-hybrid cars and self-driving cars] might not even take as long as 2030," he says, citing the way competition jumpstarts progress as evidence. "You have more and more manufacturers joining [all-electric] races because they know that's going to stimulate the engineering mind."

He also recently did an exhibition race with former racer Sam Schmidt in a semi-autonomous car designed for quadriplegic drivers like Schmidt.

"I was steering by moving my head and accelerating by blowing on a tube," Andretti explains. "The engineers have done a great job giving people like Sam that kind of freedom. He's driven at Indianapolis with that at 150 mph, which is unthinkable."

Though he knows there's still work to be done in energy efficiency and in building the infrastructure for new technology, Andretti is confident that engineers can face these challenges with creativity and pride.

"The things we can do are miraculous and stimulating," he says, adding, "I think there's a tremendous future ahead." ■

By Dash Lunde

Robots collaborating with humans. Is this the new normal?

Collaborative robots, or "cobots", are the new-age tech the manufacturing industry is talking about. Not only do they perform tasks normal robots can, but they can also collaborate with humans. They are able to sense when humans are around and slow their motion to avoid harming coworkers.

To learn more about cobots and other manufacturing topics, check out Acuity's Manufacturer Focus blog!

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Mike Rowe Talks Modern Manufacturing and the Myth of the So-Called “Good Job”

Many manufacturing workers make six-figure salaries and love their jobs. So why aren't these careers encouraged? The former host of “Dirty Jobs” and “Somebody’s Gotta Do It” takes a deeper look.

I got a call from a magazine editor who invited me to weigh in on their annual list of “The Top 100 Jobs.” I politely declined. He asked me why, and I said, “Because I don’t think you’ll print my answer.”

I get it — people love lists. They’re fun, and if someone invited me to discuss The Top 100 Films, The Top 100 Books, or The Top 100 Songs, I’m in. But ranking movies and songs is harmless. Ranking careers and colleges is not.

To each their own

I know for a fact that a great education can be found at many affordable schools that will never appear on someone else’s list. Likewise, I’m personally convinced that career contentment has nothing to do with someone

else’s perception of a “good job.”

A couple years ago, I was dropped into a 60-foot prospect shaft about the size of a manhole, somewhere in the Australian Outback. I was profiling a jolly pair of opal miners, and getting a taste of what their work was like day in and day out.

As they lowered me further and further into the narrow tube, my focus shifted from looking for opals to not losing my mind. The claustrophobia was palpable, and by the time I got to the bottom, the sky above me was just a blue dot. I yelled up to the men far above me, “Do you guys really love this?” They yelled back in unison, their voices faint but clear: “Best job I ever had.” I’ve asked the same question to hundreds of people over the years — roughnecks, crab fishermen,

welders, roustabouts, plumbers, lumberjacks, truck drivers, soldiers, blacksmiths, electricians — and they all answered the same way. And yet, none of those vocations appear on anyone’s list of “top jobs.” How come?

Training vs. education

Right now, according to the Bureau of Labor Statistics, nearly 3,000,000 jobs are available for those who are willing to learn a skill that’s in demand. The vast majority of these jobs do not require a four-year degree; they require training. Fortunately, many excellent training facilities exist all over the country. And yet, none of those schools are ever included in the “Top 100 Colleges in America.” Why?

Last year, my foundation sent dozens of people to trade schools

that most parents have never heard of, to pursue skills that few guidance counselors affirmatively encourage. Many of these jobs lead to six-figure salaries, quickly. I’ve partnered with several companies that assist potential employees with vocational training. Caterpillar has a program that will train you for free to be a dealer technician. Categorically, I can tell you that these people love their work. Many have gone on to start their own business.

Finding your “best” option

It’s impossible to know who or what will influence our capacity to learn, or challenge our intellect in a meaningful way. The most influential teacher I ever had taught music in a public school. The best professor I ever had taught English at a community

college. Had I only considered the “best schools,” or limited myself to only exploring the “top jobs,” I wouldn’t have the career I do today. And that would be a shame, because I love what I do.

This is the third time I’ve been invited to write for this supplement, and I’ve agreed to participate for the same reason I did the first two times. Too many great opportunities are falling through the cracks, and too many people are being influenced by someone else’s notion of a “good job.” Job satisfaction is important, but from what I’ve seen, it has less to do with what you do, and more to do with who you are. And character, I’m afraid, isn’t something you’re going to find on any list. ■

By Mike Rowe, MikeRoweWorks Foundation



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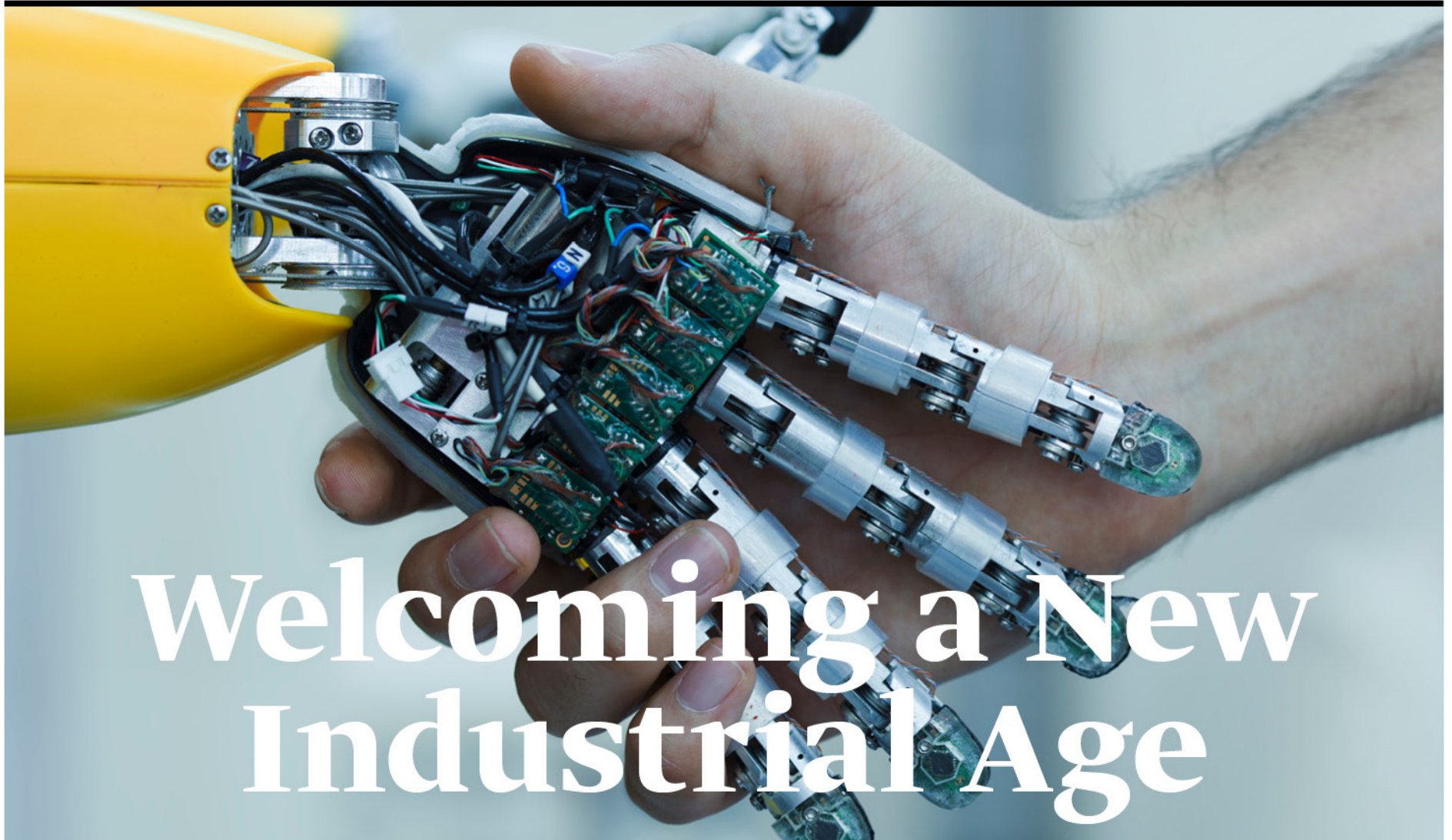


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Welcoming a New Industrial Age

The world has seen three major revolutions in manufacturing in the past 200 years. The industry is now getting ready for a fourth.

Today, manufacturing is on the cusp of yet another industrial revolution, one that promises remarkable increases in productivity with an even smaller, smarter, and more adaptable workforce.

This next great transformation is called Industry 4.0. Originally introduced in 2011 by a German government-sponsored working group, Industry 4.0 is a general term that describes the use of several rapidly evolving technologies and processes, such as the Internet of Things, advanced robotics, Big Data/Analytics, and cloud computing, to increase productivity and eventually create value in new and different ways.

A new revolution

The number 4.0 is a nod to three previous technology-driven transformations in manufacturing: the Industrial Revolution of the late 18th century when steam engines, innovative machinery, and the factory system replaced hand tools and small workshops; the advent of electricity, the assembly line, and mass production between 1870 and 1914; and the digital revolution when advances in computing and robotics allowed for the automation of production.

In our current Industry 3.0 phase, computers are used to create designs and formulate instructions that are then relayed to machines that usually focus on a single, high speed operation. In Industry 4.0, machines will be more autonomous, capable of

changing their production patterns based on real-time inputs without sacrificing efficiency. These smart, internet-connected machines will interact with all of the other machines and humans in the value chain, from suppliers to customers. The constant stream of data coming in from different parts of this network will allow a company and its stakeholders to make better use of capital, raw materials and human resources.

For example, when a customer uses an automaker's online customization tool to select the features of a new car, the vehicle's configuration is immediately sent to the factory and its suppliers so that the factory can allocate staff and machines and the supplier can send out the right components. On the shop floor, RFID tags allow the vehicle's chassis

and components to guide themselves through the assembly process, ensuring that the correct part is available at the right time. Moreover, the factory's tools and robots are always collecting data. This cloud-based information is used to predict when servicing or repair will be needed before a machine malfunctions, as well as to identify ways to improve the manufacturing process.

A glimpse into the future

Truly "smart factories" like these are still a few years away, but you can see it taking shape in welding. Some welding robots can recognize which components are connected to them and warn of incompatibilities. There are also welding management systems that can wirelessly notify the foreman if someone is welding outside

WPS parameters, ensure that only qualified welders can operate a machine, compare process performance data to relevant standards.

The concepts and technologies that encompass Industry 4.0 are still evolving, but one thing is clear: Automation will soon eliminate most of manufacturing's repetitive and dangerous tasks. Tomorrow's manufacturers will need workers with high-level problem-solving skills and technological know-how. Given the relentless pace of technological innovation, workers will have to dedicate more of their time to professional development. In fact, learning new skills will soon be a manufacturing worker's most important ability. ■

By Carlos Plaza, Associate Director of Education Services, American Welding Society

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Leaders in Manufacturing on What to Expect Next from the Industry

Our panel of experts in manufacturing talk to Mediaplanet about the obstacles and opportunities in the industry's future.



Edie Reaves
Vice President, Quality/HSE,
Faurecia Automotive Seating

How is your industry benefiting from the renewed focus on manufacturing in the U.S.?

The renewed focus on manufacturing has created better opportunities from where the automotive industry can pull talent. Due to new programs within higher education institutions, we see better prepared individuals coming into the industry.



Mark L. Farley
Co-head, Environmental
and Workplace Safety
practice, Katten Muchin
Rosenman LLP

Many perceived occupational safety and health law as a dying practice area. [But] attorneys who specialize in workplace safety compliance and major incident response have been well-positioned to provide assistance in this practice area despite the general overcapacity in the legal market.



Frank F. Britt
CEO, Penn Foster

It increases the importance of education providers because there is a need for incumbent workers to be upskilled and for new workers to be trained in a contemporary manner. And it makes me proud that educators and employers are rising to the challenge.



Theresa A. Maldonado
Ph.D., P.E., Dean of
Engineering, University
of Texas at El Paso

It has ignited the conversation about how institutions of higher education partner effectively with industry; how they engage the K-12 community in STEM education, especially engineering; and frankly, how they restructure curricula.



Chet Thompson
President and CEO, Amer-
ican Fuel & Petrochemical
Manufacturers (AFPM)

Within a decade, the U.S. went from being a net importer to the global leader in oil and gas production. This shale revolution sparked a manufacturing renaissance and increased demand for fuels and petrochemicals manufactured in the United States.

What can we do to bridge the skilled labor gap?

Some...methods of bridging the skilled labor gap include leveraging partnerships with higher educational institutions, creating internal training programs, and investing in marketing efforts to advertise manufacturing as an attractive industry.

We need to retool our educational system to consistently produce graduates with strong competencies in math and sciences; provide more opportunities for re-training workers left behind during the recession; and prioritize educational background and job skills of potential immigrants.

is generally accepted that the "shelf life" of required skills is compressing, and the skills development lifecycle is accelerating. There is great potential for people to do their conceptual and/or academic training in an online environment as an on-ramp to applied learning.

It increases the importance of education providers because there is a need for incumbent workers to be upskilled and for new workers to be trained in a contemporary manner. And it makes me proud that educators and employers are rising to the challenge.

First, we need to do a better job educating the younger generations about the many exciting opportunities that exist within the manufacturing sectors. Second, we need to do a better job of training our young people for manufacturing careers

What innovations in manufacturing are changing the industry?

Industry 4.0 has brought many changes and improvements to manufacturing. Part of that involves robotics, artificial intelligence and machine learning; virtual and augmented reality allow us to imagine manufacturing spaces and processes in new ways.

Low energy prices continue to fuel an expansion of domestic manufacturing. Natural gas, for example, is used both as a fuel and feedstock in petrochemicals. The unprecedented abundance of natural gas in the U.S. will ensure low manufacturing costs for decades.

Learning is very quickly becoming part of the workflow at progressive manufacturing organizations. It used to be a very binary choice—either work or learn. Now, smart companies are doing the conceptual foundational training online fused with workflow-based learning embedded in the operational workflow.

There are many: robotics, advancements in 3-D printing, 4-D printing (smart/functional materials fabrication), artificial intelligence, green manufacturing, Internet of Things, digital manufacturing, data analytics, software and software security, and much more.

Refining and petrochemical manufacturers are using emerging technologies to improve safety, optimize operations, and reduce emissions. The refining and petrochemical industries are two of the safest industries.

How Women Are Carrying on Rosie the Riveter's Legacy

Over 70 years after Rosie the Riveter encouraged women to join the workforce, they are still sadly underrepresented in the manufacturing industry.



During World War II, “Rosie the Riveter” represented the United States government’s efforts to encourage women to go to work in order to aid the war effort. The campaign inspired a surge of women in manufacturing, and between 1940 and 1945, the number of women in the American workforce increased from 27 percent to nearly 37 percent. By 1945 nearly one out of every four married women worked outside the home, with the aviation industry seeing the greatest growth in female workers. To many, Rosie’s iconic image – sleeves rolled up, steely gaze of determination – not only represents women joining the workforce, but also women overcoming adversity in the workplace.

Speaking out

Earlier this year former Mohawk Rubber Company splicer, band builder and cutting machine operator from 1942 to 1945, Anna Hess spoke to 130 women at The Manufacturing Institute’s STEP Ahead Awards. She spoke about the impact Rosie had on inspiring female talent and she shared how her mother’s willingness to join the workforce and her father’s openness influenced her own ability and desire to work. As she spoke, her own impact was evident. The hundreds of women (and men) in the audience were inspired to make a difference and empower a new generation to join the modern manufacturing workforce.

This matters. Women are still underrepresented in an industry that has so much to offer. And unleashing the potential

of female talent will reap big rewards for families, industry and the country’s economy.

Unleashing the potential of female talent will reap big rewards for families, industry and the country’s economy

Stepping up

Research shows that gender diversity benefits manufacturing by bringing an improved ability to innovate and overall increased

profitability. Manufacturers therefore have a strong incentive – even a fiscal mandate – to attract women to the industry. Women want challenging career opportunities and a workplace culture that addresses work/life flexibility.

There are a few steps manufacturers can make to improve their diversity efforts.

1. Increase visibility of women leaders. Female role models need to be visible at all levels, with customers and colleagues, and as role models for women and men. To move the needle on diversity in the workplace, senior leaders should be aligned on increasing female leaders a business priority.
2. Promote personal development. Women ranked opportunities for challenging and interesting assignments as a top motivator for staying in the manufacturing

industry. Manufacturers investing in personal and professional career development will help keep women engaged, motivated and committed.

3. And finally, showcase modern manufacturing. Manufacturing is a dynamic, high-tech industry that is moving the world forward as we innovate and develop products from medicines to airplanes. Manufacturing Day on October 6 is an ideal way to demonstrate to the community how it’s making a difference and building the future.

Rosie opened the door of opportunity for women in industry. The future for women in manufacturing is bright, and with the support of leaders in the industry, more and more women are walking through that door. ■

By Natalie Schilling, Vice President of Human Resources, Arconic (NYSE: ARNC)

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