

IIW Commission XIV Workshop success: Showcasing latest international developments in welding training systems

A key objective in any country should be to improve the quality of the everyday life of its people, and the optimisation of welding activities can assist in meeting this objective. The use of the most up-to-date education and training techniques to improve the competence of people is one effective strategy. Improvements in productivity, quality, cost reduction, health and safety are immediate gains for companies and individuals, and thus a country as a whole – whether a developed nation or an economy in transition.

SIX world leaders in welding education and training systems showcased their latest developments to an international audience during a workshop at the recent Annual Assembly of the International Institute of Welding (IIW) held in Korea in July. Fifty-seven countries are members of IIW, which has amongst its guiding

principles the sharing of knowledge to help identify, create, develop and transfer the best practices for sustainable development in a sustainable environment.

The IIW working unit Commission XIV *Education and training*, under the chairmanship of Australian Chris Smallbone, hosted the workshop and the

attendees from around the world agreed that the information gained would help them plan future directions for innovative, cost effective welder education and training in their countries.

The six systems summarised in the article are being utilised by training bodies, companies and organisations around the world, and are continually evolving to meet the needs of industry and educational best practice in a wide range of socioeconomic environments.

Interested readers can get in touch with the experts directly via the contact details given below. IIW Member Societies are also disseminating information regarding the systems to facilitate assessment of their potential contributions to welder education and training around the world.



Training with the Lincoln VRTEX 360

Welding education and training systems

The Lincoln Electric VRTEX 360

The Lincoln Electric VRTEX 360 is a virtual reality training system that enables welders to be trained better, faster and at lower cost. As an interactive welding simulator it uses a welding gun and helmet connected to a CPU about the size of small generator. The helmet includes speakers and 3D goggles, through which the trainee sees a virtual welding gun and work site, such as a high-rise or welding booth. Speakers in the helmet broadcast the tell-tale pop and sizzle of materials being melted and joined.



Welder education and training system experts from left: Satoru Asai (Toshiba), Claude Choquet (123 Certification Inc), Jan Neubert (SLV Halle), Chris Smallbone (WTIA), Basilio Marquez (Seabery Soluciones), Carl Peters (Lincoln Electric), Chris Conrardy (EWI/RealWeld), Jorge Huete (CESOL)

VRTEX 360 closely simulates a real welding puddle so that the student learns to weld very much like real welding. The student uses visual and audible puddle feedback to make the proper motion changes in order to make defect free welds. The system accurately scores the weld, visually indicates proper versus improper movements and indicates what welding defects resulted from any improper techniques. Visual cues can be used to help correct any improper techniques. Once a weld is complete, the student can perform a virtual bend test on the weld coupon.

Carl Peters, Director of Training at Lincoln, noted that 'Lincoln Electric worked with Iowa State University to compare traditional welding training with Virtual Reality Integrated Weld Training. The results clearly show that with a blend of both types of training, costs and time are significantly reduced, certification rates are substantially higher, and there are a greater number of welds performed using virtual reality. Team learning and interaction levels are higher with virtual welding.'

The VRTEX system is used widely in training organisations, industry, and the US military, and has been demonstrated at trade exhibitions around the world. It proved popular with competitors and visitors alike at the 2011 London and 2013 Leipzig WorldSkills international competitions and is featured in the AWS Careers in Welding Trailer which travels extensively in the US and Canada promoting welding.

The VRTEX® Mobile is the latest development of the system. This is a basic, entry level welding training system designed to provide mobility in an easy to use and engaging welding training tool. It is ideal for initial, basic welding training, as a recruitment and engagement tool for educational and industry and for employment and screening for human resources or as an evaluation tool for instructors and educators to get a baseline on student knowledge. Rental schemes may be available too, improving accessibility and affordability of the system.

Peters commented that 'VRTEX® Mobile could see application in the future in developing countries where costs and lack of training facilities are a real challenge. Exposure through IIW is highlighting the exciting potential uses of virtual training in countries around the world'.

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Soldamatic Augmented Training

Soldamatic is an educational technology for welding training which uses interactive simulation together with augmented reality. It offers a wide range of features including configuration to the different weld processes, and in turn, to different training courses – from the initial to the most advanced levels.

Welding instructors themselves recognise that the traditional training methods, though suitable in the past, can now be inefficient. High costs of materials and

consumables impact on effective time for practice and insufficient qualified trainers can reduce on-on-one training time. Coupled with the expense of equipment and facilities, these may lead to the output of personnel who are unable to meet industry requirements.

Soldamatic Augmented Training is not just a trainer-simulator for welding – it is a comprehensive educational solution that includes a full educational platform and classroom network.

The system is not intended to modify the contents of welding training courses, but simply organise them in a different way to obtain better assimilation of knowledge, and provide a greater number of effective practice experiences. It offers an incredibly realistic environment where the student follows the same steps and experiences the same sensations as if he were at his workplace, so the trainee will pass to the workshop once he really achieves all the necessary skills and knowledge.

The platform includes teacher software for training management, cloud-based blended learning capabilities, student simulators incorporating augmented reality, and a module for analysis of the exercises performed by the students. Networked computers enable the teacher to monitor each student simulator and to give personalised feedback whenever it is needed.

The advanced educational concept of Soldamatic was explained by Basilio Marquinez, CEO of Seabery Soluciones, SL which developed the system in Spain. The progressive learning model is based on students' skills and level of knowledge instead of a rigid linear model based on time. The system is also designed to fit the course contents following the International Welder (IW) Guidelines from EWF/IIW, and also the SENSE Program from the AWS. It allows any teacher or training body to upload their own training programs – or create new contents – easily introducing Working Procedure Specifications while configuring the system to perform that way, or acquiring full welding courses fitting with those international standards.

With up to 180 systems already in service in over 25 countries, Marquinez highlighted the value of remote maintenance and customer service which the company provides in real time worldwide. The website is also utilised to deliver customer care to end users and distributors, while applications for smartphones and tablets appeal to younger generations and aid in the recruitment of students to training



Soldamatic Augmented Training – not just a trainer-simulator for welding but a comprehensive educational solution

courses. Ongoing review and utilisation of modern technologies and delivery methods are helping to bring purchase prices down and promoting uptake of the Soldamatic Augmented Training system.

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123 Certification ARC®+

The Arc+ Welding Simulator is a training tool that powers lifelike virtual welding practice. It is the most complete, easy-to-use and realistic simulator on the market. The simulator's movement detection system breaks down its user's manual dexterity parameters and trains all welding positions without any need for calibration. Its graphic interface and use of real welding torches account for its unequalled realism.

The ARC®+ system platform was first introduced in Canada through companies and welding schools and has now been sold in more than 20 countries around the world.

Organisations utilising Arc+ range from high schools to universities and training authorities, all the way to private companies that use the simulators for their in-house training program.

One customer, Jean-Pierre Lupien of the Tremblay Group involved in construction and steel structure manufacturing, commented that 'The ARC®+ Simulator allows students to acquire manual dexterity much faster and efficiently, a skill they can then transfer to real welding with confidence. This process improves our training in a lot of ways.'

Simon Shaienks, Director of Business Development for 123 Certification believes the company is the only one with the flexibility to respond to complex



The GSI SLV Welding Trainer combines elements of hands-on education of welders and computer-based simulation to educate welders as realistically as possible

industry needs. 'We are working toward understanding and incorporating industry specific application into our simulator, not just basic welding training' said Shaienks. 'The uses are numerous and would bring a lot of cost saving while improving quality of welds. We are currently actively looking for industry partners to participate and test our future development.'

The next generation model of ARC®+ is designed so that customers can choose the features that they need the most and only pay for what they need. This 'build your own simulator' concept will make the use of the simulator applicable to any type of training, ranging from the most basic to the more advanced welding courses. Minimal budgets, for example, will have the opportunity to start with the basic systems at a very affordable cost and will be able to add new modules as their training programs evolve.

The company sees IIW as an ambassador of the welding trade in general, providing a forum where members can bring their local challenges and express them to an array of others from many sectors and industries. The flow of ideas that results from these discussions is really extremely beneficial and makes all participants grow. By spreading good ideas and best practices, 123 Certification believes the IIW is making a huge impact in the world of welding.

'We look forward to participate in the new IIW Commission XIV Sub-committee on welding simulation' said Shaienks. 'Welding simulation is now an integral part of many training programs and we are only scratching the potential of these tools. We have a huge vision for our welding simulators for the next 10 years and we are happy to exchange ideas with people that share an interest in that vision.'

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GSI SLV Welding Trainer

For decades the education of welders has been performed consuming a lot of material, energy and time. The integration of computer-based training systems offers a modern approach to reduce the expenditure of resources and to enhance education by modern media and educational methods.

The GSI SLV Welding Trainer combines elements of hands-on education of welders and computer-based simulation to educate welders as realistically as possible. Course participants learn basic welding techniques while handling a real arc with a minimum of amperage. All main parameters are monitored by camera and a computer-backed measuring system, and any irregularity immediately signalled to the welder. The use of the GSI SLV Welding Trainer requires minimal materials, spare parts, electrical power and personal protection and the education of welders is faster and more efficient.

Currently 90 units of the GSI SLV Welding Trainer are in use worldwide. Principally the systems are used in vocational schools, training centres for welding education and vocational training centres of companies. They are also used for education fairs promoting recruitment of apprentices and in universities delivering easy hands-on experience for students.

The system has evolved to supplement traditional educational methods in a user-friendly way. Among other advances is the development of an 'intelligent educational schedule' and its integration to the teaching methods of this educational medium.

The fact is that the costs for the education of welders in the early stages of training are reduced through the use of virtual welding. The system delivers 'just-in-time learning' because the notice of relevant handling errors takes place in



The Arc+ Welding Simulator is a training tool that powers lifelike virtual welding practice



A welding class in the USA utilises the RealWeld Trainer to give real-time feedback on live welding using standard welding machines and procedures, as well as practice welding with the arc-off

real time, allowing immediate correction of technique.

Customers report 20 and 30 per cent reduction in training costs and GSI SLV is continuing to research in this area and refine the technology.

‘The integration of an intelligent curriculum is completed and is state-of-the-art’ reported Axel Börnert, Marketing Manager of SLV Halle GmbH. ‘The next step in development is to complete the available welding processes for training by the addition of MMAW. In the near future we will have complete education systems by using linked welding trainers in separate classrooms with additional e-learning. IT will be integrated. Distance learning via internet may be possible’.

In terms of the use of the system in developing countries, what these countries need is fast recovery of the lost ground in education. Börnert believes that modern methods in education are helpful and necessary to achieve this goal. Modern training centres with modern equipment are required, and computer-based welding training systems are one of the basics.

By sharing information through IIW, the value of such systems will become widely known, and they can be assessed and implemented where they will generate the greatest benefit. As these new training methods are being constantly developed and improved, an organisation such as IIW is ideal for enabling the rapid distribution of information about current best practice.

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RealWeld Trainer

Patented by EWI and commercialised by RealWeld Systems, Inc. the RealWeld Trainer is a live arc welding training solution invented in the USA to deliver best practice applications in both the education and manufacturing sectors. Launched just eighteen months ago, the device is enjoying traction and success in North America with approximately 75% of the deployments in schools and 25% in manufacturing.

Manufacturers are deploying the system as a screening tool for new-hires, particularly to gauge the welder’s versatility in adjusting to different welds. They are also deploying the system as a weld procedure development tool by capturing the technique of a master welder, configuring that captured technique into welding procedures on RealWeld Trainer, and thereby establishing a benchmark standard for that master’s technique.

Schools appreciate that the system provides more immediate feedback to trainees before, during, and immediately after welding. The system allows the instructor to spend their precious one-on-one time on teaching and inspiring rather than mechanics.

Unlike virtual reality simulators, trainees weld live using standard welding machines and procedures, while the RealWeld Trainer gives them real-time feedback. They can also practice welding motions with the arc-off, still receiving feedback and developing consistent technique, but with significant materials savings.

Audio coaching during set-up, practice motion and live welding is non-intrusive, context specific and can be customised. Feedback enables the student to make real-time corrections to technique. Quantitative measurements during the live welding give an ongoing record of progress which can be monitored by instructors and used in team building and group and competitive learning.

The RealWeld Trainer helps prepare ‘job-ready’ welders by tailoring training targets to optimum production procedures, thus minimising the effects of transition from training to the shop floor. Duplicating target ranges for a given procedure ensures all students learn the same technique regardless of instructors, classes, locations and time periods, meeting large industries’ need for consistent staff capabilities across multiple work sites.

Current developments include the expansion of skills training packages to include broader learning objectives and media, and the inclusion of pipe welding training in the system.

Bill Forquer, Launch CEO for RealWeld Systems, Inc. sees exciting future developments which will leverage cloud, web-camera and distance learning technologies.

‘Using these technologies, measurement and recording of skill achievements and welding capabilities could evolve into digital credentials for qualified welders, where training organisations issue ‘digital badges’ and cloud-based databases provide evidence of training completion and acquired proficiency. Badges would be authenticated by the issuer, included in digital resume collections and tracked over the welder’s entire career’ he said.

The availability of welders and quality of welding instruction those welders receive is commonly cited as a bottleneck in manufacturing in developing countries. Forquer revealed that ‘RealWeld plans to develop a welding instruction kiosk whereby the trainee can safely learn to weld while their welding instruction is delivered to them over the internet.’

‘We’re excited about these future developments and the positive feedback we are receiving to our plans’ said Forquer. ‘Certainly it is the role of IIW and other welding societies to expose their membership to all advancements in welding education and training and we look forward to future opportunities to assist in that endeavour’.

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Skill Digitiser™

Originally the Skill Digitiser™ was designed to meet needs within Toshiba Corporation in Japan, and five systems are currently used in their Welder Training Centre to cover a range of processes used in production. Demand has since led to three systems being sold to other company training centres, and one is utilised at the Japanese National College of Technology.

To establish the system, the techniques of a skilled welder were first quantified and digitised. A knowledge base was developed from the real images and data and used as the benchmark for welding training and skill development of practical welders. Numerical representation and digitisation of welding skill can be achieved by the measurement of the welder's motion, using visual sensors in the system. The first training system to be developed and used was based on the visualisation of GTAW skills used in welding the first layer of flat plate.

The system is composed of four visual sensors, a computer and a display. Features of this system are digitisation, visualisation and comparison with the welder's welding skill motion. While displaying time series variations of seven measurement items, it standardises as a skill index over 14 items, the average values and variations, as well as an evaluation result chart.

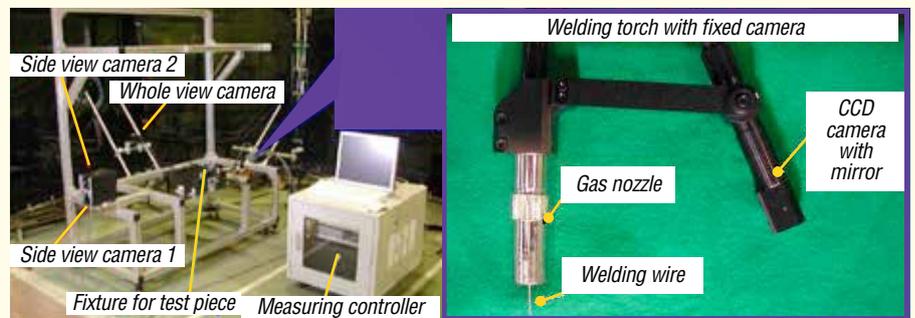
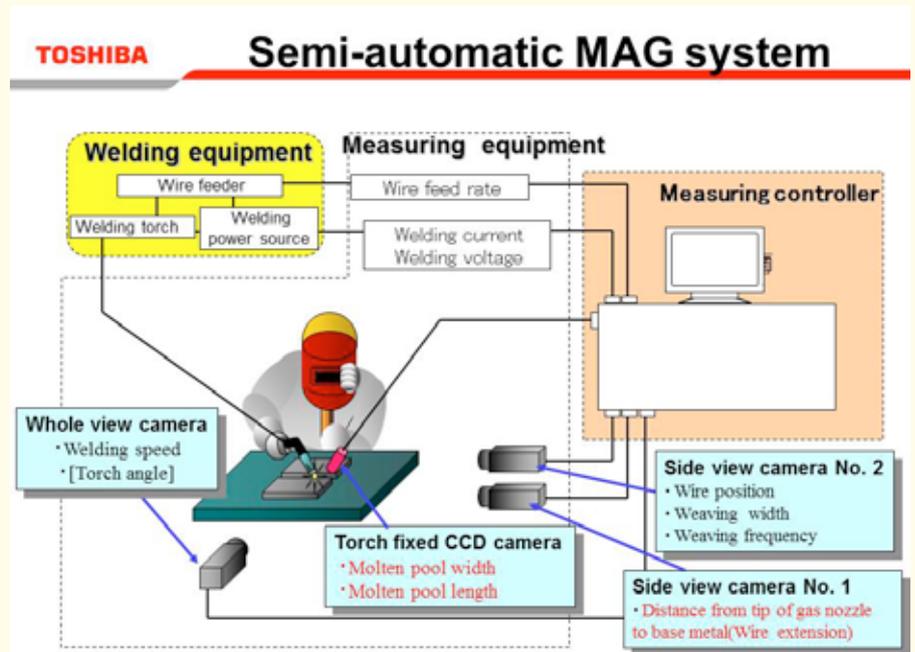
Satoru Asai, Chief Specialist, Keihin Product Operations with Toshiba reported 'it is possible to evaluate several skill indices together with different dimensions and helps give an intuitive indication of the welder's skill'.

The digitisation system has been developed for visualisation and digitisation of

Future Forums

Welding educators from training providers and industry around the world will have exciting opportunities to learn about these systems and others first-hand, and discuss their application with the experts, during the IIW Annual Assemblies; 28 June to 3 July 2015 in Helsinki, Finland and 10-15 July 2016 in Melbourne, Australia.

IIW Commission XIV will present the outcomes of the ongoing evaluation of such systems, as well as innovations in the field of welder training, so mark these dates in your diary now.



Skill Digitiser™ setup for semi-automatic MAG welding

TIG root pass welding, semi-automatic MAG welding of flat plate, all-position TIG welding of pipe and MMAW.

The Skill Digitiser™ enables a quantitative evaluation, by image comparison, which can be utilised effectively in the early training period of skilled welders and in their on-going skill development. These systems show successful results in actual training and also the pre-screening and selection of skilled welders for specific production welding tasks.

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Conclusion

The IIW Commission XIV review above demonstrates that both welding simulation/virtual welding and live weld monitoring can deliver excellent outcomes for welder training. They can augment current training methods and tackle on-going issues common to countries around the world, such as the cost of materials for training, lack of facilities and skilled trainers, difficulties in standardising and recording training and achievements, and the health and safety of students.

These modern training methods and media also serve to make welding as a career more attractive to younger generations. Not only do they gentrify the image of welding and link with current trends in electronic gaming and communication technologies, they also enable large numbers of youngsters to 'have a go' at welding in a controlled environment before committing to training. This in turn should reduce attrition of students and apprentices, and improve workforce stability and forecasting for industry and training bodies.

IIW Commission XIV has established a Working Group to promote, and make more accessible, the developments in welder training that are continually taking place around the world. The group will provide a forum to discuss dovetailing such technologies with traditional training methods, and explore the potentials for improved, globally harmonised qualification and certification of welding personnel.

This objective links with the broader IIW project 'to improve the global quality of life through optimum use of welding technology'.