CONCORE
TŪHURA

Welding the Future: Augmented Reality in Apprenticeship Training

Case study | ATNZ

ACKNOWLEDGEMENTS

ConCOVE express their gratitude to all those whose contributions were invaluable to the successful completion of this report. Foremost, we extend our appreciation to the team at ATNZ for their support, participation, and enthusiasm throughout the interview process.

Their willingness to provide time, access and to share their insights was instrumental in shaping this case study.

In particular, we'd like to acknowledge Tim Wilson, Ben Julian and Svend Hansen whose time, perspectives, and support of the project was indispensable.

In addition, thanks to Jeremy Mikoz, HR and Development Manager at MJH Engineering in Lower Hutt; and Paddy Doohan, Senior Tutor & Programme Coordinator for Mechanical Engineering at EIT, for their support. Finally, thank you to the lead author and researcher on this case study, Kate Dobbin.

We are appreciative of the collaborative efforts extended by all parties, which enabled the successful completion and delivery of this report.

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EXECUTIVE SUMMARY

Purpose

This case study showcases a local group apprenticeship organisation, ATNZ, and the use of augmented reality (AR) delivered by trainers on its welding apprenticeship programme. It directly relates to ConCOVE's purpose in reimagining vocational education for the construction and infrastructure sectors and sharing innovations across the sector.

We conducted a series of interviews with industry representatives, current apprentices and ATNZ staff, including trainers, account managers, partnership officers and senior executives. These interviews looked to capture their thoughts and insights into the simulated welding apprenticeship programme, what makes it unique, how it supports apprentices, potential improvements, and the overall value it adds to ATNZ as a leading provider of managed apprenticeships and industry training programmes.

The case study also highlights the key benefits and challenges of simulated welding and provides recommendations for the construction and infrastructure industry, along with the vocational education system, to design and improve apprenticeship models using a technology-led approach.

INTRODUCTION

ATNZ is New Zealand's largest employer of apprentices in mechanical engineering and related industries and has been operating since 1999. Across the motu, it trains more than 600 apprentices across more than 220 companies who are heavily investing in the country's future by training and mentoring the next generation of highly skilled tradespeople.

In August 2022, ATNZ achieved NZQA registration as a Private Training Establishment (PTE), marking its transition from previously operating in conjunction with Competenz. This was a critical first step in enabling it to provide its own apprenticeship programmes and other training for the engineering, manufacturing, refrigeration, welding and air conditioning workforce.

Technology strategist Tim Wilson was appointed as CEO of ATNZ in March 2023, bringing extensive experience in vocational education, and an aspiration to create a technology-led and future-focused training organisation. He had previously been Director of the New Zealand Maritime School for nearly 20 years, where he saw first-hand the benefits of what AR could bring in a maritime training environment. He oversaw the installation of full mission bridge and engine room simulators at the school, making it the largest maritime simulator facility in the Southern Hemisphere and gaining global recognition as a Centre of Excellence. The simulation equipment provides students with the opportunity to learn and practise ship handling techniques for vessels ranging in size from fishing boats to super-tankers (including the Cook Strait ferries), delivering a superior maritime training experience that fosters critical thinking, problem-solving, proper decision making and confidence.

Keen to implement technology that would improve skill level, productivity and training efficiency, ATNZ conducted desktop research into what kind of off-the-shelf technology was available for use in engineering.

They discovered that welding simulation was one of the relatively few areas in engineering where the technology was already available, and the scale at which industry body Weld Australia had already implemented that technology – partnering with TAFEs (vocational education providers) throughout the country with positive results.

Evidence from Weld Australia has shown the benefits of using combined AR with practical training, leading to a more consistent and higher skill level. In New Zealand, there is not yet sufficient evidence to substantiate this, but it may have more to do with the relatively limited use of the equipment, rather than any shortcomings.

"Weld Australia is heavily invested in this technology – they have implemented more than 500 machines compared to our six."

ATNZ purchased four simulated welding machines in August 2023 with strategic funding support from the Tertiary Education Commission, adding a further two machines and two robotic units the following year. Weld Australia supplied the Spanish-manufactured Soldamatic machines, offering on-the-ground support and training for ATNZ's team of national account managers.

Over the past 18 months, ATNZ has trained around 100 apprentices and 600 non-apprentices using simulated welding equipment. It has run around 60 independent sessions from Kerikeri to Dunedin, deploying the equipment in new training with employers, in ATNZ's own apprentice training, and in use in careers events, trade shows and in schools to enhance skills and raise interest in engineering careers.

"We're committed to providing learning opportunities that are as close to the real working environment as possible. The simulators take that achievement to a higher level."

WELDING SIMULATION TRAINING

Welding provides opportunities in several industries, including construction, manufacturing, automotive, shipbuilding, fabrication and metalworking. Job prospects in Aotearoa New Zealand are high, with the average salary for a qualified welder around $73,000 per annum.

"Getting a welding qualification is very valuable to NZ Inc."

AR in welding provides an immersive simulation experience for learners-- welding elements such as helmet, torches and gloves are real, with real sound and real welding machine settings.

The equipment we use delivers effective training in a true-to-life experience.

Beginner to Advanced Modes

GTAW

MMAW

Mig Welding

Robotics Welding

Multi-Positional Welding

With the aid of robotics, the equipment can be programmed to simulate all weld types, materials, consumables, difficulty levels and body positions, and can be freighted anywhere around the country.

It offers a personalised, collaborative, real-world experience with the use of QR codes and cameras enabling learners to weld and get feedback in real-time. It also has robust reporting features and metrics, showing the learner their weld in graph form and scoring them out of 100. Every learner is given a personalised report of their input at the end of the session with their training partner watching progress on a screen in real-time.

"It's not a one-size-fits-all approach."

ATNZ had identified a skills need on block courses, with many apprentices concerned that they were being required to complete a welding module without any prior experience. The simulators offer intermediate and expert-level welding, and notable programme additions to address these skill deficiencies were the introduction of Level 3 and Level 4 NZQA Approved New Zealand Certificates in Welding, which ATNZ made available in 2023.

"Some apprentices were being set up for failure – they were required to do advanced welding as part of their block courses with no prior experience. They were understandably upset, but with use of the simulators prior to attendance, they are now doing it."

BENEFITS TO EMPLOYERS AND THE WIDER INDUSTRY

Developing training with a welding simulator removes the barrier to entry by eliminating many health and safety concerns, providing a faster, more flexible, personalised learning experience based on interactive methodology. It also reduces costs and waste for providers.

Benefits include:

Effective, safe and clean learning environment – learners can practice their skills in a safe, comfortable and controlled classroom environment without risk of injury or hazards – there is no exposure to fumes or X-rays, and no consumables.

Faster, real-time learning – simulation technology allows clear and immediate feedback on a learner's performance, such as gun angle, wire stick-out, and travel speed. Trainers can instantly review simulation results and provide feedback on improvement areas, helping trainees learn far more quickly and efficiently (reduction in learning time from one month to two weeks for a first-time learner).

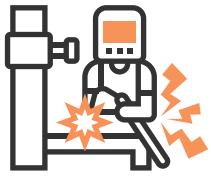
Flexibility – the flexibility of welding simulation technology allows trainers to tailor training programmes to the needs of individual learners, giving them the opportunity to practice in multiple disciplines without the need for specialised training facilities.

Repeatable training scenarios – trainers can easily create repeatable scenarios across various welding techniques and procedures, allowing learners to practice their skills and respond to different welding challenges and various difficulty levels at their own pace.

Reduction in costs and waste – welding simulation technology reduces costs by decreasing the materials, laboratory time and equipment required for training. It also reduces waste.

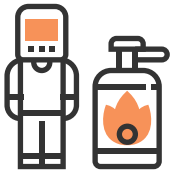
Engaging and fun – the gaming delivery of simulation technology is highly engaging, offering a relatable, accessible and popular learning tool.

56%
decrease in time to learn

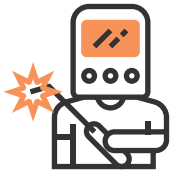


84%
reduction in accidents

99%
reduction of CO_2 emissions



68%
decrease in laboratory costs



34%
more certified welders than traditional methodology[1]

[1] Simulated welding statistics, https://seaberyat.com/welding-simulator-soldamatic

PROVIDING ACTIONABLE OUTCOMES FOR PRIORITY GROUPS

The ability to deliver simulation technology directly to potential learners is a key part of ATNZ's broader recruitment strategy. EIT invites ākonga from Māori immersion schools, Pasifika and female students, along with their whānau, to their workshop sessions in order to encourage participation and generate interest in engineering as a possible career.

"We show them that their children can succeed in this. In 45 minutes, they can go from beginner to intermediate level."

Many learners often don't consider non-traditional roles (such as women in welding), due to a lack of awareness of the career pathway. The use of simulation technology can be an innovative and non-threatening way to demonstrate the accessibility of a potential career.

Learners are competing for high scores in simulated welding in the same way that they use gaming technology – it helps send the message that it can be a fun and accessible learning experience for everyone.

"In school environments, it enables an introduction to engineering to non-traditional engineering learners."

MITIGATING CHALLENGES AND BARRIERS

Resistance to change in technology and training methods – the approach and delivery model for welding training hasn't changed in many years. There is scepticism from some experienced welding trainers and practitioners who don't see the value of the technology and believe that real-life welding remains unparalleled for mastering the craft.

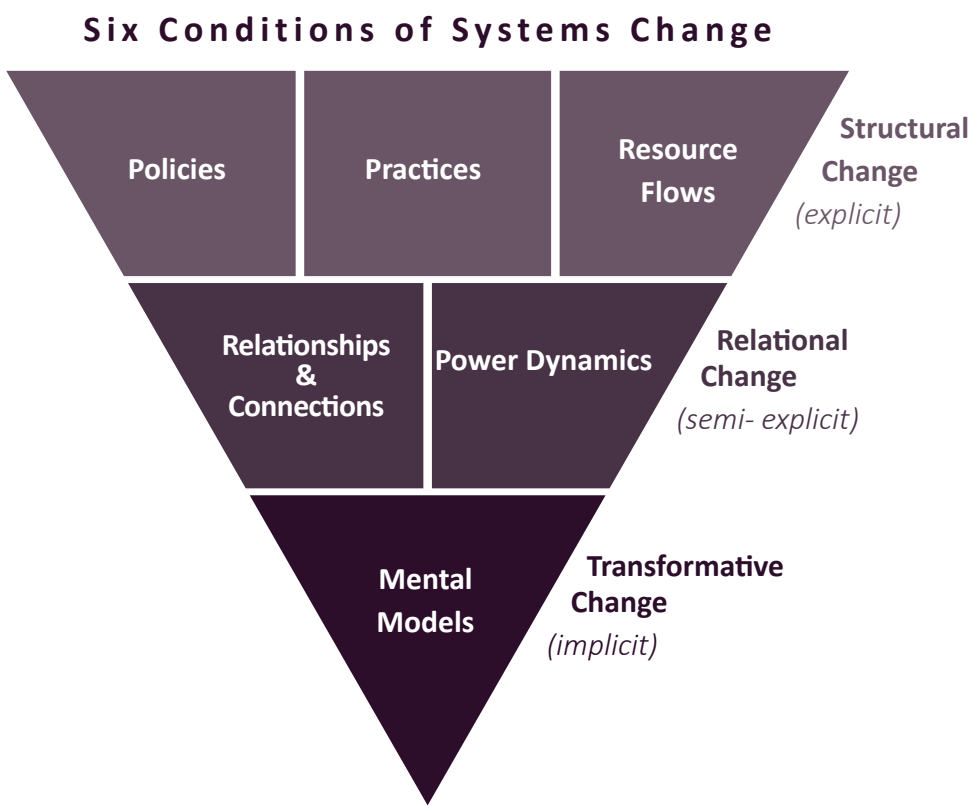
At ATNZ, everyone on the field team connected with the welding industry is fully trained in the use of the simulation machinery. Weld Australia ran two-day training sessions for national account managers in their Auckland office, where they could make their own evaluation of the technology and user experience, providing honest feedback and raising any concerns. Additional training is offered on the simulator management software, which enables trainers to build custom courses for learners.

> *"No AR is ever going to be a perfectly true recreation of the real environment. But things are changing so fast in this field, so it's vital that we refute any scepticism by validating and demonstrating the effectiveness of the technology with full knowledge of its capabilities and potential."*

Perceived start-up costs – there are significant start-up costs in purchasing the simulation tools but this needs to be considered in comparison with the cost of training on workshop equipment, along with the time, materials and safety perspective of real-world training.

A limitation for some training providers is being able to cover both the initial capital cost and ongoing operational costs.

GAP ANALYSIS BASED ON THE SIX CONDITIONS OF CHANGE MODEL



Policies	Practice	Resource flow	Relationship and connections	Power dynamics	Mental models
Commitment to future-focused training means looking beyond New Zealand for ideas and technology that has proven successful overseas. Evidence from Weld Australia has shown the benefits of using combined AR with practical training, leading to a more consistent and higher skill level. Along with their own investment, ATNZ received strategic funding support from the TEC in order to purchase the initial four welding machines. This is available to all providers who might want to try it, but the key constraint is around funding. Ensure that funding rates enabled appropriate training technology to be acquired and utilised.	Deliver simulation technology training directly to potential learners as a key part of ATNZ's broader recruitment strategy. Welding simulation training transitions perfectly into a Fabrication Engineering Apprenticeship or associated micro-credentials. Simulation should not be viewed in isolation – in its most advantageous form, it should involve transition to real-world practice. The use of simulation is to enhance initial training and develop better skills in order to transition to real-world practices.	Invest in building a field team of national and regional account managers who can offer customised training on AR equipment anywhere in Aotearoa New Zealand. Through their personalised approach and technology- enabled learning, ATNZ seeks to be New Zealand's leading provider of apprenticeships and work-based learning in the sectors they serve.	Ensure the company 'walks the talk' and everyone on the field team connected with the welding industry is fully trained in the use of the simulation machinery, as well as the benefits of simulated training. Use real-world examples to illustrate the importance of welding safety and best practice, demonstrating the consequences of improper welding techniques and the importance of safety. As well as bringing benefits to the learner, it also empowers the trainer – giving them more feedback and control of the learning experience. Most of the resistance and scepticism with simulation is around fidelity – how closely it replicates real-world experience.	Encouraging employees to continue practising and improving their welding skills benefits companies by creating an adaptable workforce receptive to new ideas and technologies. Empowers learners and gives them more control over their own learning.	Resistance to change in technology and training methods – the approach and delivery model for welding training hasn't changed in many years. There is scepticism from some experienced welding trainers and practitioners who don't see the value of the technology and believe that real-life welding remains unparalleled for mastering the craft. Perceived start-up costs – there are significant start-up costs in purchasing the simulation tools vs real welding equipment. Many training providers are not able to cover both the initial capital cost and ongoing operational costs. A welding training comparative study[2], looking at time and resources involved with traditional welding methodology compared with Soldamatic augmented training, found that the full Soldamatic method reduced the average time spent in the workshop by 56% Anecdotal evidence has shown a learner can reach the required skillset on simulation after a week, compared with a couple of months on real-world practice.

[2] Welding Training Comparative Study: Traditional Methodology vs Soldamatic Augmented Training, Seabery, April 2014

KEY LEARNINGS FOR OTHER PROVIDERS

Recommendations for improving and scaling AR integration

Develop and implement a strategy – Focus on how you use the tool and train your instructors, not the technology itself. Back that up with an investment plan to acquire and support the technology you need.

Exercise creativity – get over that financial mindset barrier that there's not enough money in the system. There's always a route to funding if you are serious!

Choose a vendor with a long-term commitment to software development - negotiate an appropriate licensing arrangement which gives you access to regular product updates. Ideally, work with a vendor who will partner with you on ongoing development.

"It's always a trade off in this game between current functionality and what the software development programme looks like."

Adopt an incremental approach - start small and relatively simple. And then if you have initial success and an increase in demand, start to scale even though it may still be relatively new.

Be open to change and new technology - if you keep doing it the way it's always been done, you'll find yourself obsolete very quickly. At the same time, be very clear about what you're trying to achieve, and what the technology can do for you. And look beyond the traditional paradigms – there are some really interesting developments happening in the most unlikely of places.

"In an industry, you must change and if you don't, you won't survive. New Zealand is very behind on this level of training."

NEXT STEPS

ATNZ continues to evaluate which practical skills can be best supported by simulation or virtual technology, compared with those best learnt in training workshops or in the workplace, looking at best practice internationally. It has plans to introduce VR simulation in refrigeration and air conditioning, fluid power engineering, forklift licencing and CNC.

Simulation has potential in fields with significant safety or cost concerns. While it is less ideal for tasks requiring direct, practical experience, simulation can be a great tool for emergency response training, incident management scenarios and other high-risk, high-cost environments (such as confined space or working at heights training).

THE EIT EXPERIENCE

EIT in Hawkes Bay has worked alongside ATNZ for the past two years, running a series of one-day mechanical engineering workshops combining work on the welding simulators with practical workshop sessions.

These events have included hosting a variety of local schools to spend half a day on the simulators and half a day in practical workshops applying welding and fabrication skills.

EIT's team of tutors has also had experience in using the welding simulators and has positive feedback about the engagement for new and entry level learners.

"The simulators gave students a good idea of what to expect when picking up a welding torch for the first time."

Student Reaction to Simulated Welding

Paddy Doohan, Senior Tutor & Programme Coordinator for Mechanical Engineering at EIT, says that students have responded positively, particularly enjoying the competitive element provided by the scoring features.

The ability to progressively increase the difficulty by removing real-time feedback has made the learning process engaging and more realistic, he says.

Once students have completed different weld types using the simulators, they then move on to perform welding tasks on some CNC plasma-cut parts (wall-mounted bicycle storage hooks) - folding up the cut parts, preparing them and completing the welding requirements.

EIT has had several successful conversions from students attending these experience days into its Level 3 NZ certificate in Mechanical Engineering (NZCME), with its first enrolment coming from the inaugural workshop they ran in November 2023.

The student went on to secure a Level 4 apprenticeship with Fonterra after graduating from EIT's Level 3 NZCME programme.

"This is a significant positive for us, as many high school students are not exposed to the trades within their regular scheduled activities."

THE MJH EXPERIENCE

Leading structural steel company sees value in simulated training

Lower Hutt-based structural steel fabricator MJH Engineering specialises in delivering large-scale commercial and infrastructure projects nationwide, including Tākina, the new Wellington Convention and Exhibition Centre, and the MIT building and transport hub in Manukau, Auckland.

Apprenticeships and training programmes are a key part of their commitment to developing skilled tradespeople, ensuring the next generation is equipped to meet the demands of the industry.

They recently ran a team of their welders through a day-long simulated training session with ATNZ national manager Ben Julian and Southern region account manager Adrian Abel.

“We were keen to show how it can help reduce training time, and also get more people exposed to the industry so we can get them trained in a cost-effective way,” says Ben.

The session covered different weld types, positions and materials, stepping up the degree of difficulty from beginner to expert coupons over the course of the day.

“Simulated welding training provides a safe, controlled environment for trainees to develop their welding skills and confidence before transitioning to live work,” says Jeremy Mikoz, MJH’s HR & Development Manager.

“At MJH, we see real value in integrating this technology as it enhances learning outcomes, reduces material waste, and allows for more efficient training.

“Investing in training and upskilling is critical for the future of our industry, and initiatives like this help bridge the gap between learning and practical application.

“We actively support initiatives that enhance training opportunities and strengthen the pipeline of talent entering the structural steel sector.”

It was the first time MJH has done simulated training with ATNZ, and they’re planning to work with them again to help train a group of local high school students they support.

“We’re always open to new partnerships that support the development of future welders and fabricators,” says Mr Mikoz.

Jacob, who is completing a three-year apprenticeship at MJH, learnt how to weld on the job. He valued the simulation experience for its ability to be able to go back and check his stick angles and speed, and how that affected his weld.

Mason, who’s been a welder for three years, says he found himself adjusting his technique to the feedback provided by the report. “It’s like a computer game. The longer you spend on it, the better you become.”

Twenty-year-old Finn, who joined MJH’s plate processing division a year ago and is hoping to complete an apprenticeship, had never welded before.

He found the training very beneficial, saying it was a good starting point and helpful to be able to translate the skills he learnt from the training room to the workshop.

APPENDIX

Seaberyat.com: Simulated welding statistics, https://seaberyat.com/welding-simulator-soldamatic

Welding Training Comparative Study: Traditional Methodology vs Soldamatic Augmented Training, conducted by Seabery (manufacturer of Soldamatic, augmented training technology for welding), April 2014.

Advanced Welder Training Centres

Weld Australia has worked with partners around the country to establish Advanced Welder Training Centres (AWTCs).

Schools Outreach Program Encourages Kids Across NSW To Explore An Exciting Career In A Trade

The Advanced Manufacturing Schools Outreach Program is encouraging kids in secondary schools across New South Wales to explore a meaningful career in the trades. With a skills deficient crisis impacting a raft of labour markets across Australia, industry is calling for the Program to be rolled out nationally.