



# RECRUITING AND PREPARING SKILLED PERSONNEL FOR LEADERSHIP ROLES IN WELDING AND BRAZING

N. Cole, J. Weber, M. Pfarr, D. Hernandez

The American Welding Society, Doral, FL, USA. E-mail: nccenqr@gmail.com

A shortage of welders and welding professionals is felt globally, and it will worsen as the current skilled and educated leave the workforce. Thus, many countries are actively designing programs to improve the image of welding and to train and educate persons to meet those needs. Virtual welding, by means of computer simulation, is one method of introducing and exciting the young about welding. Some companies are even using the virtual welder as to test or even give basic training to new employees. Females are 50% of the population, yet too few choose welding. We have good role models in the many different areas of welding and they are highlighted here. Once persons are interested in welding, they need to be properly trained and educated. Weld-Ed is a program in the USA that has 1) a model curriculum for 2-year colleges; 2) a program to update and upgrade instructors; 3) a method of pairing industry with schools and colleges to offer necessary skills and knowledge for available jobs. New technology is being used by several countries in a variety of ways to enhance training and education. Several types, including online learning and electronic devices, will be described. As persons become skilled and educated, they need a way to prove their competence. A cost-effective means of demonstrating their competence is a Certification Program. Bright young persons are needed in welding science and technology to meet national and global challenges. Our future, structures, and infrastructure depend on them. 2 Ref., 17 Figures.

*Key words:* educating, computer simulation, virtual welding, Weld-Ed program, Certification Programs

## 1. Introduction

At present, there is a worldwide shortage of welders and welding professionals. Persons around the world emphasize that we need to attract and train more persons to enter and contribute to welding and brazing. Of the half-million or so welders presently working in the United States, the average age is in the upper 50s, and some 50,000 of these skilled craft-people retire each year. At the same time, there is a growing need for professional welding personnel in national infrastructure, energy production, petrochemical and many other industries. If this need is not met, the U.S. welder shortage could reach a quarter million by 2019.

However, the need is for skilled and educated welding professionals. Since 2009, the unemployment rate has risen dramatically in the United States. Data from the Bureau of Labor and Statistics indicate that this spike in unemployment has disproportionately affected «blue collar» workers. Yet, the high unemployment rate affecting the manufacturing industry is inconsistent with manufacturing job market. While the manufacturing industry is experiencing high unemployment rates, it also reports a large number of unfilled, high-paying jobs. This separation between the larger numbers of unemployed workers and open positions can be attributed to the «skill gap» existing in the workforce. This «skill gap» is formed by the separation between the skill or knowledge base needed to compete in the global marketplace and the skill or knowledge base currently held by the workforce.

A skills gap study looked for a means of determining the nature of the skill and talent gap in the manufacturing industry in the United States [1]. The survey was answered by more than 1,100 executives from all fifty states in the USA. The Skill Gap Report indicated that 67% of manufacturers in the United States describe a moderate to severe shortage of «available, qualified workers». In addition, the survey indicates that 5% of current jobs (approximately 600,000 jobs) at responding manufacturers are unfilled due to a lack of qualified workers.

This skill gap is further complicated by the necessary evolution occurring in the welding industry. The American Welding Society's Vision for Welding Industry report states: «Until recently, welding itself was a skill that craft people could learn without a real understanding of the science behind it. The scientific and engineering principles behind welding must replace the art of welding for it to achieve its potential as a preferred state-of-the-art manufacturing process [2].»

Thus we have a need, but we must attract persons to the field by effective means, and we also must overcome a pervasive incorrect image and then provide the necessary training and education.

## 2. Attracting persons to the welding and brazing profession

### 2.1. Welding Offers Numerous and Varied Job Opportunities

The skilled worker problem is exacerbated by the fact that welding has long had an image problem. Many students, parents and guidance counselors hold an out-of-date perception of welding as an unpleasant and dangerous occupation suitable only for those who



cannot, or do not wish to, pursue university educations. In fact, welding as a profession offers many opportunities at all levels of employment in energy, defense, manufacturing, construction, aerospace, shipbuilding, utilities, repair, environmental applications — in short, wherever metals are permanently joined. Job opportunities start with the welder, but also include engineer, inspector, educator, researcher, business owner, equipment sales, computer programming and more. Workplace environments include manufacturing facilities and construction sites in just about every industry imaginable. And, potential income is high, often significantly higher than that achieved by university graduates in other fields. The average starting salary for graduates of the Tulsa Welding School in Jacksonville, Florida, is \$42,800USD (32,400EUR) and it increases rapidly as new skills are developed. Pipeliners on Alaska’s North Slope oil fields have earned as much as \$1000USD (757EUR) a day.

**2.2. Spreading the Word through Print Publications and Videos**

One of the first steps taken by AWS was publishing a guide to available careers in welding, as well as establishing a Web site devoted to explaining employment opportunities in the field. This was followed by a special edition of an Iron Man comic book commissioned by AWS with the Marvel Comics Group. Aimed at a younger audience (9-15 years of age), the comic used the action hero’s print medium to tell a story of career opportunities in welding.

This was followed by establishing links with several television personalities in the United States starring in reality shows that feature welding. These included Troy Trepanier, named hot rod «Builder of the Year“; Brian Fuller, of «Two Guys Garage“; and female welder Jessi Combs of «Extreme 4X4.“ AWS also visited well-known television talk show host and automobile collector Jay Leno, who recorded a video segment testifying to the importance of welding and the well-paying job opportunities in the field. AWS then produced a DVD — «Hot Bikes, Fast Cars, Cool Careers“ – featuring all four personalities and dis-



AWS Produced DVD

tributed thousands of copies through schools, trade shows, career days, and the society’s 160 member Sections throughout North America. Of course, the entire contents of the video were also posted on the AWS Web site.

For those individuals who gained a basic interest in welding, AWS established a Welding School Locator on its Web site that lists thousands of schools across the country that can provide quality welding education. The Society also launched a separate Web site, [www.jobsinwelding.com](http://www.jobsinwelding.com) that brought together trained welding personnel and potential employers. That valuable tool contains over 88% of the welding jobs posted anywhere on the internet.

**2.3. Publicity through Outside Media**

AWS has also successfully sought media publicity about the shortfall of needed welding personnel. This has resulted in major stories on the subject in the New York Times, U.S.A. Today, Atlantic Monthly and many other publications. Television and radio networks have also broadcast stories on the need for welding workforce development. One of the most widely heard of these was a radio interview with AWS Marketing/Communications Director Ross Hancock on the BBC World News.



Career In Welding BrochureIronman Comic Book CoverIronman Comic Book Inside Page



## 2.4. The Careers in Welding Road Show

Another method of putting the word out about welding careers was to plan a road tour where interested parties could actually get the feel of welding. Through the inspiration of 2012 AWS President William Rice, and with a large donation from The Lincoln Electric Company, AWS designed and built a 53-ft (16m), over-the-road tractor trailer with over 650 sq.ft. (60 sq.m.) of exhibit space to travel throughout the U.S. and Canada promoting career opportunities in welding.



AWS Trailer Containing Virtual Welders and Welding Exhibits

Lincoln Electric donated five VRTEX 360 virtual welding simulators to give trailer visitors a realistic sense of the welding experience. The simulators also provide a score for each person using them to help measure aptitude for the profession. The trailer was previewed in late 2011 at the Future Farmers of America National Convention, where it attracted more than 5,000 young people interested in welding. It has since been featured twice at the FABTECH show in the U.S., at FABTECH Canada, at several State Fairs, at the Indianapolis 500 auto race, and at other specialty events with a focus on welding. It reached over 35,000 individuals in its first year and is designed to excite young people about the many career opportunities available in the welding industry.

## 2.5. Image of Welding Awards

Yet another important step AWS has undertaken to improve the public perception of welding is establishing the annual Image of Welding Awards. These prestigious awards are presented each year at the FABTECH show to honor individuals, companies and AWS Sections that have shown outstanding achievement in promoting welding careers and creating a positive image for the profession. The awards include presentation of a handsome trophy, and the winners receive media recognition in numerous trade publications and local media.

## 2.6. Boy Scouts of America Welding Merit Badge

To further interest youth in welding careers, AWS has worked with the Boy Scouts of America (BSA) in establishing a Welding Merit Badge, officially launched in 2012. Boy Scouts earn the badge by studying welding technique and completing a welding project. To help them prepare, many AWS volunteers



Boy Scouts of America Welding Merit Badge

actively work to train and counsel the scouts attempting to earn the badge.

## 2.7. Social Media Involvement

A recent effort by AWS to publicize welding careers has been to become strongly involved in Facebook, Twitter and other social media. AWS has launched a Facebook page that actively promotes careers in welding. The Society has also hired a permanent staff expert in social media.

## 2.8. Women in Welding and Brazing

The above efforts target the general population worldwide and youth in particular. However we need to target another specific audience. Women make up about 50% of the population at large, but their percentage in welding and brazing is much lower. In fact in the USA, the Department of Labor estimates that women in welding make up no more than 6% and female welders are probably no more than 2%. That population provides a great opportunity to increase the numbers of welding professionals. In the USA during World War II, women stepped into the workforce to meet the country's need. Rosie the Riveter was advertised, but there was also Wendy the Welder and Barbara the Brazer. Women can do it again and in fact we have plenty of female role models, we just have to let them be known. Below are several women who are effective role models.

Callie Jones Hughes is a welder at P&H Mine Pro in Wyoming. She has a family history of welders. Her great grandmother welded during World War II, and her grandfather on the other side of her family welded in a shipyard. She says, «I would love to inspire other women to be welders. I think it is very neat that I had past family members who were welders on both sides.»

Another welder is Melissa Hall, who has been welding since the 9th grade. She has an Associate Degree in Welding and Fabrication from Triangle Tech in Sunbury, Pennsylvania, and is a member of Local 520 of the Plumbers and Pipefitters Union. She does welding for nuclear and shale gas companies.

Chris Monroe is a welding trainer at Hobart Brothers, Troy, Ohio. She sums up the opportunity well: «There's an opportunity in this industry to have a



Welder Callie Jones-Hughes



Trainer Chris Monroe

career for life. You can work on the manufacturing floor or in the field as a welder, or as an ironworker building a stadium. You can become an engineer and develop welding products or travel around the country as a Certified Welding Inspector

Other role models are members of AWS Board of Directors. Nan Samanich is District Director 21 and is an AWS Certified Welding Inspector (CWI) and Welding & Metals Technology Instructor at Desert Rose High School and Career Center, Las Vegas, Nevada. 2014 Incoming District 20 Director, Pierrette Gorman, has a B.S. in Welding Engineering Degree from The Ohio State University (OSU), Columbus, Ohio, and she's a laser and soldering specialist at Sandia National Lab, Albuquerque, New Mexico. She went to OSU at the age of 40 to get that degree.

Robin Gourley is a Materials Engineer at Cur-



Welder Melissa Hall

tiss-Wright, Cheswick, Pennsylvania. She's responsible for metal brazing processes of pumps and motors for commercial and naval products. She has been an active member of the AWS Brazing and Soldering Committee for over 15 years and has presented papers and been responsible for helping organize the successful International Brazing and Soldering Conference for many years. She also writes for the Brazing Handbooks.



CWI Nan Samanich

Hui Zhao of Creative Thermal Solutions, Urbana, Illinois, is one of the few females who has a PhD and is working in the joining field. Her undergraduate work was in China and she earned her PhD in Mechanical Engineering at the University of Kentucky. She is pictured in front of her lab furnace where she is able to observe the brazing of micro channel heat exchangers. An enlargement of the heat exchanger is also shown.

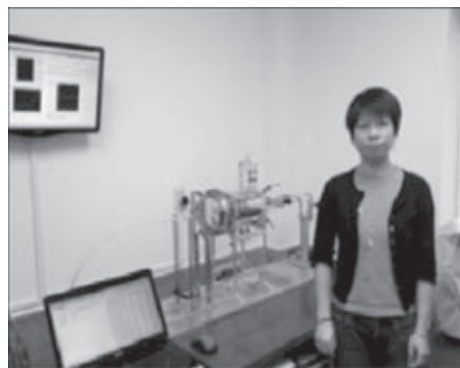


Welding Engineer Pierrette Gorman

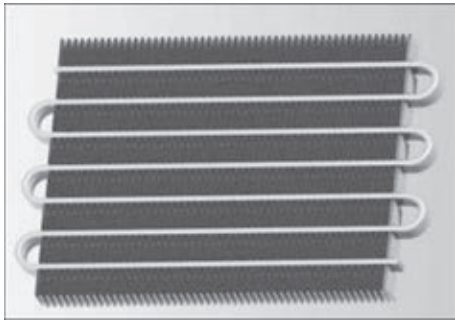
Deanna Postlethwaite of Lincoln Electric Co., Cleveland, Ohio, is in Technical Marketing. She says, «I am enjoying the opportunity to provide solutions to companies to keep productive manufacturing in the



Materials Engineer Robin Gourley



Brazing Engineer Hui Zhao



Microchannel Heat Exchanger (Enlarged)

USA. I am also actively involved in the development and marketing for our virtual reality welding solution.“

Claudia Bottenfield, former AWS District Director from Maryland was a single mother raising two sons and welding sales provided the income she needed.



Welding Class at Floresville High School, South Carolina

She says, «Four years after starting at Arc Welders, I was asked if I wanted to sell our products to end users. I jumped at the possibility since I would be the first woman in the Baltimore area to ever have accomplished this feat.

Karen M. Gilgenbach has many credentials, CWI, CWS, CRAW-T, WTC-WI, B.S. Engineer. She is also a Weld Process Specialist with Airgas, Inc., and the Past Chair, AWS Milwaukee Section. She is also known as a very good welder.

These women are only a few of the female role models working in welding and brazing, so we do have role models who are leading the way. However, because their percentage is currently small, females need to be encouraged in all possible ways. They need mentors and need to be given opportunities.

The general public needs to know that welding and brazing is a great field for both men and women with many opportunities in a variety of occupations. Hopefully, in the future we will see more instances like the welding class in Floresville High School with a ratio closer to the world’s population of 50/50 of women to men.

**2.9. Obtaining National Science Foundation Funding**

In 2007, AWS teamed with Ohio State University, Lorain County (Ohio) Community College and other educational institutions and created the National Center for Welding Education and Training (Weld-Ed) using a financial grant from the National Science Foundation. Operational partners for Weld-Ed include AWS through its Foundation, Lockheed Martin, The Lincoln Electric Co., and a number of schools – all committed to increasing the number and quality of welding and materials joining technicians to meet industry demands. In addition, Weld-Ed’s network has grown to include over eighty education and industry affiliates who participate in the Center’s programming and utilize its resources.

One important result of this partnership was a joint AWS/Weld-Ed publication designed to promote careers in welding. Titled «In Demand – Careers in



Karen Gilgenbach with other AWS members



Tech Marketer Deanna Postlethwaite



Welding Sales Claudia Bottenfield



In Demand – Careers in Welding Publication

Welding,“ the magazine contains articles promoting welding as a dynamic field with a strong future, personnel profiles with realistic salary figures, technical facts about welding, and more. So far, more than 50,000 copies of the magazine have been distributed, and an on-line version [www.careersinwelding.com](http://www.careersinwelding.com), has proven equally popular. The site contains useful information for students, parents, educators, and counselors, as well as welding professionals.

### 3. PROVIDING PROPER TRAINING AND EDUCATION

Attracting persons to the welding profession is not enough. It's the skilled and educated welding professional that is in high demand. Therefore, several means of delivering the necessary skills and education have been devised locally and internationally. Canada has a case study of a modern welding education facility that uses technology to enable multiple students to see the instructor and activity clearly and is used to illustrate a variety of application technologies. The IIW has designed a system that ensures that qualified students can be admitted to welding training and education courses in a wide range of personnel categories. These students benefit by taking courses that are harmonized across national boundaries and their diplomas can be recognized as equivalent. This system has proven advantages in closely related economies such as the European Union. Sweden has adopted that method and now has welding as a specialization that is available in upper secondary schools. Sweden is considered to be a role model for that method of providing a welding education.

In the USA, we are pursuing other models. Schools, colleges and universities teach welding in the traditional way in a classroom and lab setting, but their curriculum may vary depending on the school and location. We tend to measure outcomes – the skills the student has obtained and what has he/she learned, which is the basis of the certification programs, rather than where the person received their training. However, different means of providing the skills and education are being developed.

### 3.1. Weld-Ed

Weld-Ed strives to improve the quality of education and training services to address the hiring and professional development needs of the welding industry. Weld-Ed has three overarching goals that drive its activities.

1. Increase the number of welding technicians to meet workforce needs. This goal is accomplished in partnership with the American Welding Society and involves several initiatives. The first is the development and distribution of recruiting materials for middle school, high school, and college age students, covered above. Additional, very successful resources have been developed, including a DVD — Improving their Competitive Edge: Students in Welding. AWS and Weld-Ed also collaborated on a resource for secondary educators to use in their math and science classrooms. Engineering Your Future explores the ever-increasing relationships among science, technology, and society. The goal of the program is to excite students about some of the natural laws of physics and their application in the technological world in which we live, while perhaps guiding them to consider science-based careers. In the first six months since its introduction, over 4,900 free copies were distributed.

2. The second initiative involves disseminating the message that careers in welding are abundant, highly skilled, and utilize advanced technology. The Careers in Welding trailer, described earlier, reached over 35,000 individuals in its first year. This mobile exhibit features the five arc welding simulators as well as interactive exhibits designed to excite young people about the many career opportunities available in the welding industry.

3. The third initiative includes research on welding industry trends. In 2010, Weld-Ed released The State of the Welding Industry report, a comprehensive examination of the welding industry, including industry and workforce data by region, figures for new and replacement workers needed, and recommendations on filling the gap in the welding education pipeline. The employment projection data is continuously updated and currently shows a need for over 310,000 welders, inspectors, technicians, and engineers by 2019.

#### 3.1.1. The comprehensive reform of welding technician education

In 2011, the Weld-Ed Center published a national core curriculum model. This core curriculum, appropriate for all postsecondary Welding Technician education programs, provides a validated listing of the core of what students should know and be able to do after completing a welding technician program. A student learning outcome specifies what a student should learn as a result of their education experience in the classroom and laboratory. That experience might also include internships or other industry experiences. An



outcome reflects the consequences or results of what the student learns, not what the instructor teaches. The student learning outcomes listed in the model are not intended to describe every conceivable student learning outcome that a postsecondary welding technician program might include. In fact, it is expected that most programs should include additional student learning outcomes that are germane to the specific location where students may be employed.

### **3.1.2. Enhance faculty professional development and continuing education**

Weld-Ed has developed a series of professional development modules for secondary and post-secondary educators. These modules incorporate the list of student learning outcomes from the national core curriculum model and thus prepare educators for successful instruction in a welding technician program. The core professional development program includes four modules, typically offered in the summer months, with each module consisting of one week of instruction.

#### **3.1.2.1. Welding Metallurgy and Weldability of Commercial Alloys**

This course covers the concepts and fundamentals of atomic structure, grain structure, heat flow, phase transformations, welding metallurgy, and the weldability of ferrous and non-ferrous commercial alloys. Laboratory work consists of welding metallurgy investigation on welded samples and weldability testing for specific applications.

#### **3.1.2.2. Cutting and Joining Processes**

This course covers the basics and principles of major joining and cutting processes. Advantages, disadvantages, equipment, consumables, techniques and variables for each process are discussed. Applications, criteria for consumable selection, and how to establish process parameters are emphasized. Laboratory work involves equipment set up and operating of the welding and cutting equipment for specific applications.

#### **3.1.2.3. Design for Welding, Fabrication, Assembly and Robotic Welding**

This course covers the concepts and fundamentals of the design for welding, fabrication, assembly and robotic welding. Laboratory work consists of case studies using standard design equations to determine the behavior of welded materials, part processing and optimization of fabrication, design considerations for work holding and manipulating equipment, and the programming and operating of robots for GMAW welding.

#### **3.1.2.4. Weld Quality and Inspection, Welding Codes, Specifications and Safety**

This course covers the concepts and fundamentals of weld quality and inspection methods, welding codes, specifications, and safety. Laboratory work

consists of setting up and operating the instruments and equipment for identification and characterization of weld discontinuities and defects.

These four professional development modules have been offered for three summers to over 275 educators. The success of these core modules led the Weld-Ed team to develop two additional one-week modules to be offered for the first time in summer 2013. These include the following:

#### **3.1.2.5. Laser Welding**

This course covers the concepts and fundamentals of laser welding technology including basic optics, laser welding systems and welding process optimization, and metallurgy of laser welds. Laboratory work consists of case studies that involve optimization of laser welding equipment and identification and characterization of weld discontinuities and defects.

#### **3.1.2.6. Efficient and Effective Welding Technician Instruction**

This course covers the foundations of welding technician education; program needs assessment and program development, developing program and course objectives, a survey of learning theory, laboratory development, teaching methods, and classroom management techniques.

In addition, Weld-Ed offers an annual Educators Conference in conjunction with the FABTECH show. This one-day conference is open to educators and industry trainers and features updates on Weld-Ed offerings, best practices from educators, and presentations and free resources from Weld-Ed industry partners. More than 200 individuals have taken advantage of this outstanding programming over the past few years.

As Weld-Ed looks to the future, plans include continuous improvement of the existing professional development modules; expansion of professional development opportunities to include the advanced needs of industry; investigation into new delivery approaches for education and training such as on-line and blended delivery; growth of offerings to include consulting in needs assessment, program design, program improvement; identification of future strategies to sustain the existence of the Center.

### **3.2. AWO — American Welding On-Line**

AWS statistics of the welding industry in the United States show an abundance of school programs dedicated to the entry-level and advanced-level welding, but precious few programs dedicated to welding supervision, inspection, or engineering. As the welding certification body in the United States, AWS provides some training in the bodies of knowledge for each of these fields, but that training has historically been limited to survey courses helping students review prior to examination. These courses are not designed to instruct on fundamentals, nor are they meant to teach the subject to individuals interested in entering those



career fields. Rather, these courses are developed for individuals already functioning in those roles to fill in knowledge gaps in preparation for examination. Individuals seeking to enter into one of welding careers fields with little or no prior knowledge are most commonly left to rely on self-study. Recognizing this shortcoming, the American Welding Society is utilizing American Welding Online as a means of establishing profession pathways for individuals seeking to advance their careers. Instead of teaching only the advanced knowledge needed for test preparation, American Welding Online courses span the gamut of knowledge levels from those who are looking to break into the field, to those who are well established. With the development of AWO, individuals will no longer need to seek out specialized schools or training programs to learn the variety of skills needed to obtain an AWS Certification. Clear, interconnected curriculums provide the learner with career pathways that can take them from entry level to certification.

AWS recognizes that in order to close the widening skill gap in the welding industry new means of training welding personnel are required. In an effort to address these issues, the American Welding Society developed American Welding Online ([awo.aws.org](http://awo.aws.org)). American Welding Online, or AWO, is a virtual educational community dedicated to training the welders and welding personnel of the future. The foundation of AWO is a simple principle: To provide welding education to anyone, anywhere, and at any time. In order to fulfill this mission, AWS has adopted a modular approach to American Welding Online.

The cornerstone of American Welding Online is the library of e-learning courses and virtual conferences offered by AWS. These seminars are offered asynchronously, allowing students from around the world to access the course content on their own schedule and complete the program at their own pace. The American Welding Society offers multiple levels of training and testing, from entry level certificate training to advanced certifications. Through American Welding Online, AWS currently offers several online courses including the Certified Welding Sales Representative Program, Welding Fundamentals, Safety in Welding, Math for Welders Level I, Understanding Welding Symbols, Welding Metallurgy, and the soon to be released The Science of Non-Destructive Testing, Welding Economics, and Lean Management for Welding Shops courses.

All American Welding Online courses are built to teach the necessary knowledge base while focusing on STEM (Science, Technology, Engineering, and Math) education. Unlike most welding education currently in the marketplace, AWO courses do not focus on the physical act of welding, but rather the theoretical base; the scientific and engineering principles;

critical thinking; and problem solving. Courses, such as the AWS Welding Fundamentals seminar, provide science-based education on six of the most common welding processes: Oxyfuel Welding, Shielded Metal Arc Welding, Gas Tungsten Arc Welding, Gas Metal Arc Welding, Flux Cored Arc Welding, and Submerged Arc Welding. The seminar provides in-depth study of these welding processes through the use of diagrams, animations, high-definition videos, and synchronized audio narration. The seminar study material is presented in a thoughtful way that challenges participants to think critically about the topics. For example, when reviewing Shielded Metal Arc Welding, the course does not simply review the basics of how the process works, instead it examines the practical application of SMAW, the science of the welding arc, and how various welding variables, such as travel speed or amperage affect the final weld. The seminar also integrates education on higher knowledge skills such as welding electrical theory, welding metallurgy, and welding discontinuities. The participants receive constant feedback and reinforcement in form of interactive elements, practice problems, quizzes, and in some courses, workbook practice. The combination of interactive instruction and constant feedback provides participants the opportunity to use high-level thinking skills and critical thought to understand deeper connections in the instruction material.

Almost as important as offering professional pathways, American Welding Online allows learners to take ownership of the educational process, customizing the experience to their individual needs. The on-demand training offered through AWO allows the user to determine which courses in the professional pathways are suitable for their knowledge level. This customized curriculum provides learners with the most time- and cost-efficient means of gaining the knowledge necessary to advance in their careers.

As of February 2013, American Welding Online began offering synchronous learning opportunities in the form of monthly webinars. These live training opportunities offer the individual the opportunity to learn from experts in a variety of fields from anywhere in the world. In addition to the ability to access this training from any computer in the world with an internet connection, these webinars allow the learner to ask direct questions to a live instructor/ expert, network with like-minded participants, and contribute their own experiences to the educational process. In order to reach the largest number of individuals possible, AWO will also host recordings of these webinars on American Welding Online so that those individuals who could not attend can still access the information.

Aside from the asynchronous and synchronous learning opportunities offered through American Welding Online, AWS continually offers informal





learning opportunities such as the Professional Program Podcast. This complimentary podcast can be downloaded to any portable device through the AWO Podcast page on iTunes (<https://itunes.apple.com/us/podcast/american-welding-online/id505523313>) or watched directly through the AWO website. AWO will also be launching a series of phone and tablet apps geared towards allowing individuals to learn in informal environments. The AWS app library will consist of apps designed to help prepare individuals for the Certified Welding Inspector exam (both D1.1 and API 1104 versions), as well as virtual welding apps with both educational and entertaining aspects meant to draw interest to the welding field while educating the user through the use of a game.

With the advent of American Welding Online, the American Welding Society is realizing its goal of bringing welding education to anyone, anywhere, and at any time. This multifaceted response to the growing gap of skills and knowledge needed to compete in a global economy will ensure that all levels of the welding industry, whether the entry-level student or the professional, are provided the opportunity to obtain the education required for the technologically advanced jobs of tomorrow and today.

#### 4. CONCLUSIONS

The worldwide need for skilled and educated welding professionals is recognized by those working in the field, but people who could potentially fill that gap must be reached. Therefore a concerted effort is underway to improve the image of welding and

to reach the general public, as well as targeted populations, such as youth and women. Media such as publications, brochures, videos, DVDs, and TV personalities are targeting the general population. Youth are also targeted through Iron Man Comic Books, the virtual welders, BSA merit badge and social media. Women in welding are highlighted as role models to interest females and their parents.

Once persons are interested they need to be properly trained and educated. A variety of means of delivering those skills and education are underway depending on the location in the world. Most countries have schools, colleges and universities that teach welding. AWS in co-operation with Weld-Ed has programs to reach youth and to provide a model welding technology curriculum and courses for faculty professional development and continuing education. AWS has launched American Welding On-Line to provide a welding education to anyone, anywhere, at any time and dedicated to training the welders and welding personnel of the future.

These projects as well as others are focused on successfully educating the population on the needs and opportunities, then providing the training and education necessary for welding professionals to properly build our infrastructures and provide the workforce for energy production and many other industries.

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