



Dave Betts, Paul Alexander, Gordon Reid and Clive Osborn

The restoration business

A quarter of a century ago, academic research into audio restoration planted the seed for a unique company. **Barney Jameson** visits CEDAR Audio

IN THE EARLY 1980S, SPRINGTIME

arrived in the British technology industry. It was Mrs Thatcher's Britain, the land of the Iron Lady, and the yuppie generation was rising. But, for a handful of dedicated, pioneering academics, there were better things than money to consider. Their research led to the first flush of affordable computing in the UK, as floppy disks and BASIC programming arrived in classrooms and homes for the first time. For a brief moment it felt like living in a future shaped by larger-than-life inventors and the professors of the

great British universities.

Decades later, little remains of that time but the memories of those who were there. But the ideals that drove it forward: the pursuit of knowledge, a belief in academia and a passion for redefining what is possible can still be found in a small building near the English city of Cambridge. It is the home of CEDAR Audio, a company founded almost 25 years ago in the heart of Cambridge University, and which has never forgotten its roots.

'There are certainly people here who are academics at heart, for

'The idea of a digital noise reduction system was radical within the audio industry'



The CEDAR system prototype in 1988



CEDAR Audio headquarters, located near Cambridge in the UK

whom academia is a huge part of who and what they are,' says Gordon Reid, CEDAR's managing director, and a man who describes himself as 'at heart a musician, though I thoroughly value my links with the university'. He adds: 'There are no hard-nosed business people here'.

Indeed, while many companies claim to be unique, CEDAR Audio deserves the description more than most. At its very beginning it wasn't even a business at all, but instead a project dedicated to preserving the ageing, historic recordings of a Britain long since past.

'It started in 1983, the dawn of digital audio in the UK,' explains Mr Reid. 'A very far-sighted man named Dr Christopher Roads was the director of the British Library National Sound Archive (BLNSA), an institute that contained many of the

UK's ageing cylinders, 78 records and old tapes, many of which were deteriorating. He had the idea (which may now seem obvious but at the time was brilliant) to transfer the audio onto the new digital medium, at the same time removing the problems within the audio signals themselves – the clicks, the crackles and the hiss.'

It was, Mr Reid emphasises, 'a radical idea in 1983 – absolutely radical. But Christopher managed to secure a grant from the British Library to initiate a research project into what would later be called audio restoration'.

It was the beginning of a long journey that would lead to the company that Mr Reid now leads but, in 1983, it was unclear whether audio restoration was even possible. Set-backs were hard to avoid – one early partnership even led to a

mixing console with a button named 'declick', but this never was able to remove any clicks.

'They were unable to solve the problems of declicking,' reminisces Mr Reid. 'But in 1985 they then introduced Christopher Roads to Professor Peter Rayner at the Engineering Department of Cambridge University.'

This was a turning point. Professor Rayner explained that the ideas for turning Mr Road's ideas into reality existed, but could not be implemented at that time in a piece of conventional, real-time audio equipment. The processing power didn't exist, so restoration had to start its life as a set of offline processes. In other words, the audio had to be loaded into a computer, processed in some fashion and then played off the computer onto some other medium.

It took three years for Professor Rayner and his team to turn the idea into a reality. 'They developed an early prototype of the original CEDAR system, containing just declick and dehiss algorithms,' recounts Mr Reid. 'It was running at something like 7,000-times real-time, so one second of one channel of audio took two hours to process. If you had a 20 second snippet, you didn't just come back the following day, you came back the day after that!'



A 1988 article from The Times newspaper in the UK, reporting on the very first CEDAR system



The first CEDAR System, as photographed in 1990

Yet, even after so much work had gone into creating this early audio restoration technology, the people involved in the project had not yet addressed its commercial potential. But that changed thanks to an appearance on a popular BBC television programme named *Tomorrow's World*, highlighting the

best of future technology to a prime-time BBC1 audience.

'They showed the computer and played some before and after samples,' recalls Mr Reid. 'I've still got some of the letters that were sent to the BLNSA as a response to that broadcast.'

He continues: 'Those letters were arriving on the desk of Christopher Roads, but neither the Library nor the University knew what to do with them - neither organisation was set up to develop the system into a commercial product. But they suspected that they had a tiger by the tail, so the idea was hatched to find a commercial partner, and then develop the research project into a service or product.'

Meanwhile, if the early 1980s was springtime for the British computing industry, then by the end of the decade autumn had already set in, and Mr Reid - a former astrophysics post-graduate researcher, Cambridge resident and keen musician - was experiencing it first-hand in his day job.

'I'd just walked away from running a small group of computer businesses in Cambridge,' he explains. 'When I entered computing in the early 1980s it was similar to where digital audio was in the late 1980s. It was exciting. There was

BUSINESS: COMPANY PROFILE

lots of quirky development going on and it was populated by enthusiasts who were passionate about what they were doing. But by 1988 it had all become horribly corporate. The PC had taken over the market and a new, almost purely commercial philosophy now dominated.'

Seeking a new challenge, Mr Reid offered an unusual blend of commercial understanding, scientific background and audio knowledge, so Christopher Roads charged him with turning his project into a commercially viable product. In the meantime, telecommunications giant Cable & Wireless had joined the project, becoming one of the four owners of the new company alongside Professor Rayner, the British Library and the University.

'We were provided with a tiny room with a sloping floor at the top of an old university building, and some

new employers when he met a senior director of the British Library. 'He asked me what I thought of the project,' he explains. 'My answer was "this will last two weeks, and it might last two months, but I'm making no promises about two years".'

If that made the owners pause for thought, then there was a clue lurking in Mr Reid's academic past to help reassure them of their choice. Though declick technology was new to digital audio, something like it already existed in a field that Mr Reid knew well.

'The idea of a digital noise reduction system was radical within the audio industry, but I had come across some of the concepts before,' he explains. My third-year project as an undergraduate had been to remove clicks from a radio telescope trace. It had never occurred to me that this



Gordon Reid, managing director of CEDAR Audio, in the company demonstration room



A 1990 promotional shot for the first CEDAR system

old fashioned, military-style desks and chairs,' Mr Reid grins. 'We also had enough funds to buy a couple of computers to start turning the prototype into something useable. We had no staff yet with whom to do it, but it was a fantastic time.'

The original team eventually comprised five members in addition to Mr Reid, one of whom is still with the company today. 'Dave Betts is one of our engineering directors,' says the MD. 'and he's been with CEDAR almost since day one.'

It was, he remembers, an 'amazing' time. But even amid the excitement, he was characteristically honest with his

technology would have these wider applications, but Christopher Roads, perhaps without even realising it, had come up with something that was valuable. Not just viable, but something that would be of genuine value to the people who used it.'

Not that it was easy. For the first 18 months of the company's life, the technology did not exist to support its ambitions. 'Each process took 10 to 15 times real-time,' says the MD. 'You could run one process over a four minute piece of music in an hour.' The new team had to adopt new hardware and start again with new DSP code, edging ever closer to the goal of real-time

processing. 'It wasn't possible to develop the existing system and tweak it.'

In the interim, CEDAR established itself internationally as an agency for the growing market in remastering for CD. 'We bought six computers, loaded audio onto machine number one, set the parameters and let it run, then did the same for machine number two, number three and so on. By the

It was arguably the first milestone achievement of a company that quickly went on to experience a whirlwind of challenges and successes. Those first sales paid for an increase in staffing, and more systems were soon sold across the world, each more advanced than the previous. Yet Mr Reid adds that 'we had moved premises, but it still felt very much like a university lab. We were young people paying ourselves next to nothing, doing some intense research because it mattered, because we were passionate about it.'

As a result, the technology developed rapidly. The original declick and dehis processes were soon joined by a decrackle algorithm proposed during a conversation between Peter Rayner and CEDAR's senior engineer, Simon Goddard, on a London Underground platform whilst waiting for a train. 'Digital decrackling has never strayed very far from that original concept,' smiles Mr Reid, 'and it was invented on Redbridge Tube station'.

To many companies that might seem like an unusually relaxed approach to R&D, but within CEDAR it was just another example of the philosophy that continues to drive its innovation. Within reason, team members are free to start and end the day when they wish, wear what they wish, and take the time needed to do their work. Deadlines matter, but not as much as getting the job done properly.

'Worrying about deadlines is not always compatible with doing the job well, it's compatible with doing the job quickly,' Mr Reid argues. 'Sometimes you can both do the job well and hit a deadline, but on other occasions you might reach the deadline and be dissatisfied with what you've achieved. You might want to go back and look at something again, improve it, or you may even want to say that you've learned a lot and now know how to

'We created a company that enables people to get out of bed in the morning and look forward to the day, having been given the time and facilities to do their jobs well'

time number six was loaded, the audio processed by number one was ready for review. That kept us afloat while we tried to turn the system into something saleable.'

Finally, in June 1990, the money ran out. 'The small investment we had received from the Library and Cable & Wireless was gone,' Mr Reid recalls. 'But on the day that we would have gone into overdraft, we received the deposits for the first two CEDAR systems. It really was that close.'

BUSINESS: COMPANY PROFILE

do it better, and then start again. That's happened on numerous occasions in the history of the company.

'Even now, the atmosphere harks back to those early days. We created a company that enables people to get out of bed in the morning and look forward to the day, having been given the time and facilities to do their jobs well.' It means, he adds, that 'products are ready when they're genuinely ready'.

Moreover, when CEDAR announces a new product, it is ready to ship immediately. 'With a few minor exceptions we've made that our philosophy all the way through,' agrees Mr Reid. 'Until the product has passed all of its tests and passed quality control there may still be changes. When you believe that quality is more important than timescales, you might get 95 per cent toward announcing and shipping it, then discover a tweak or a change that will make it better. Some companies handle this by launching the product and then releasing a second version. But that's not the CEDAR way.'

That philosophy may remain, but a great deal more has changed. As the years swept past, CEDAR evolved as the available technology allowed. Those first CEDAR Systems were sold, the MD explains, immediately after the company did what many believed impossible by inventing real-time dehis processing. 'Real time was vital,' he stresses. By the end of 1990, the system was delivering real-time dehis, declack and decrackle.

This also attracted the disbelief of some traditionalists, who refused to accept the technology laid out before them. 'We were told that real-time audio restoration was impossible - not just hard but impossible,' explains Mr Reid, recalling a particular AES show where a visitor attempted to



The CEDAR Audio demonstration room

dismantle the CEDAR booth to disprove a demonstration of real-time declacking. 'He thought he was listening to before and after samples that were somehow being switched. We had a turntable with an old 78rpm record on it, and we invited visitors to put the tone arm down and hear the unrestored music, then press a button and hear the clicks go away. They could prove to themselves that they were doing it. But he lifted up the covers looking for switching systems, while telling us that it was impossible.'

By 1991, the company had split product development into two tracks - one focused on the improvement of the computer-based systems and algorithms, the other on the concept of real-time hardware products, initially for declacking. This became another breakthrough. A brief relationship with a German manufacturer proved the concept and, in 1992, the CEDAR Series 1 appeared.



CEDAR engineering directors Dave Betts and Christopher Hicks celebrate winning an Academy Award for the DNS1000

to Cambridge, so we put together a plan for a management buyout.'

A meeting took place between Mr Reid, sales manager Clive Osborn and Dave Betts. 'We discussed whether we were ready to do this, which we were, and then reached an agreement with Professor Rayner (who remains a shareholder and non-executive director) and the University. On April 13th 1994 we bought the company.' Crucially, the new CEDAR would be, it was decided, 'a cooperative - not just the management, but every member of staff at that time was offered a shareholding.'

As if spurred on with something to prove, the company accelerated, with waves of new ideas and products. A huge new market presented itself when, in 1994, CEDAR's audio restoration began to be adopted to aid the work of police and security forces around the world. 'The requirements of the commercial audio industries and the audio



The CEDAR DNS 8 Live, offering digital dialogue noise suppression with virtually

'This was a heavy 2U rackmount unit,' says Mr Reid. 'It had multiple boards, lots of cabling, and even point-to-point wiring. It was an amazing beast of its time, but it nonetheless removed clicks very effectively in real-time.'

As intended, the DC-1 Declicker quickly found a home in remastering studios all over the world. The CR-1 Decrackler followed in 1993 and suddenly studios had a complete real-time restoration solution.

'Combining a hardware DC-1 Declicker, a hardware CR-1 Decrackler and a CEDAR computer system for de-hissing, allowed you to perform all three processes in real-time,' remembers the MD. 'You could play a record and hear the results with a latency of only half a second.' It was the first true multi-process, real-time restoration system.'

A year later, the company launched the CEDAR Series 2. Described as 'our mainstream product', this included a much revised DC-1 and CR-1, and later included the DH-1 Dehisser and the AZ-1 Azimuth Corrector.

Then, suddenly, the company's roots were torn out from beneath it. 'In 1993' says the MD, 'the British Library and Cable & Wireless decided to "divest themselves of non-core interests".' CEDAR was for sale.

'There was no real possibility of a commercial buyer at that time,' Mr Reid continues. 'CEDAR was too closely linked to the University and

forensic community are completely different,' explains the MD. 'In film and TV, the primary consideration of restoration is how much noise you can remove before you affect the voice. With audio forensics, affecting the tonality of the voice is usually irrelevant, it's much more important to make it intelligible.' Forensics now accounts for the company's second largest market behind postproduction.

CEDAR 20 - a 20-bit version of the PC system - introduced more processing power, while CEDAR for Windows, launched in 1996, proved a watershed moment. 'Up to that point, the computer-based systems had been working in the DOS environment, which only supported one application at a time, but CEDAR for Windows could run multiple processes on up to eight processor cards, each of which could support one restoration process on two channels in real-time.'

The 1U Series X debuted in 1997, offering declack, decrackle, dehis and azimuth correction at a more affordable price point. A digital debuzzer was also created, doing away with the unpleasant side-effects of comb-filtering systems. By now, the company had grown again and was in its third premises. Yet despite the achievements, the management team could see trouble on the horizon. 'By 1997, we realised that the remastering bubble was going to burst,' Mr Reid explains.

It was time to look for a new

opportunity but, in the end, opportunity found CEDAR. 'We were approached by a postproduction studio in Canada that was converting a number of rooms from analogue to digital,' he continues. 'They had been using an analogue noise suppressor and asked us whether we would develop a digital version of that product. Our response was that we would analyse their problems and develop a product to address their needs. That was the birth of the DNS1000, the original CEDAR dialogue noise suppressor.'

This is the product that has arguably come to define CEDAR Audio in the modern industry, so influential and widely used that it ultimately won the company an Academy Award. 'It was presented by Scarlett Johansson,' Mr Reid says. 'I don't know who wrote her script but she said that almost nothing comes out of Hollywood that hasn't at some point been through a CEDAR DNS1000.'

It was, he says proudly, 'a milestone that came from not just one customer's requirement but a whole industry's requirement - the need to suppress background noise in the digital domain, quickly and intuitively with virtually no latency'.

Even amid equally crucial moments such as the 2003 launch of the first CEDAR Cambridge system - effectively the system that Christopher Roads had dreamed of so many years before, and the invention of PhotoShop for audio in the shape of Retouch, the arrival of the DNS1000 lit the way for a host of developments that followed, including its most recent descendent, the DNS 8 Live. Designed specifically for use in live applications - not just live-to-air broadcasting but also conferences, houses of worship, live music events and more - the processor offers perhaps the greatest potential yet for carrying the company into new territories.



CEDAR Cambridge V8, the latest system to build on the legacy of Christopher Roads and Peter Rayner

'We developed the DNS1000 and its immediate successors for use in post, but many of them are used in broadcast, particularly live broadcast,' explains Mr Reid. 'So we knew there was a desire for a live-sound DNS, but we needed to reduce the number of controls while retaining the same processing quality across multiple channels,

and that required redeveloping the DNS algorithm as well as designing new hardware. When we look back on it, I hope that the DNS 8 Live will rank alongside the Series 1, Retouch, and maybe even the DNS1000 in terms of importance. For the first time, digital dialogue noise suppression is available with virtually zero latency for live events.'

With so much potential for growth, new markets to address, a continuing tradition of innovation and an imminent 25th anniversary to celebrate, it is remarkable that the Academy Award-winning CEDAR Audio remains, at heart, the same academically influenced project as at the beginning. Business is good, but there are still better things to think about.

'There are so many occasions when my colleagues and I realise that being part of CEDAR is a real privilege,' enthuses Mr Reid. 'This is not working in a dead-end job, waking up on Monday morning and wishing for Friday.'

In the early 1980s, springtime arrived in the British technology industry. Decades later, in a small building near the English city of Cambridge, the seeds are continuing to grow.

www.cedar-audio.com



zero latency