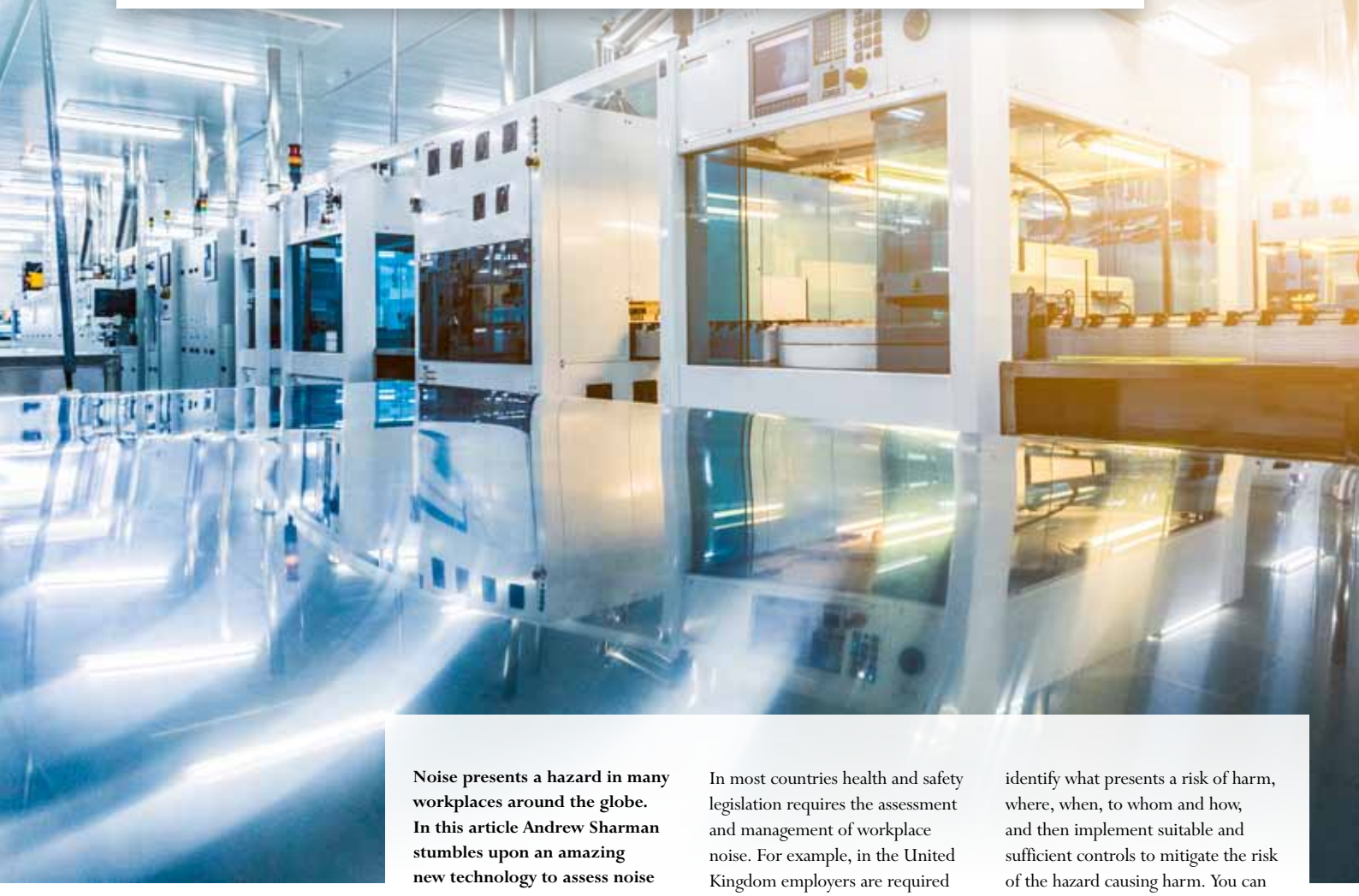
Sound and Vision

Listening to risks and behaviours with our eyes



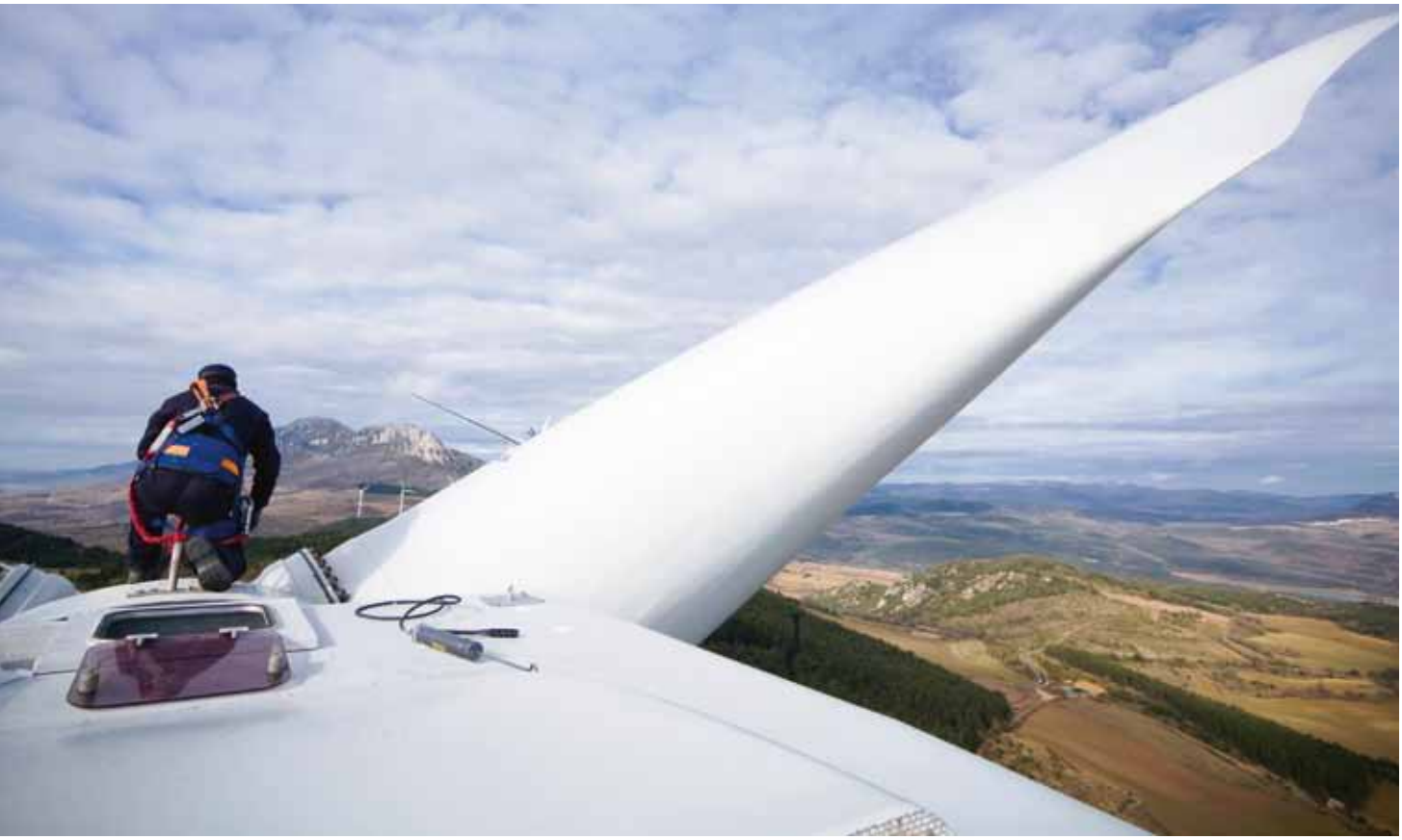
Noise presents a hazard in many workplaces around the globe. In this article Andrew Sharman stumbles upon an amazing new technology to assess noise risks and realises that the same approach can also build a better culture of safety, too.

Noise is a potential hazard in many workplaces: from Noise Induced Hearing Loss caused by loud plant and equipment, to the risk of acoustic shock to call centre operators, or the onset of tinnitus through exposure to intense noise. Beyond damage to our ears, noise also presents a serious risk to the health of our heart, too. For example, the risk of cardiac infarction (what we commonly refer to as a 'heart attack') increases significantly when we are exposed to continuous sound levels of above 65 decibels.

In most countries health and safety legislation requires the assessment and management of workplace noise. For example, in the United Kingdom employers are required to "make a reliable, representative estimate of workers' daily personal noise exposure." Daily personal noise exposure or 'L_{EPd}' represents a the typical 'dose' of noise experienced by a worker and includes a combination of how loud the noise is and how long someone is exposed to it during a working day. Peak sound pressure levels ('L_{CPEAK}') must also be measured.

There are many excellent guidance documents available on the internet that handle the process of noise assessment, so in this article we won't duplicate the approach unnecessarily. Like any risk assessment it's key to identify what presents a risk of harm, where, when, to whom and how, and then implement suitable and sufficient controls to mitigate the risk of the hazard causing harm. You can find more on noise assessment in my previous article 'Hearing Hazards: Behaviour's Influence on Workplace Noise Protection', published in H&SI in April 2015.

Most readers will be familiar with the Hierarchy of Controls pyramid, which sets out a general order for good risk management – beginning with Elimination of the hazard at source, then Substitution, Engineering Controls, Administrative Controls, and finally, as a means of last defence, the application of Personal Protective Equipment. Despite the frequent appearance of noise as an industrial hazard, often the approach to ▸



tackling the risk deviates from the norm, with employers commonly offering unlimited supplies of hearing protection such as disposable earplugs to workers. There's some logic here, many organisations will sincerely provide earplugs as an immediate first step in their noise risk mitigation strategy, as they then work out what to do next to reduce exposure to the harmful noise. But often this first step is also the last, as the organisation discovers that eliminating the noise is difficult, substituting the noise-causing equipment challenging, and installing engineering controls can be costly.

Using Personal Protective Equipment in response to workplace noise is far from ideal. During site visits I often notice workers with their ear defenders slung casually around their neck, or a single plug in one ear and nothing in the other, or perhaps worse – foam earplugs so old that they've become engrained with workplace oil and dirt as the user rolls them in his fingers before popping them into his ear canal.

So given these challenges, could there be a better way to assess the risk of workplace noise in order that effective control measures can be implemented and monitored?

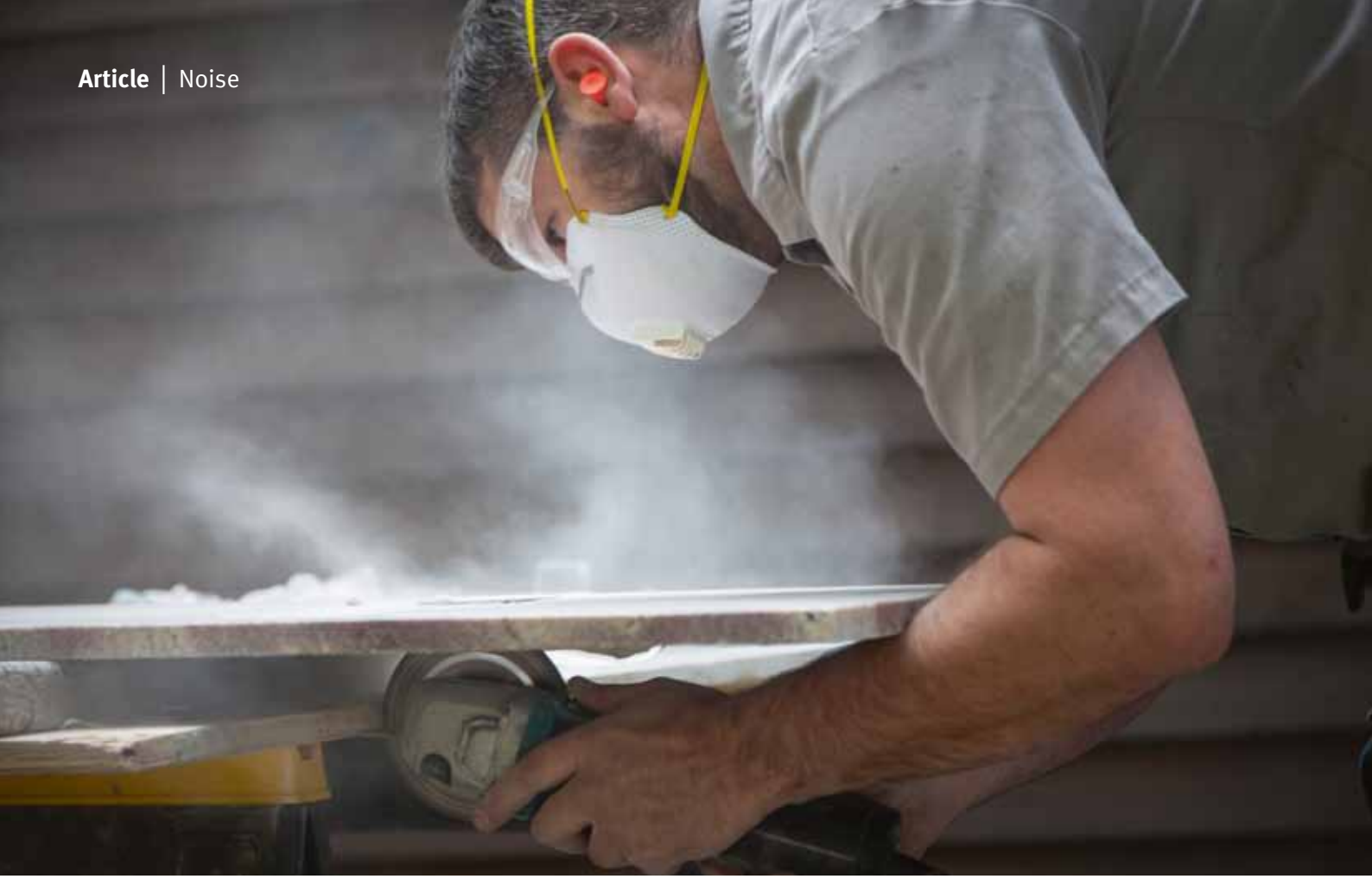
Come on, see the noise

Just a few weeks ago I found myself standing on a barren plateau in the Highlands of Scotland starring at the very latest advances in renewable energy generation. I'd donned my wet weather boots and jacket and strode out to meet a group of employees to talk with them about safety culture in their company. I'd been tipped off that they were on site conducting noise assessments. It's been more than a while since I'd calculated Time Weighted Daily Noise Exposures but I could just about recall the laborious task of standing at certain locations around the factory with my Noise Meter, taking samples and then meticulously noting down the decibels on a scale drawing of the shopfloor layout. I can even remember helping employees put on their dosimeter badges - and pleading with them not to deliberately shout into them to artificially peak the readings.

Crossing the moorland, as I approached the dull thrumming sound of the blades, I did a double-take. Scattered around the site were several 'baby turbines'. At least that was my guess; these devices were somewhat confusing. Standing just a metre or so tall, as I got closer I could make out their tripod structures, each one topped by either what looked like a colourful satellite dish, or with a latticework reminiscent of the wireframe of a naked umbrella.

It transpires that new technologies for measuring noise have been developed in recent years. Instead of those familiar handheld block-and-microphone systems of my past, I was facing a modular system of acoustic cameras.

Conducting noise assessments on complex plant such as a wind turbine isn't straightforward. Using traditional technology to measure noise from a wind turbine requires data sampling from a wide range of measurement points - certainly not an easy task, when you consider the size of these giant towers and rotation of their blades. Hand-held sound meters only go part of the way there and a good degree of accuracy is hard to achieve. For example, during operation wind turbines may radiate impulsive noise from the hydraulic ▸



or electrical break. There's also the challenge of measuring the efficiency of the dynamic vibration absorption panels typically installed on the gearbox to reduce noise. Neither are easy places to reach. Acoustic cameras however solve the challenge of getting a traditional noise meter close to the source by pin-pointing the strongest noise source in a multisource environment, and you can do the same analysis for single frequencies, octave bands or in a specific frequency range. Pioneered in 2001, I missed their arrival, but in less than two decades acoustic cameras are now used in a range of industry sectors around the world and for uses as diverse as analyzing noise emissions from vehicles, plant and machinery, hand held tools, IT equipment, and much more.

Taking measurements with an acoustic camera doesn't only provide information about the noise and its composition, but also detailed data on exactly where the noise is coming from. The technicians on the moorland were able to create acoustic pictures and movies (in 2D or 3D). In real-time I was able to 'see the sound' with my own eyes as it was being generated by different parts of the turbine. Intrigued, I was guided though the software system and found it easy to use (even for a non-acoustician like myself) and noted that in addition to the improved accuracy, this method has numerous advantages. Instead of placing microphones in a machine or plant and tediously looking for noise sources, the entire object as a whole – whether a wind turbine or factory shopfloor - can be quickly and accurately assessed in only a few measurements from a range of sample points. Records of the assessment are produced instantaneously and can be stored as secure digital files indefinitely. Within minutes I was in awe as these machines accurately visualised the sound emitted by the turbines around us.

> "Acoustic cameras pin-point the strongest noise source in a multisource environment"

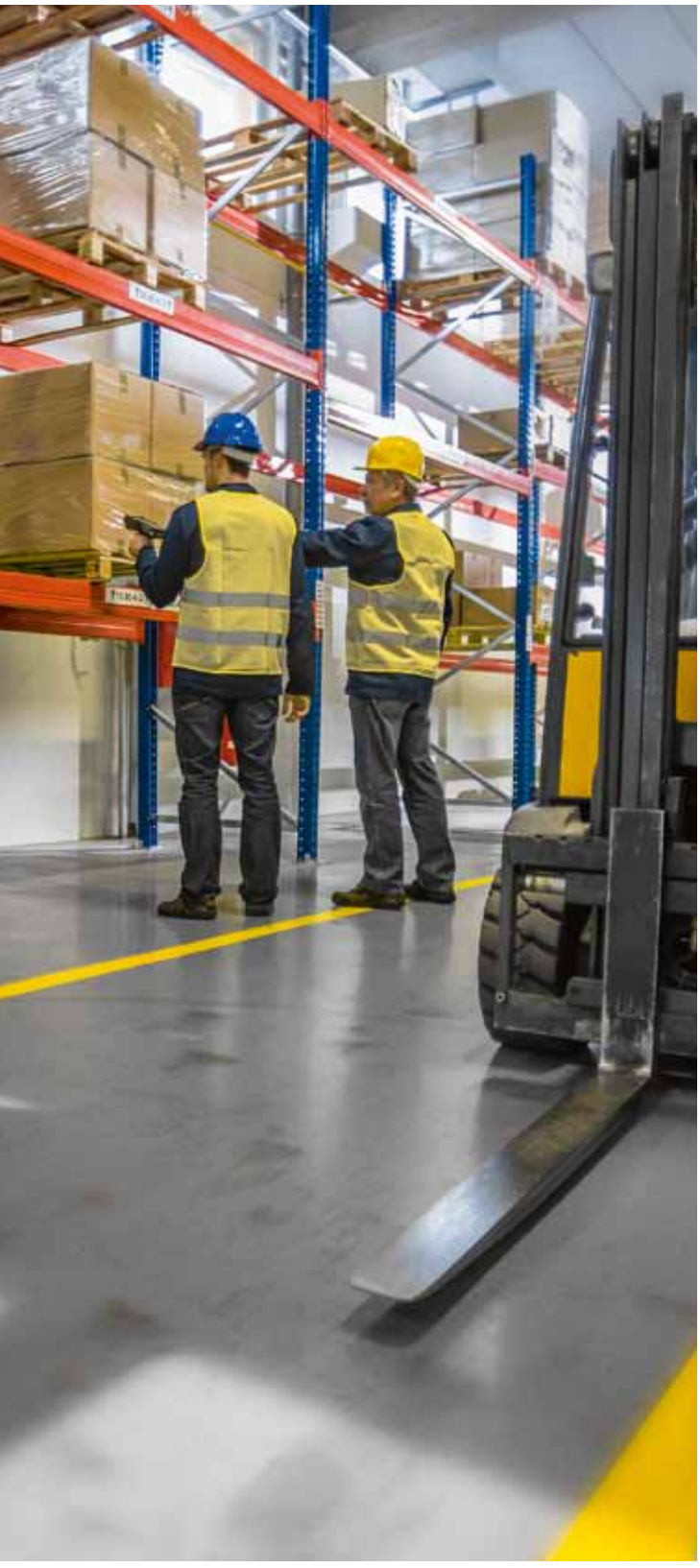
The technology revolution

As I left the Scottish moorland, my fascination with this new technology continued to play on my mind. Over the last few years new technologies have sprung in every industry sector and changed workers lives across the globe. Think for a moment on the technology that you use in your job. Gone are the days of sending hand-written faxes. The mainframe networked computer that took up more than half of your desk has been continuously replaced by smaller, sleeker laptop notebooks. The mobile phone that used to take days to charge and make your shoulder ache is now a gadget as small as your wallet, but now it packs a mighty punch – sending and receiving emails, surfing the web, holding your music collection, your diary, plane tickets, credit card details and so much more.

As a specialist in organisational culture and behaviour I couldn't help but wonder whether this technological revolution would somehow infiltrate my domain. By the time I'd reached the airport I realised that we are already using a system to assess the safety culture within an organisation that operates in a similar way that those acoustic cameras checked noise up in the hills.

The sight and sound of corporate culture

Assessing the culture of an organisation is always a fascinating exercise for me. Our clients often ask us to tell them what their safety culture 'looks like'. We use ▸



"BBS is increasingly viewed as a solution to help organisations progess in safety"

a proprietary model that we've developed over the years, and refining and evolving it into a remarkably accurate tool that gives us not only a picture, but also helps us understand what a culture sounds like too. Just like using a sound level meter, we take metaphorical 'audio samples' from around the workplace by talking with employees as individuals and in groups, with supervisors, managers and top-tier leaders too. In a similar way to the acoustic camera, we also take a 'audio-visual snapshot' of what we see going on, too, through direct real-time observations of work in progress.

We find that this combination of watching and listening provides the data needed to create a deep and rich cultural tapestry of an organisation or site, giving us a full three-dimensional picture of what things are like – in a similar way to those acoustic cameras on the Scottish moors.

Whilst we use a specific model to assess culture, there are aspects of the process that can be adopted and utilised effectively by any manager, anywhere at any time. So let's look at these individually now.

Picture this

Between the late 1950s and early 1970s the links between risk-taking behaviours, human nature and accidents were thoroughly explored by social scientists and psychologists including Burrhus Skinner, Albert Bandura and Jean Piaget. Each developed a series of experiments to demonstrate how behaviour could be observed and then shaped through feedback and the provision of positive or negative consequences. In 1978 the words 'safety' and 'behaviour' were truly connected when a fascinating study by Judith Komaki and Ken Barwick presented the results of perhaps the very first formal attempt to observe and then influence workers' behaviour around safety.

In the 1990s the concept of 'behavioural safety' was born, with several American writers including Scott Geller and Dan Petersen articulating their views on why people behave as they do with regard to safety at work. Behaviour-Based Safety (or 'BBS') considers the 'psychology of safety' and how to identify the motivation for individual risk-taking behaviours, and then making adjustments to the working environment in order to positively regulate these behaviours.

BBS is increasingly viewed as a solution to help organisations progess in safety. Having systematically worked through the Hierarchy of Controls and implemented engineering controls such as machinery guarding, and administrative measures including training and supervision, many organisations found themselves on a performance plateau and keen to revitalise their approach. Observing and moderating behaviour through BBS programmes has become a core element for many companies today. While some BBS programmes rely on a standardised observation checklist which the manager works through while watching an employee work, this doesn't always lead to positive results as the worker may feel pressured by a sense of 'big brother' watching.

Sound analysis

A useful adaptation to observation programmes is to actually engage workers in dialogue about safety matters. When we begin safety transformation programmes with our clients they frequently begin by telling us that managers aren't really sure what to say when it comes to asking ▸

"listening to what's being said as well as watching what's being done, just like the acoustic camera, we get a much clearer 3D picture of what's going on"

questions about safety. As we walk with them around the shop-floor all too often we hear them saying things like: "Is everything safe?", "Is there anything you need to be safe?" or "Are you working safely?"

Look back at these questions again – what do you notice? Indeed, each are 'closed questions', meaning that they can be answered simply with a single word, either 'yes' or 'no'. When a worker is asked such questions by a superior they may immediately try to respond in a way that pleases their boss, or makes their life easier, by offering the answer that they believe the supervisor wants to hear. In the example questions above, answers are often 'Yes', 'No', 'Yes'. Of course, responses depend to a large degree on the culture within the organisation. So how can we build a better culture of safety through our safety communications? We can start by asking great questions. Great questions are questions that encourage the other person to think before they respond. For example, on a safety walk around a workplace you might try the following:

"If I were working with you today, what would I need to know in order to be safe?"

"What one thing could we do to improve safety at this process line?"

"If you could do anything to improve worker safety around here, what would you do?"

"What is slow, inconvenient or uncomfortable about doing this job safely?"

"What's the most important thing to know about safety around here?"

Each of these questions encourages the other person to reflect before answering. In responding to the first question, safety is positively reinforced as the worker verbalises important aspects of their job while responses to the other questions help to develop a feeling of engagement and encourage suggestion. Key at this point is our ability to demonstrate that we are listening. Reflecting back what's been said can help here, and great follow-up questions that connect to the first information we have received are also immensely useful. You could use several of the great questions above to keep the dialogue going.

Conclusion

Burrhus Skinner (considered by many to be the Godfather of behaviouralism) talks about the importance and value of using great questions in his seminal 1974 book About Behaviourism when he suggests that "a person who has been made aware of himself by the questions he has been asked is in a better position to predict and control his own behaviour." Skinner advises that 'increased self-knowledge is shaped by society' – what he's saying here is that it's only when people become fully aware that our behaviour is important to those around us that it becomes truly important to themselves.

When we adapt our approach to observation to include really listening to what's being said as well as watching what's being done, just like the acoustic camera, we get a much clearer 3D picture of what's going on, and we are more likely to be able to identify the points that really need our focus. ■

Further Reading and Reference List

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Find out more great safety dialogue questions, and learn about safety culture, leadership and behaviour with Andrew's best-selling book entitled From Accidents to Zero. It's available to Health & Safety International readers this month with a huge 30% discount. Go to www.fromaccidentstozero.com and enter HSI30 to take advantage of this special offer.