A clarinet trio all performing with one-handed clarinets at OHMI's Tenth Anniversary Awards, September 2021

Rachel Wolffsohn, general manager of the OHMI Trust, tells us about a volunteer-led project to bring a commercially viable one-handed clarinet to market

ENABLING MUSIC-MAKING

If you play a woodwind instrument like the clarinet, you might never have conceived of playing it one handed. It is, after all, an instrument of considerable size and weight, and one which requires a significant amount of dexterity.

Yet, for the many thousands of adults and children in the UK living with an upper limb difference – either as a condition of birth, or as a consequence of illness or accident in later life – playing an instrument like the clarinet is often frustratingly out of reach.

The OHMI Trust (One-Handed Musical Instrument Trust) seeks to tackle this exclusion by enabling children and adults with physical impairments to play the instruments they want to play, whether at school, home or in a professional ensemble. It does this by developing adapted instruments, emulators and enabling equipment, and it remains the only organisation in the world undertaking such work.

10 years on, OHMI's work is needed more than ever. In the UK, one in every 400 children is affected by cerebral palsy; one in every 1,000 is born with hemiplegia; 15,000 under the age of sixteen have arthritis; and there are 31,000 with a physical disability in mainstream English schools. Add to that the number of adults with these same conditions or those whose lives have been impacted by stroke, or other brain and physical injuries, and it is clear there is a large cohort of musicians who are simply being ignored.

The issue is a complex one. The lack of suitable instruments means that parents of disabled children often write off participation in music-making. Lessons are then not requested, so teachers, music hubs, and even SEN/D coordinators are either not aware of the need or options available. Low participation then leads to another difficulty: OHMI's instruments, being made in quite small quantities, can be expensive. A one-handed clarinet, for example, costs around £6,000.

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OHMI's Instrument Hire Scheme makes it more affordable to acquire such instruments. Where suitable instruments do not already exist, the Trust supports designers and technicians in bringing new creations to market. It does so through a biennial competition, with entries accepted in three categories: Concept, Enabling and Playable.

Woodwind instruments and their enabling equipment have featured regularly amongst competition winners. They have included the 'Claritie', a device from Cambridge Woodwind Makers, which relieves the weight on the right thumb for instruments such as the clarinet; and a Toggle-Key Saxophone, from Professor David Nabb of the University of Nebraska and Stelling Brass & Wind of Kearney. The Norfolk-based maker of woodwind instruments, Peter Worrell, has been selected as a competition winner several times over the years, including this year's Playable category for his High and Low D Whistles.

Many of these inventions are incredibly expensive to reproduce, at least on the scale needed to reach those musicians with limb differences and in the numbers required. So, OHMI was delighted to have the opportunity to partner with Creative United and Plexal in 2020 to launch an Accessible Instrument Challenge, which would address the specific challenge of affordability through scaling up manufacturing techniques.

Eight virtual teams were set up as a result to collaborate on addressing a series of innovation challenges, focusing on the design, manufacture and supply of non-standard musical instruments and assistive equipment for both disabled and non-disabled musicians.

Amongst their number was the One-Handed Clarinet Project, which sought to explore how the fabrication process can be improved and supply chain issues ➡

addressed to improve accessibility.

Four questions in particular were posed for the team of volunteers to address:

- What alternative processes can be used to enable small to mid-scale production?
- Which alternative materials can be used to enable new production processes?
- Can any standard clarinet components be utilised (e.g. body)?
- How do we enable parity of sound quality?

It was clear that for the project to succeed, three distinct qualities were needed to form the project team: an understanding of the workings of the traditional instrument, an understanding of the technology to design to scale, and an understanding of how the instrument would be used in practice.

The role of lead facilitator in the project was fulfilled by engineer Sharon Jones. Working as part of Barclays Eagle Labs, Sharon was one of several experts who helped communities gain access to digital fabrication and digital skills. She was introduced to the project by a personal connection at Plexal, and it soon became apparent that her design skills and her own clarinet playing skills would help to address a real need in the music community.

3D-printed one-handed clarinet

With his 40-year experience of making one-handed clarinets, one-handed recorders and many custom adaptations for musicians of woodwind instruments, Peter Worrell was a crucial member of the resulting challenge 'dream team'. Peter's first commission in this area was to create an affordable one-handed recorder for Dolmetsch recorders during his time at Howarth of London (or TW Howarth as it was known at that time). That was over 30 years ago, and many of the recorders were sold to Reach Charity Limited, a charity that supports children with upper limb differences across the UK and Ireland.

The challenge team's work centres on the same version of Peter's one-handed clarinet that won OHMI's biennial competition in 2017. Rather than being an adaptation, the fully chromatic instrument, with a range from low E to high F, has been designed from scratch for a one-handed musician. The key work is designed so that it can be mirrored for right-hand and left-hand models.

From the early days of creating that instrument, Peter was adamant the design should be open source and that anyone should have the opportunity to copy it, at the same time making it better and cheaper. The hope is that the new manufacturing ideas used in the challenge might inspire someone to do this.

Joining Peter and Sharon in the core project team is co-facilitator Clare Salters, who is woodwind tutor to, amongst others, a limb-different student who plays the one-handed recorder and one-handed clarinet. Clare is also chair of trustees at Reach Charity Limited, whose musicians have been happy recipients of Peter's adapted instruments over many years.

Clare describes Peter's clarinet as 'an absolute miracle of design and superlative craftsmanship'. The driver for her involvement in the project is to ensure that the marginalisation faced by children with a disability when learning a musical instrument is consigned to the history books.

The exact demand for one-handed clarinets is relatively unknown. It is not viable to mass produce these instruments in cheaper factories abroad, as moulds must be built and order quantities are small.

Peter Worrell's one-handed clarinet

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Peter Worrell demonstrating his one-handed clarinet

The team explored the possibility of using mass-produced bells, barrels and mouthpieces. These components are the same on all clarinets, but there were concerns about whether they would fit the existing instrument, and if so, how they would affect the tuning. Focusing on the latter first, tuning is not a massive issue for beginner players, so using plastic parts might potentially make the instrument lighter (certainly helpful for younger learners).

The concerns regarding the components fitting 'straight out of the box' were more problematic. Plastics perform very differently to wood, and the type of tooling needed to work them efficiently needs major investment. Hannah Williams, a clarinettist and music industry professional, joined the project as a collaborator and was able to source bells and barrels from a Chinese

factory that fitted the current one-handed instrument with no adjustment. These would result in definite savings in the larger buying capacities in terms of both time and cost. French manufacturer SYOS, who produce 3D-printed single-reed mouthpieces and accessories, were very generous in donating some ligatures to assist the project development.

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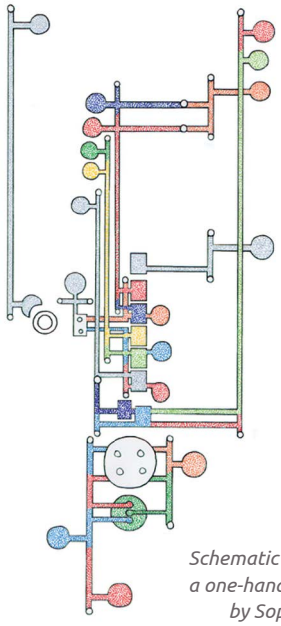
The team have since moved away from using standard B flat clarinet components, instead exploring the possibility of 3D printing the entire body, bell and barrel of the one-handed clarinet.

One of the most significant lightbulb moments of the project was when Peter realised he did not have to think about keys and shapes being created in a traditional way. It is indeed possible to 3D print anything from a sketch; this revelation led him to consider keys as units rather than individual components soldered together.

Since the conclusion of the Accessible Instruments Challenge in October 2020, the team has continued to work together towards the goal of creating a more affordable entry-level one-handed clarinet. The biggest task to date has been the CAD drawings which have taken in excess of 40 hours, and which were created by CAD designer Michael Sanders of Michael Sanders Design. As well as a background in designing and making flutes from unusual materials, Michael is a folk musician. Both he and Peter are musicians and makers, which has led to the two speaking a shared language that has made communication throughout the project effortless.

Completed CAD drawings have afforded Sharon the opportunity to 3D print the components out of BASF Ultrafuse Pro PLA on an Ultimaker Extended 2+. Polylactic acid (PLA) is an industrially compostable, plant-based polymer. The addition of chemicals has supported both hardening and faster printing, with a total printing time of 25 hours for the first clarinet prototype. This prototype has allowed Peter and Michael to check the positions and modifications they made when creating the CAD drawing.

Nevertheless, a 3D-printed solution is far from a simple one. So far, there have been two different prints from four different iterations of the drawings. The quality of some of the early printed components has, unfortunately, been disappointing, as has the structural integrity of the material. PLA may machine well, but shows issues in porosity. Whilst some success has been achieved using Woodfill filaments (sawdust with PLA as a binder), Sharon has continued to explore different slicing settings to reduce porosity. As this emerging form of manufacture evolves, issues will undoubtedly be resolved.



Schematic diagram of a one-handed clarient by Sophie Hyman

The University of Manchester and Arts University Bournemouth are helping with the printing of prototype bodies, which is allowing the team to move on to the most time-consuming and labour-intensive aspect of the instrument – the key making. Old technology may have brought us composite clarinet bodies (plastic, ebonite, compressed wood dust, and so on), but there have been advancements in strong plastic keywork for student instruments. If this material indeed works, it cuts out a significant cost of initial tooling.

A revelation on the keywork is also helping to drive down the cost of the project. Model maker Sophie Hyman joined the project as a collaborator, after working on the accessibility of public places as part of her dissertation. One particular challenge was this: how might one of the project's most expensive elements – the key making – be resolved?

Two key groups of musicians that stand to benefit from the project are absolute beginners and the more experienced who seek to take their learning to the next level. The team had established that beginners would need access to virtually all the keys on Peter's instrument in order to access basic repertoire. The exception was the 'wobble plate' mechanism that enables the player to play, with a single key, all the notes played with the pinky fingers on a standard clarinet. This is a complex mechanism, costly to include on a beginner instrument but essential for anyone progressing beyond Grade 1. With her problem-solving hat on, Sophie came up with the idea of treating this section in a modular way – with a single-key low F module for beginners and a more complex wobble plate module that could replace it once musical progress has been made. This creative approach will not only drive down the cost of manufacture, but will make the instrument available to a much wider cohort of musicians, and quicker.

So, what of the future? The skill base for the assembly of the resulting instrument will, undoubtedly, still be quite high, but not at the same level as the current handmade version. Once the design has been finalised, the method of manufacture will be further scrutinised to see if there are ways to improve the assembly.

The committed team of volunteers – with the knowledge they bring from clarinet teaching, instrument making, model making and technology – has certainly made progress. Like many inventive projects, however, there is one huge barrier: funding the cost of development time and materials. Until now, the project has relied on the energies of its team of volunteers. An injection of financial support would allow the project to truly accelerate and include the appointment of a project manager, who would work with the design team for at least 12 months.

The accessibility of the one-handed clarinet as a playable instrument may have been addressed long ago. Making it affordable is now tantalisingly close, but it will not be realised without investor support. ■

You can learn more about the OHMI Trust Accessible Instruments Challenge at www.accessibleinstruments.com, and find out which adapted instruments are available as part of OHMI's Instrument Hire Scheme at www.ohmi.org.uk/instrument-hire-scheme. If you'd like to donate to the OHMI Trust or one of its specific projects, including the One-Handed Clarinet Project, visit www.ohmi.org.uk

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