Engineering and Design in America

NASA engineer Julie Townsend talks about getting into robotics in high school, advice for engineering undergrads and the coolest part of her job.

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Learning from the Past & Imagining the Future

One engineer reminisces about the history of manufacturing in America and what the future holds for this crucial industry.

When I was growing up, my family owned a small machine shop in the Chicagoland area. My grandparents all immigrated to the United States in the early 1920s with the hope of a new life. Both of my grandparents were machinists and my father was an engineer.

The good old days and today
I have had many conversations about the “good old days” of manufacturing with my colleagues. The discussion often turns to times when the United States was a powerhouse, dominating the manufacturing world. The conversation then inevitably leads to the downturn in American manufacturing, the loss of jobs and the idling of plants. We see images of production lines and plants from years ago that now sit idle.

What people don’t often think about is that by modern standards, those idled facilities were highly inefficient, polluted the world and caused many short-term and long-term health issues for the workforce. The modern production facility is a high-tech, clean and efficient operation that not only produces quality goods but is the backbone of American society and economy.

A quick tour of a modern production facility will demonstrate just what a wonderful place modern manufacturing plants are. I have seen children of all ages amazed by CNC equipment cutting high-temperature super alloys for jet engines or robots assembling cars and high-performance aircrafts. Better yet, after such eye-opening tours, I have heard those children enthusiastically profess their desire to work in such a high-tech place and go into manufacturing.

It still puts a smile on my face when I pick up the scent of coolant which reminds me of the countless early-morning hours I spent at my father’s machine shop, working on the lathes and mills. But back then, we did not have mist extractors, which make modern machine tools and facilities much healthier. What lights my fire today is that change. Where are we as a society now and where are we going.

Looking to the future
What does a future in manufacturing look like? Well, it’s all about advanced technology enabling innovation. As technical innovation in plants moves forward, the current and future workforce will need new skills to use the latest technologies available.

In the years to come, manufacturing will continue to advance, enabling innovators to make the world a better place, not only providing wonderful products for humanity but also good jobs for the American workforce. An exciting time in the industry, the opportunities in manufacturing today are greater than they ever have been.

Strong and efficient manufacturing is critical for a successful society, and to make a difference in the world. I am proud to be a part of this vital industry and look forward to the continuing advancements it brings.
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Speeding Up Change in the AEC Industry

The AEC industry is slow to change, which also means it’s slow to improve. But disrupting the old way of doing things by improving communication can change all that.

According to the US Bureau of Labor Statistics, the architecture, engineering, and construction (AEC) industry is the only industry that has actually become less efficient and productive since 1964.

The AEC industry is one of the most important drivers of current and future success of the United States economy. It’s a homegrown industry and an excellent avenue for someone to start their own business. But if the industry doesn’t change from the old way of doing things and improve, it will lose a golden opportunity.

Slow to change

The AEC industry is fragmented and slow moving. The legal industry, which drives the structural relationships in construction contracts, is even slower to change. This combination has trapped the industry in a morass of contractual silos that create confrontation. A silo approach is supposed to protect one party over another. But the studies demonstrate that this leads to busted schedules and costly overruns, followed by claims and litigation. Fortunately, things are changing, but too slowly.

Fueled by a combination of frustration with current results, a desire to improve and a technological revolution, the industry is trying new things. The hospital market, which has the most expensive and complicated construction per square foot, has been a market leader for change: The change comes from searching for a better way of doing things. And that better way is through really collaborating.

Building the foundation

A better foundation to build requires three things: trust, collaboration, and innovation. Building trust requires all parties to understand and act in accordance with what was agreed in both letter and spirit. You can’t say “general contractor” without saying “contract.” Good legal writing is simply good writing. Trying to address all contingencies up front is more likely to muddy the waters. Vague, broad responsibilities that place all the risk on parties that are not in a position to control or mitigate the risk is the antithesis of trust. Ambiguities will naturally arise so don’t hide in your turtle shell when they do. Communicate constructively and avoid the blame game.

By Brian Perlberg, Executive Director, ConsensusDocs

Hispanic Students Are STEM’s Biggest Untapped Resource

Job growth in STEM fields is booming but there aren’t enough candidates to fill the jobs available. A rising Hispanic youth population could be key to bridging this gap.

The economic future of America lies in the science, technology, engineering, and math (STEM) fields. According to the United States Department of Commerce, employment opportunities in STEM are booming, with 24.4 percent growth over the last decade. But the workforce is not keeping up with the growth. There are currently two STEM job openings for every qualified job seeker.

This is a national crisis. To fill shrinking applicant pools, companies are increasingly hiring foreign-born STEM experts. But a rising Hispanic youth population here at home offers a perfect solution. Indeed, Latinos are the nation’s second fastest-growing ethnic population and, on average, they’re significantly younger.

Empowering Hispanic youth to pursue STEM fields won’t be easy. Hispanic students aren’t sufficiently exposed to STEM at the K-12 levels and they are underrepresented in undergraduate and graduate STEM programs. Given that less than two percent of the STEM workforce is Hispanic, there are not enough visible role models for students to emulate.

Yet there is hope. Overall, the number of students enrolling in STEM fields is rising, and according to the Hispanic Association of Colleges and Universities, the number of Hispanic students enrolling in STEM studies increased by 33 percent from 1996 to 2004. However, despite the uptick in enrollment, more must be done. Only nine percent of STEM degrees and certificates went to Latinos in 2013.

A comprehensive approach

One organization leading the charge for Hispanics in STEM is the Society of Hispanic Professional Engineers (SHPE). SHPE’s vision of a world where Hispanics are highly valued and influential as leading innovators, scientists, mathematicians and engineers can be realized. And by empowering the Hispanic community around STEM, it is possible to change the face of America’s future innovators.

Early engagement and retention are two of SHPE’s highest priorities. We are devising strategies to help Latinos finish degrees and working with community colleges to include them in vital scholarship programs. And our chapters are actively growing our SHPE “familia” from the early age. Through the Noche de Ciencias program, SHPE undergraduate and professional chapters invite K-12 students to participate in hands-on STEM activities and excite them about STEM while also providing important role models — our chapter members themselves. We also give parents college resources to help them prepare for the journey ahead and help explain the benefits of supporting their children’s desire to study STEM. Parents are often cited as the most critical influence in the decision to pursue careers in STEM.

STEM workplaces are quickly becoming environments where diversity is valued for giving companies a competitive edge. Supporting Hispanic youth as they engage in these fields opens doors for the future leaders of both these companies and the country.

Breaking down barriers

By Miguel Almazán, Board Chair, Society of Hispanic Professional Engineers

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Smart Manufacturing Is Vital to the American Economy

Manufacturing provides millions of jobs for Americans today. And thanks to smart manufacturing, those jobs in the future may get even more challenging and even more rewarding.

Twelve million Americans support themselves and their families with jobs in manufacturing. Another 60 million jobs are made possible by this manufacturing core according to the Council on Competitiveness. That’s a large part of the economy, so remaining competitive in the global manufacturing market is essential to national interests. But given the high standard of living in the United States, competing on the basis of low-cost labor alone is not possible.

So how do today’s manufacturers compete? They use innovation and a culture of continuous improvement, two hallmarks of the American workforce.

**Keeping up with changing tech**
Smart manufacturing puts innovation to work and enables much of today’s productivity throughout the value chain. Smart manufacturing leverages rapid advances in information and communications technologies to digitize and connect every part of a manufacturing enterprise. This optimizes production and increases global competitiveness.

By digitally simulating the manufacturing process and supply network, manufacturers can design the most efficient processes and delivery channels, reducing time to market. Once installed on the manufacturing plant floor, smart, connected equipment can start up twice as fast as standalone machines and cut unplanned downtime in half. Experts located hundreds of miles from an oil well or bakery can warn local technicians if there’s an impending problem.

**Staying ahead of the game**
On a global level, America still contributes one-sixth of the total worldwide manufacturing output. The jobs and the standard of living enabled by manufacturing only survive in a large country such as the United States if we continue to innovate, evolve our infrastructure and, most importantly, attract and develop a skilled workforce.

The first task is to attract students to the business of making things. According to a Deloitte study, it is estimated that 600,000 positions in American industrial companies go unfilled today because the right talent cannot be found. Fortunately, the news is getting out that advanced manufacturing combines high-tech with making things and provides high-paying jobs.

**Keeping sharp**
Science, technology, engineering and math (STEM) skills will become even more important as demand for tedious, unskilled labor decreases. These skills must be refreshed constantly over a career that may last 40 years or more to stay current with new technology and keep problem-solving skills sharp. As supply chains become disaggregated, so do sources of talent. The combination of internal investment in research and development and partnering with outside sources of expertise will often represent the most effective path to get innovation to market, according to a study by the World Economic Forum.

The benefits of globally competitive smart manufacturing are hard to overestimate. The multipliers of additional jobs created, new “adjacent” businesses started and even national security are powerful motivators.

By Blake Moret, Chairman, Manufacturing Institute; Sujen Chand, Visiting Committee, National Institute of Standards and Technology

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The Threats of Climate Change Are Inspiring Innovation in Building Design

To withstand the extreme weather events brought on by climate change, building design has to change.

Shelter is a basic human need, and humans have come a long way since the days of dwelling in caves. But today climate change represents a real threat to our built environment. There are financial and safety risks anticipated with more frequent extreme weather events. To remedy this infrastructure, transportation systems, commercial real estate and homes need to be designed to provide greater resilience to extreme weather.

As seen in the past year, people and communities continue to be impacted as life-threatening weather conditions bring record rains, intense flooding, increased temperatures and wildfires. In addition, the corporate world must find ways to prevent and minimize risk and financial loss associated with the disruption of business after severe weather episodes. These fierce storms threaten production facilities, supply chains and the infrastructure required for profitable operations. A resilient built environment will protect necessary infrastructure and safeguard society.

Building flood ready building portfolios
Floods, like those seen in Hurricanes Katrina, Sandy and Harvey, are becoming part of the new normal, resulting in huge financial impacts and devastating effects. That's why preparing the built environment for high water situations along coasts and rivers, as well as surface water from heavy rainfall, needs to be a top priority for those designing, building and managing residential and commercial structures.

BRE’s Innovation Park allows for testing innovative new designs and concepts to address a range of built environment issues. The Innovation Park in Watford, England recently built a flood-resilient house to test best practices and evaluate new materials for building resilient structures. The building was adapted to allow flooding from water up to two feet deep with no damage to the structure and to be quick drying so that the property is ready for people to move back into a very short time after a flood.

Taking simple measures
When developing resilient and resistant buildings even simple design measures can keep the most vulnerable areas safe. For example, electrical outlets are placed higher up on walls, with wiring to them coming from the ceiling. Automatic sump pumps empty any flood waters through floor drains. Windows and doors have flood resistant seals. Appliances like the refrigerator, oven and washing machine are mounted at a raised height. These innovations that can easily be applied to commercial or residential structures.

The future for resilient buildings looks promising. As awareness and understanding increases, it becomes clear that it doesn’t matter how sustainable we make our buildings and infrastructure. If our built environment becomes uninhabitable or worthless due to weather related events, then it’s not sustainable at all.

By Barry Giles, CEO, BRE America
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This NASA Engineer Talks Getting Inspired & Women in STEM

NASA robotics engineer, Julie Townsend, talks to Mediпланет about how she got interested in engineering as a kid, women in STEM, and operating the Mars rover.

First and foremost, what motivated you to pursue a career in engineering & robotics?

When I was in the 8th grade, I was an intelligent kid but fairly unmotivated in school. I qualified for a summer program for gifted and talented kids. Ended up going to this summer program at Purdue and taking an aerospace program almost on a whim, almost at random. I really loved the class and taking that course and that summer program really opened my eyes to possibilities I had never really considered. From that time on I was focused on becoming an aerospace engineer.

What aspect of your job gets you the most excited?

The coolest thing I do is go interact with the rover on the surface of Mars. It’s a really cool thing that not many people are able to do. On the other hand, I really like working on those experimental projects. Actually going, sending a sequence of commands to this robot and watching it actually do its thing live and in person.

At Stevens Institute of Technology, you have the opportunity to be a part of collaborative, multidisciplinary research programs dedicated to high-tech, modern solutions to the challenges that face society.

Professor E.H. Yang and his team are researching transparent, flexible nanomaterials for solar energy harvesting on a broad scale. These engineering breakthroughs are representative of the caliber and scope of interdisciplinary research happening daily across our campus.

“Imagine every vehicle windshield or every window in a skyscraper becoming an invisible power source.”
—E.H. YANG, Professor of Mechanical Engineering
Harnessing the Power of Women in Technology

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Synopsys

At Synopsys, women play vital roles in developing the tools that engineers around the world use to design smart chips and develop secure code. We interviewed three Synopsys engineers, who reflect on their experiences as women in tech and offer advice on carving out success in a male-dominated field.

Amelia Shen, Director of R&D, focuses on the circuit simulators used to verify that chip designs for smartphones, laptops, cars, and HDTVs will work properly. Before companies invest in manufacturing them. For Amelia, communication is the key to success: “A successful engineer must have good communication skills because our work is done in teams of people from all over the world. I spend time listening to everyone and exploring possibilities to find the best solution.”

When asked what it’s like to influence a room of fellow technologists, Amelia offers this advice: “Have confidence in yourself and your unique strengths. Speak up. State your opinions. By demonstrating confidence in your abilities, you will inspire everyone else and they will have confidence in you.”

Shelab Aboud is a Senior Applications Engineer, helping customers design next-generation transistors—the building blocks of circuits inside all electronic devices. She finds her daily work rewarding as she gets to apply her expertise in physics to a new area of software R&D: advanced quantum transport tools.

“The dimensions of transistors are continually shrinking and are now so small that their behavior is governed predominately by quantum mechanics, the fundamental theory of physics that describes atomic-level phenomena,” Shelab explains.

For Shelab, the ability to collaborate is paramount. “There are four types of collaboration that I rely on: internal project teams, customer partnerships, supervisor guidance, and discussions with colleagues.” As a single mother working at Synopsys, Shelab enjoys flexibility with her schedule and leverages virtual collaboration tools.

Meera Rao, Director for Secure Development Practice, develops customized programs for detecting software defects and leads security initiatives for clients in various markets such as healthcare, finance, and aeronautics. “One day I could be reviewing millions of lines of code; the next I could be developing a threat model,” she explains.

On what it’s like to be a woman in tech, Meera explains that confidence is key. “The true key to my success has been speaking up; making sure my opinions and ideas are heard; and being confident in my vision for projects.” Synopsys has given Meera unique opportunities: “I have felt respected and encouraged from the get-go, regardless of my gender or background. Synopsys has mentoring opportunities and sponsors employee participation at conferences around the world.”

Regardless of gender, it’s clear that communication, collaboration, and confidence are central to the future of Smart, Secure Everything.
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