Centre for
Construction Work Health and Safety Research

Using digital technology to share health and safety knowledge

An evaluation of the CodeSafe system

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The Centre for Construction Work Health and Safety Research provides leading-edge, applied research to the construction and property industries. Our members are able to work with organisations to analyse health and safety (WHS) performance and identify opportunities for improvement. We can develop and evaluate innovative solutions, provide specialised WHS programs or undertake other research-based consulting activities. Our work addresses real-world WHS challenges and our strong international linkages provide a global perspective to our research.

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Executive summary

This analysis of the CodeSafe system has shown significant work health and safety (WHS) benefits when compared to traditional approaches to providing WHS information to construction workers.

In particular this analysis showed the CodeSafe system

- Improved understanding of WHS processes though the use of visual communication
- Identified opportunities to improve processes, and
- Improved workers' engagement and morale.

However, it also showed that the potential may be impeded by current usage of mobile technologies on construction sites.

The benefits of visual communication and understanding how to work safely

The worker interviews revealed that visual presentation of work tasks was favoured by many workers. This reflection was echoed by managers who felt greater confidence in workers' understanding of WHS requirements.

The examples also show how visual representation is well-suited to the depiction of knowledge relating to 'know how' rather than 'know what,' making it particularly useful as a method to represent ways of working safely.

Enabling process improvements

The examples suggest that the visual aspect of the CodeSafe system is also particularly effective in creating opportunities to analyse how work is performed and developing safer and better ways of working.

Improving workers' engagement and morale

The examples show the benefits of the CodeSafe system extending beyond the development of instructional WHS videos and the delivery of these videos using Quick Response code technology. The real innovation and impact of the system lies in the social and cultural changes that can be realised through engaging workers in organisational safety improvement efforts.

Mobile technology usage

Comments made during the worker and past client interviews indicate that the use of digital video and mobile technology was a convenient way to provide instantaneous access to WHS information to workers who needed to know it. The convenience of being able to view content in the field was noted.

One limitation with the CodeSafe system was that some workers expressed reluctance to use their personal smart phones in the site environment and it was noted that older workers were less likely to want to access information in this way. For these reasons it is recommended that, prior to implementation in a workplace, workers' comfort levels in using digital and mobile technology should be assessed and sufficient support provided to workers who may not have used this technology before.

Part 1: Introduction and background

Developing WHS capability

Improving work health and safety (WHS) capability is an important objective in the *Australian Work Health and Safety Strategy 2012-2022*. It is imperative that workers are provided with the knowledge, skills and abilities they need to perform work safely (Safe Work Australia 2012). However, research demonstrates that conventional WHS training methods are not particularly effective in the construction industry.

This may be partly because construction workers have relatively low levels of educational attainment and literacy compared to workers in other sectors (Loosemore & Andonakis, 2007). Language barriers to the effective communication of WHS information have also been observed as increasing numbers of migrant workers are employed in the construction industry (Bust et al., 2008; Loosemore & Lee, 2002). WHS regulators have long acknowledged the need to provide WHS information in languages other than English.[1]

Some researchers also advocate the provision of WHS information using audio-visual narratives (Bust et al. 2008) and multi-media as forms of communication (Loosemore & Andonakis, 2007).

Gaming and other IT-enabled communication approaches

The provision of critical WHS information in visual form is an effective way to ensure that important knowledge is understood by workers whose levels of language and literacy may be low and various forms of multi-media and digital technology have been advocated. For example, Saidi et al. (2002) proposed providing handheld computers (HHC) for construction field workers to improve the accuracy and timeliness of information flows. Bowden et al. (2006) also proposed using mobile technology to provide training via video conferencing applications on workers' smart phones. More recently, the use of computer gaming has been investigated to determine its effectiveness in providing WHS information to construction workers (see for example, Liaw et al., 2012 and Greuter et al., 2012).

Given the increasing popularity of smart phones, the provision of information using Quick Response (QR) codes is increasingly prevalent. In several instances, QR codes have been used to support learning and teaching activities, though not typically in an industrial context. For example, Liu et al. (2010) developed a QR code and handheld augmented reality supported mobile learning system called the Handheld English Language Learning Organization (HELLO). The HELLO system provides learning resources and functions to facilitate English learning among undergraduate students. Bonifacio et al. (2012) created a system in which QR codes are used to teach the periodic table of the elements to blind and visually impaired students through audio description of elements. The audio periodic table is proposed as a learning resource for

[1] Some Australian WHS regulator information on this issue can be found at:
http://www.worksafe.vic.gov.au/forms-and-publications/forms-and-publications/communicating-occupational-health-and-safety-across-languages-compliance-code
http://www.workcover.nsw.gov.au/__data/assets/pdf_file/0015/15324/worker-rep-participation-guide-3961.pdf

high school students and first year undergraduate students. Chaisatien & Akahori (2007) describe how QR codes displayed on posters in classrooms can support student learning. QR codes are also now used to manage student registrations in some universities (Ramsden, 2008).

Pedagogical approaches

Notwithstanding the comprehension barriers that may exist, a more fundamental reason for the low level of WHS training effectiveness may lie in the general educational approach underpinning the training. Pedagogical approaches involve an “expert” instructor transmitting knowledge to recipients. This approach may work in the education of children, but is, arguably, inappropriate and ineffective when applied to adult learning (Vella, 2002). A contrasting approach, known as andragogy, involves a trainer helping adults to learn by facilitation, rather than dictation (Wilkins, 2011).

Hale and Borys (2013) identify two different approaches to achieving workplace health and safety. Traditionally, WHS has been managed using a “top down” approach in which WHS rules are seen as static, comprehensive limits to workers’ freedom of choice. Violations of these rules are seen as negative behaviour to be suppressed. However, WHS management philosophy has shifted in recent years. The traditional “top down” approach which focused on enforcing workers’ compliance with absolute safety rules is being increasingly questioned. In contrast, a “bottom up” approach to WHS considers rules to be dynamic, and situated locally. Workers are seen as experts whose competence enables them to adapt WHS rules to suit their particular situation (Hale & Borys, 2013).

Workers as WHS experts

The construction industry is notoriously poor at applying its knowledge to improve performance (Kamara et al. 2002). Construction workers present a largely untapped source of WHS information because traditional WHS approaches have focussed on top down management control of workers (Saksvik & Quinlan, 2003). Such traditional approaches emphasise enforcing workers’ compliance with safety rules established by managers and technical specialists (Sherratt et al., 2013). There is evidence that organisations with mature cultures and high WHS standards actively seek employee participation and feedback in WHS planning, decision-making and improvement (HSE, 2005, Torner & Poussette, 2009).

Yet Ayers et al. (2013) describe how, despite a statutory requirement to consult workers, most construction organisations do not involve workers in making strategic decisions about WHS. For example, it is rare for workers to be asked to participate in the design of workplaces or systems of work.

This is a missed opportunity because workers possess a wealth of knowledge about WHS hazards associated with construction tasks and about ways to work more safely. Much of this knowledge is tacit, i.e., it is difficult to transfer to another person by means of writing it down or verbalizing it (Polanyi, 1958). This type of knowledge can be described as “know how,” rather than “know what.” For example, knowing how to use a complex piece of equipment or perform a complicated work task safely are forms of tacit knowledge. In many cases the people who possess tacit knowledge are not aware of their knowledge and do not know how valuable it could be to others. Construction workers may not appreciate the extent and value of their WHS

knowledge and are unlikely to possess the skills to easily communicate their knowledge to others. Tools that can help to unlock the tacit knowledge of workers have significant potential to improve WHS.

Understanding work in practice

Concerns have been raised about the growing proceduralization of WHS, because critical information that is needed by workers is 'buried' inside long and overly complicated documents (Bieder & Bourrier, 2013). Despite their length and complexity, formal WHS documents record 'work as imagined' by managers rather than 'work as performed' (Borys, 2012).

For example Safe Work Method Statements (SWMS), a mandatory requirement for some elements of high risk construction work, are often written by managers and supervisors with little input from workers. No matter how complicated they may be, documented work procedures can never cover all eventualities. Thus, workers' competence to perform work tasks is considerably more important than the volume and content of safety documentation.

Despite criticisms that SWMS have become overly long and complicated, Breslin (2014) presents data collected within the Australian construction industry to suggest that SWMS have a positive WHS impact. The large majority of Breslin's respondents agreed that SWMS have improved WHS standards in the construction industry and workers' competencies and that SWMS are key to controlling WHS risk. Very few respondents disagreed with statements about the benefits of principal contractors reviewing sub-contractors SWMS or felt that too much time was spent in the process of reviewing SWMS. However, the majority of respondents also agreed that involving workers in the development of SWMS increased the likelihood of compliance with them.

There is ongoing debate in the construction industry about SWMS. The current CodeSafe research was outside this debate. However, the results do suggest that visual means of making WHS information accessible to workers in a format that they can easily comprehend is important. Thus, the CodeSafe system can be seen as an approach that can augment or supplement the role of WHS procedure documents, including SWMS.

From enforcement to engagement in WHS

Recent developments have emphasised the benefits associated with engaging workers in WHS improvement processes. Changes to WHS legislation in Australia have increased the prominence of consultation with workers in the control of workplace hazards (Safe Work Australia, 2011).

Integral to a worker engagement approach is the belief that treating workers with respect and providing them with input into decisions that affect them will produce better workplace WHS outcomes. Research shows that the way in which WHS is spoken and written about on construction sites still reflects a culture of enforcement – and not engagement (Sherratt et al. 2013). Indeed, a participatory (worker-led) approach to developing WHS capability has been found to produce demonstrably better results in terms of knowledge acquisition and injury prevention than traditional WHS training approaches (Burke et al. 2006). Thus, it is important that new ways are found to shift the construction industry's dominant discourse concerning WHS from an emphasis on enforcement to one that promotes engagement.

The CodeSafe system

The CodeSafe system has the potential to address some of the critical challenges to the implementation of WHS in the construction industry. The system combines a systematic process for:

1. eliciting the tacit knowledge of construction workers relating to the WHS aspects of the work tasks they perform

2. engaging construction workers in scripting, acting and recording films to visually represent this tacit WHS knowledge, and

3. using Quick Response (QR) code technology to make this knowledge quickly and easily available to other workers.

The CodeSafe system uses an andragogical approach which does not dictate WHS knowledge to workers but, instead, facilitates learning based on practical experience. Workers are regarded as subject matter experts in performing their work tasks. Their tacit WHS knowledge is captured using an experiential learning model appropriate for adult education. In developing and scripting the films, workers "unpack" work sequences and identify habitual behaviours that are unspoken but critical to performing a task safely. This can also reveal gaps between "work as imagined" and "work as performed," enabling these gaps to be resolved.

The involvement of workers in writing, acting and producing films reflects an engagement, rather than an enforcement, orientation to WHS. This has the potential to improve worker motivation and ownership of organisational WHS activities. The provision of critical WHS information in visual form is also likely to be an effective way of ensuring that important knowledge is understood by workers whose levels of spoken English and English literacy may be low. Research shows that training is also more likely to be transferred into practice if the trainer is credible and the training situation closely resembles the work environment (Holton et al., 2000). Therefore, films featuring workers themselves depicting how to perform a task in a field setting may support the transfer of knowledge into practice more effectively than alternative modes of training delivery. The provision of the films via QR code technology enables workers to access WHS information quickly and easily when they need to use it – particularly when they are at the work-site.

Research aims and scope

The research aimed to investigate industry experiences of using the CodeSafe system. In particular, managers and workers' perceptions of the benefits and challenges associated with using the CodeSafe system were explored.

The research examined:

- the extent to which workers who participated in making video content engaged with the CodeSafe system
- the extent to which the CodeSafe system resulted in an improved construction process
- the extent to which managers perceived the CodeSafe system to have produced WHS benefits in their organisations, and
- the way in which workers' responded to using digital and mobile technology to access WHS information.

Methods

In-depth interviews were conducted with representatives of five organisations that have previously implemented the CodeSafe system. These organisations were engaged in water infrastructure construction and operation/maintenance activities. Case studies describing the implementation of the CodeSafe system in the organisations were documented. Interviews were also undertaken with construction workers who were involved in scripting and filming a CodeSafe video. The interviews were audio-recorded, transcribed and the thematic content analysed.

The structure of this report

The research results are presented in the remainder of this report. The report is structured as follows:

- Part Two presents a qualitative summary of the interviews conducted with past clients of CodeSafe Solutions, the developers and owners of the CodeSafe system
- Part Three presents examples of the practical use of the CodeSafe system in organisations that participated in the research. Where possible, quantitative data is presented to indicate the impact of the CodeSafe system.
- Part Four presents an ethnographic observation of the CodeSafe process of engaging with workers
- Part Five presents the thematic analysis of interviews with workers who were involved in the process of scripting and developing CodeSafe videos, and
- Part Six provides a discussion of the results and some key findings and recommendations that flow from the research.

Part 2: Past client interviews

Five interviews were held with representatives of organisations that had implemented the CodeSafe system. The interviews were audio-recorded and transcribed and subjected to thematic content analysis.

Table 2.1 illustrates the eight key themes that emerged from the interviews with past CodeSafe clients.

Table 2.1: Key themes – CodeSafe clients

Theme
Improved WHS communication and knowledge retention
Revealed opportunities for WHS improvement
Increased worker engagement
Strategic use of workers' WHS knowledge
Identified the gap between work as imagined and work as practiced
Fun to participate in and well received
Accessibility of information
Productivity and quality gains

This section will address each of the eight themes separately and, in doing so, introduces five relevant case studies that highlight and detail elements of these themes. Where possible, photos have been included in the case studies to provide a visual record of the issues that were addressed in the worksite or process, or of the safety improvements that were realised.

WHS communication and knowledge retention

Several participants described how the visual nature of CodeSafe, i.e., filming workers undertaking tasks safely, was a more effective way of communicating WHS information to construction workers than relying on traditional ways of communicating procedures - using written documents and manuals. A Project Manager who had experience of the CodeSafe system commented "*the guys are often in a trade because the written word is not their specialty and it's more seeing and doing, it's more visual. I think in the industry we have to become more visual in communication.*" He described how his organisation used CodeSafe "*to bring to life some of our procedures and processes….we quickly saw the benefit in having the visual aspect brought to life.*"

Another WHS Manager whose company has utilised the CodeSafe system reiterated this point, remarking that workers in her industry sector "*don't like to read and write*" but "*for some reason they don't mind handling a script [because] they understand, they've seen the filming done onsite, they've seen how it all works.*" She described how the visual nature of the CodeSafe-produced videos provides workers with "*the stuff they need out onsite. You're not talking about the Regs and the Acts, it's not about that. It's about just what you really need to know while you're out there on the site.*"

This WHS Manager also described how the system increases workers' ability to retain and recall important WHS information. In particular, she described how the State Manager of her business telephoned a number of contracted workers to ask them whether they remembered the content of the company's electrical isolation procedure. Having had access to the CodeSafe video depicting this procedure, the contractors replied "*you've got to be kidding, who doesn't know that*?" The WHS Manager described how some of the contractors commented that "*just looking at the code now prompts or triggers what's in the video*."

The same WHS Manager also described how the CodeSafe system had been instrumental in enabling her company to communicate important WHS information upwards in the supply chain to educate their own clients about the importance of safe work practices. As the organisation is engaged by builders to install insulation, the worksites at which they operate are not under their control, but are controlled by principal contractors or builders. Electrical safety is one of the most significant issues faced by the company's workforce. The WHS Manager described how the situation in relation to electrical safety was "*untenable*" before the CodeSafe system was introduced. She described how "*a situation had developed out on site where it had become a gentleman's agreement between the trades and ourselves 'okay you need power so we won't isolate because of the inconvenience that it would cause out on job sites'. Rather than challenge the status quo, that situation had become expected*."

According to this WHS Manager, a CodeSafe video made about electrical isolation prior to installing insulation "*empowered the guys to understand the risks and be able to communicate them and also have that position brought to builders [their clients] in a way that they can see it and understand it immediately*." She described how the CodeSafe videos produced much needed "*cultural change*" among her company's clients. In particular, the WHS Manager described electrical isolation as a contentious issue with some builders even threatening to terminate her organisation's contract when they learned that the installation workers worked to a strict electrical isolation procedure. The WHS Manager described this as a "knee jerk reaction" but explained how "*with the video we can actually show [the builders] and they get the reasoning behind it, the justification behind it and the simplicity of the [isolation] process.*"

Revealed opportunities for WHS improvements

The interviews revealed how filming and reviewing the footage of workers undertaking work tasks and processes enabled a number of WHS issues, that were hitherto unrecognised, to be identified and resolved. Example 1 below illustrates how, in the process of filming and producing a video depicting the erection of a mobile tower scaffold, it became apparent that workers were exposed to a fall hazard. This hazard was present in the standard erection process for the tower scaffolds but, because the period of time for which workers were at risk was relatively brief, the

hazard had been accepted as part of the erection process. The issue was identified during the production of the CodeSafe video and this enabled a solution to be found and recorded. This improvement opportunity would have been difficult to identify by referring to documented erection procedures and would probably not have been identified were it not for the opportunity to watch and analyse the video-recorded erection process.

Example 1: mobile scaffold erection sequence

A CodeSafe video was made about how to erect a mobile tower scaffold. The scaffold supplier and work crew were involved in making the video. They filmed the construction method for the mobile scaffold and took the video back to the site office to review it. While watching and reviewing the footage, the project team identified a period of time during which workers' erecting the scaffold tower had no fall protection. As one Manager described "*there was just one phase, for 30 seconds, where they were unprotected and I said 'I'm sure we can do something different'…so we went back out to the worksite with the crew, the supplier and he showed the crew the issues and said 'how do you reckon we fix it?*'" The crew spent several hours trying different erection processes and procedures and eventually worked out a new method for erecting the scaffold tower without having the window of exposure to the risk of falling from an unprotected edge. The Manager commented: "*the previous way of building [the scaffold] had been custom and practice for decades…no one had sort of thought twice about it but once you saw it on the screen it didn't look quite right…and we just got the guys who had been doing it for years to try and find a way to fix it and in the end they did."*

The following images 1-5 depict the erection of the scaffold before the CodeSafe video was viewed, and the new process that was designed in responses to the video. Images 1 & 2 clearly show the worker in the scaffold with the unprotected side, where images 3-5 show the scaffolding being erected with the revised methodology, and the worker now working within in a side structure at all times.

Images 1 and 2: erection of scaffolding showing the unprotected edge

Images 3, 4 and 5: erection of the scaffold showing the alternative erection sequence

In order to provide more detail around the differences between the two erection methodologies, Table 2.2 details the steps involved in the tower scaffold erection 'before' and 'after' the introduction of the CodeSafe system. In this table, Steps 1-3 remained unchanged; it is in step 4 that the new methodology becomes apparent showing how to move safely through the different levels.

Table 2.2: Before and after scaffold erection methodology

Before introduction of the CodeSafe system	After introduction of the CodeSafe system
STEP 1: Fit the castors to the extension frames and lock them. Fit horizontal brace to the end frame.	STEP 1: Fit the castors to the extension frames and lock them. Fit horizontal brace to the end frame.
STEP 2: Fit the end of the brace to the second brace frame. Attach the second horizontal brace to the other side of the frames. Fit the plan brace diagonally on to the brace frames as low down as possible. Once these are fitted level the base frame using adjustable legs. Check with the spirit level.	STEP 2: Fit the end of the brace to the second brace frame. Attach the second horizontal brace to the other side of the frames. Fit the plan brace diagonally on to the brace frames as low down as possible. Once these are fitted level the base frame using adjustable legs. Check with the spirit level.
STEP 3: Attach the forward diagonal braces.	STEP 3: Attach the forward diagonal braces.

STEP 4: Fit mid-range platforms as needed. To increase the height of the scaffold (unprotected live edge), insert extra frames on to the top of the base unit. Depending on the width of the tower, you may need to fit outriggers if it is not tied off to a stable structure.	STEP 4: First fit the yellow horizontal braces to act as a handrail. Then fit a temporary mid-range platform as needed to enable the addition of extra frames to be done in the safest manner. To increase the height of the scaffold, insert extra frames on to the top of the base unit. Attach the four horizontal braces at required handrail height followed by the blue diagonal braces. Now remove the temporary handrail and platform and install the full platform level at the desired height. Make sure the platform is fitted correctly with the trapdoor opening to the outside. Now go-ahead and fit the ladder and braces to secure it properly. You can now access that level safely. To increase height, install further temporary platforms and handrail as before. Depending on the width of the tower you may need to fit outriggers if the tower is not tied off to a stable structure. Once you have reached your work height, fit the plain platform first, then the trapdoor platform with the hinges of the door to the outside of the tower.
STEP 5: Once you have reached your work height, fit the plain platform first, then the trapdoor platform with the hinges of the door to the outside of the tower. Fit the guardrail extension (unprotected live edge) in to the top of the last rail. Then attach two braces to the top rung and two to the mid rails. A diagonal brace is then fitted to make the scaffold more rigid.	STEP 5: To complete the work platform, fit the toeboards making sure that the trapdoor opens freely.
STEP 6: To complete the work platform, fit the toeboards making sure that the trapdoor opens freely. Finally, attach the single industrial grade ladder through the trapdoor platform to the hooks on the top rung. The ladder should extend 900mm above the platform. The bottom of the ladder should then be secured to the base rail.	STEP 6: Finally, attach the single industrial grade ladder through the trapdoor platform to the hooks on the top rung. The ladder should extend 900mm above the platform. The bottom of the ladder should then be secured to the base rail.

The identification of safety issues inherent in organisations' standard operating procedures was a recurrent theme in the data that was collected from the interviews. The second example below illustrates how, through watching video footage of a hazardous work task undertaken from a barge in an aerated sewerage channel, a new and safer access system was designed.

Example 2: Working above an aerated sewerage channel

Workers were coating concrete sewerage channels with epoxy to prevent corrosion. The task was very dangerous because the channels contain aerated liquid. A fatality had occurred six months prior to the operation at another facility when a worker fell through a dislodged cover into an aerated channel and drowned. The prosecutor in that case commented that if someone were to fall into a channel like this it is almost certain they would drown.

In order to apply the epoxy to the channel beams, work was performed from a barge. The operation for accessing the barge safely was scripted and filmed as part of the CodeSafe implementation at the site. The Project Manager described how in "*even just a little thing, how they hooked themselves onto the safety line we identified there was a little gap. Like, there was virtually a 10 second gap [during which time] they weren't hooked on.*"

The Project Manager described how the problem inherent in the process of entering the barge became apparent "*only when they acted it out that they were conscious of 'hang on, because you have to actually undo [the harness] from the side and attach it to the base of the boat'*" there was a period of time during which the workers had no protection against falling into the sewage channel.

As a result of this observation a new work process was developed in which multiple connection points were utilised. This meant that workers were protected from falling into the channel at all times. The Project Manager commented "*So it was only with just acting it out and the crews themselves identified it*." Image 6-10 shows this process.

Image 6: The barge

Image 7:
attach the lanyard to the inertia reel

image 8:
descend into the barge by the fixed ladder

Image 9: once in the barge detach the lanyard from the inertia reel

Image 10: reattach lanyard to the barge's centre safety bar

Increased worker engagement

Users of the CodeSafe system described how CodeSafe provided their workplaces with much more than an innovative use of mobile and digital technology. One Project Manager described how the CodeSafe system was essentially a social process and worker engagement tool. He commented "*I say to everyone that CodeSafe is more than just a funny sort of digital pixelated marker and just being able to view a video off it. That's not the value of it, you've got to have it embedded in a broader program in a genuine attempt to bring workers' input and involvement*."

All of the previous clients described how workers' became engaged in WHS activities through the CodeSafe system. One commented *"…so yeah, it was that whole engagement. If you're getting them [the workers] to do it, if you make it a bit of fun, don't make it too serious, and they muck around a bit because they all don't like the initial thought of doing a video, it doesn't enthral them but then they got into it and saw the benefits*."

"*one of the benefits we saw in the system was it allowed us to build great engagement with the workforce….*"

One WHS Manager whose company uses the CodeSafe system described how the increased worker engagement produced by the CodeSafe system "*has actually translated in our performance results*." In this organisation, workers have developed a strong sense of

involvement in WHS through the system. This involvement is reflected in the way that workers interact more openly with WHS staff in the corporate office than they did previously. The WHS Manager commented "*there was no way you could get the operations guys to come in the office because they thought they were going to be, yeah, performance managed…and now they're coming in quite freely and making a point of dropping by in here so it's good*." In this company, the WHS Manager described how they "*had 100% turn up for the end of year barbeque and they all wanted to see the… video, and that's never happened before*."

The interviews suggest that the engagement with the workforce has been instrumental in improving the flow of communication and building trust between workers and managers in workplaces in which the CodeSafe system has been implemented. The WHS Manager interviewed in the insulation installation company commented "*The camaraderie is great, which opens up free thinking and free speech and things come forward. When you ask their [the workers'] opinion, they feel valued."*

Strategic use of workers' WHS knowledge

One Project Manager described how the CodeSafe system was initially used at his workplace to provide instructional material to workers. However, he described how this usage evolved to develop WHS materials based on workers' involvement and experience. Workers' participation in the development of the CodeSafe video content became an essential part of the implementation process and "unlocked" a great deal of valuable WHS knowledge that may otherwise not have been accessed.

The Project Manager described how *"[the] crews themselves were the film crew and we had them act out their safe work method statement, actually role play that out and train them and supervise [them] how to use the cameras.*" The benefits associated with workers' active involvement in making WHS videos were described by this Manager as follows: *"the benefit is [in] getting the guys' input… making them act it out rather than sitting in a crib shed half asleep in the morning…that's a much more powerful engagement mechanism."*

The previous clients of CodeSafe commented that the participatory process of seeking workers' input and involvement in making the WHS videos encouraged workers to make suggestions about how WHS could be improved in their workplaces. One WHS Manager commented "*They're not afraid to bring forward their ideas because they think everything's going to be considered*."

The interviews revealed several examples of suggestions made by workers about how to improve or add to the content of WHS procedures to be enacted out and captured using the CodeSafe system in their workplaces. In particular, workers' involvement in the developing of visual procedures provided workers with an opportunity to improve and contribute to the design of work processes. One WHS Manager described workers' antipathy to written WHS procedure documents that are often developed without workers' input. She contrasted this with participatory development of the CodeSafe visual WHS procedures, saying "*They [the workers] can see that it's not fixed in concrete. They have an ability to improve it and contribute to it and it's made up of what comes from them*."

In one example, workers suggested the addition of a reminder to eat hydrating food in a video depicting safe ways of working in hot weather (see Example 3 below).

Example 3: workers' suggestions for practical WHS information

During the scripting and development of a CodeSafe video about working safely in the heat, the WHS Manager of a construction firm sent the script to the Queensland division of her company. Although the pilot video was being made in Victoria, the Queensland division made the suggestion that the video should include advice about the benefits of eating hydrating food. The WHS Manager commented "*everyone talks about hydration but no-one talks about hydrating food and when you lose your appetite and don't eat [this] can add to your fatigue*." The video was amended to include the slogan "rehydrate and refuel." The WHS Manager described the production of the video that involved filming a portable insulated container containing hydrating food and a scene of one of the workers taking a rest break, opening up the container and eating some pineapple. Advice relating to the consumption of hydrating food is now included in the company's work method statements and also in the video.

The interviewees also identified examples of workers' suggestions for ways that the CodeSafe system could be used effectively. For example, one commented: *"a great innovation was suggested by one of the work crews. He suggested 'oh why don't you put all your emergency contacts on the front gate so as you can come in the gate anyone can scan the code' then you've automatically got all the faces and numbers of the first aiders and emergency contacts so if you ever needed it you knew… because a lot of subbies go in and out of multiple sites during the day."*

Several past clients commented that workers who were initially sceptical about the CodeSafe system had come to embrace it and *"pretty soon the guys started coming to us with ideas about more stuff we could do."*

Identifying the gap between work as imagined and work as practised

The gap between work as imagined and work as practised was often illustrated during the filming of the CodeSafe videos. One participant commented. "*During the process it's amazing how many things the crews themselves picked up… they said 'oh actually what we do in practice is not what the document says. Actually we do this*.' *So it actually I think resulted in improvements to written safe work method statements to better reflect what crews were doing*."

One example of how the CodeSafe system revealed a significant gap between work as imagined and work as practised was reported by the WHS Manager of the insulation installation company at which the CodeSafe system was implemented. This is documented in Example 4 below.

Example 4: an innovative approach to accessing ceiling spaces

One third of the residential construction installation work undertaken by the company involves accessing ceiling manholes at a height of between 2.4 and 2.7 metres from the floor.

The company has a safe operating procedure for the selection and use of ladders and working at height. It was decided that this procedure would be the subject of a CodeSafe video.

The script was developed based on the documented safe operating procedure and distributed amongst workers and management for comment. The WHS manager commented that "*no-one had*

an issue with it theoretically." However, when it came to the filming, the WHS manager describes how "*shooting it and viewing it through the camera's eye, we had to stop… the camera doesn't lie*." She explained how "*To place a straight ladder at the 1:4 ratio just doesn't work, you can't get a body in there as well because it blocks off the access and you have to contort yourself to actually get in [to the ceiling space]."* (See Image 11 & 12 below).

Image 11 and 12: difficulty accessing ceiling manhole using a straight ladder

The safe operating procedure requires the ladder extend 900mm beyond the "step off" point, which was almost impossible to achieve due to conduits, cables, cross beams, roof space and other obstructions. The small size of the manholes did not allow adequate entry for the ladder, the worker and the pack of insulation to be installed. The WHS Manager described the process for passing ceiling packs through the manhole. Workers used a straight ladder which meant they have to contort their bodies to manoeuvre themselves into the ceiling space, then move the ladder to get the packs in. "*It's pretty cumbersome*" she explained. If the workers used an "A-frame" ladder, "*which they do because they can't use a straight ladder,"* they are forced to step off the top rung of the A-frame into the ceiling space because it is difficult to haul their bodyweight into the ceiling space from the 2nd rung below the top plate (see image 13).

Image 13: accessing ceiling manholes using an A-frame ladder

The practical difficulties associated with following the safe operating procedure became apparent during the filming of the CodeSafe video. The filming was halted and the company embarked on a project to find an innovative industrial rated solution for accessing ceiling manholes at a height of 2.4-2.7 metres. It was a requirement that the solution should also be able to extend 900mm beyond the manhole.

As a result of this project, the WHS Manager identified a solution used in the orchard industry in New Zealand. The alternate access equipment has curved rungs which envelope the body "*so it is easy to get three points of contact and as it was originally designed for restricted space such as amongst tree branches, you don't need the 1:4 ratio lean so you can adjust its' position so it does not encroach on the manhole opening space and there is a clear shaft opening for the ceiling packs"*.

The WHS Manager describes how the same system is being engineered to be used around the frame of a house because the access equipment has adjustable stabilising legs to provide secure support on uneven ground. The system is currently undergoing a few engineering modifications following initial testing before being trialled more widely. The WHS Manager explains "*we've had to stop [the filming] while we develop this long term solution, but this is looking really good. We are leading innovation and discussion around standards for ceiling access.*" She attributes the innovation to being able to identify the access problem experienced by the insulation installers "*while filming the CodeSafe video*."

Fun to participate in and well received

Interview participants commented that workers were initially sceptical about participating in the CodeSafe video production process but soon overcame their hesitation and that workers involved in the CodeSafe implementation had fun. One organisation had recorded a series of "bloopers" and presented these at the end of year barbeque. The WHS Manager commented that showing the bloopers "*was a brilliant way of engaging workers and breaking the ice*."

A Project Manager with experience of the CodeSafe system also described how the CodeSafe system used technology to deliver WHS information "*instantaneously and discretely*" to workers. He described how "*the guys, they're all in a bit of a macho environment, they don't like to not know how to do something and so having the code they can just sort of, as they walk out of the lunchroom door, just take a scan of that and so no-one knows…they can just discretely themselves watch that and I think those subtle little things make a difference.*" He continued "*it's communicating in a way that lets the guys, rather than asking or putting up their hand in a meeting, you know, 'how do we do that again? Can you show me?' - they won't do that – so it's giving them opportunities to get the information to be safe or do the work the right way.*"

Accessibility of information

The CodeSafe clients identified increased accessibility to WHS information as a significant benefit associated with using the system. One commented "*CodeSafe allowed us to give [WHS information] instantaneous access.*"

The provision of the CodeSafe videos via QR codes that could be accessed using workers' smart phones enables the information to be provided at the point of task. Thus, one organisation placed QR code stickers on electrical isolation kits, on the inside door of vehicles and on ladders and other equipment. As the WHS Manager commented "*We're always thinking of accessibility of information because if you go and ask a guy for the Safe Operating Procedure for whatever process they've got a folder somewhere in the back amongst all the other stuff and when you watch them try to retrieve it, it's painful. This way, it [the information] is where it's needed*."

It is useful to note that although accessibility if video-based information was a major benefit, technological limitations were mentioned elsewhere as a potential problem.

Productivity and quality gains

Several examples were provided by interviewees about how the CodeSafe system had contributed significantly to improving productivity and/or quality performance at their worksites For example, at one site, maintenance logs on items of plant and machinery were made accessible using QR codes. This ensured that it could very quickly be verified at each site, that an item of plant had been properly maintained and checked before it was put into operation. Prior to using QR codes, the Manager explained "*it was always a source of delay. We'd be waiting to get a bit of equipment or a crane or excavator into operation and there's some documentation missing or there wasn't somebody around so that was very useful*."

The last example (Example 5) details a visual procedure that had been frustrating workers for some time. The new procedure showed how the task could be done with just one worker and in a shorter timeframe.

Example 5: improving quality and productivity by developing a visual procedure for a pipe jointing detail

One participant described a particular pipe jointing detail in which a rubber end joint needed to be fitted in a particular way. "*None of the subbies could get it right, so we thought we'd put that on a code and put it on a number of the pipes so they could watch a little two minute video of how to get these rubber end joints on…. so it was a quality issue so we don't have leakages in the future and problems and delays.*" Workers had previously found it extremely difficult to install the "Sintajoint" rubber seal and typically this job was performed by two people.

The video showed the practical technique by which the rubber joint could be installed by one person quickly and correctly. The video demonstrated the easy and simple way to install the joint and provided clear visual instructions for those workers attempting this task for the first time. As a result of the video, workers' confidence, productivity and quality of work was substantially improved.

Image 14-17 shows the correct technique for fitting the rubber joint.

Image 14: preparation

Image 15: placement

Image 16: place the knee

Image 17: push, compress and snap

Part 3: Case studies of organisational use and impact of the CodeSafe system

This section of the report presents case studies of organisations that have implemented the CodeSafe system to address a specific identified WHS challenge. Where possible, quantitative data is provided to indicate the use and/or impact of the CodeSafe system in these organisations.

For each case, the following information is provided:

- The WHS problem/challenge addressed, and
- The WHS change/improvement effected by the CodeSafe system.

Organisation A

What was the problem/challenge?

Organisation A is a pipeline constructor in Australia. Its operations include the engineering, procurement, construction, and maintenance of pipelines Two years prior to introducing the CodeSafe system, Organisation A reported two high potential near miss incidents related to the use of pipelaying machinery. In the subsequent investigation of one of the incidents, it became apparent that the required daily pre-start inspection of the pipelaying equipment was not always completed as thoroughly as required. The investigation found that, in some cases, the inspections failed to identify when a pipelayer was not safe for use because written documents about what to look for in the pre-start inspection were not very clear.

What was the change/improvement?

Organisation A realised they had to improve the way pre-start inspections were performed for this high-risk piece of equipment. They engaged CodeSafe to create a video to provide information about how to undertake a pre-start inspection of pipelaying machinery. This was one of 23 videos created for Organisation A using the CodeSafe system. Organisation A's corporate Health, Safety, Environment and Quality (HSEQ) Manager believes that using CodeSafe improved the safety learning experience and standards throughout the company, commenting:

"Educating our workers using procedural videos accessed using quick response scan codes is a breakthrough initiative to improve health & safety, quality, productivity and sustainability throughout our business".[2]

As a result of the CodeSafe implementation, Organisation A won the International Pipe Line & Offshore Contractors Association (IPLOCA) Health and Safety Award in 2013.

[2] Quotation included in the submission for the 2013 International Pipe Line & Offshore Contractors Association (IPLOCA) Health and Safety Award.

In the award submission, Organisation A's Human Resources Manager also explained the significant impact the CodeSafe initiative has had within the company:

"Remote working environments provide their unique challenges to building capability. [The] CodeSafe initiative provides us with the ability to simultaneously build knowledge and emphasise safety by providing visual information of safe working procedures in a format that our people can use immediately. It's brilliant and we intend to use it extensively throughout the business. The application of this technology is limitless, and I see value in implementing it not only on projects but within the corporate offices."

Organisation A reports that it has achieved improved safety awareness and behavior, better communication between the office and the field, a stronger safety culture, improved worker engagement with WHS procedures and a reduced injury rate as a result of using the CodeSafe system.

Organisation B

What was the problem/challenge?

Organisation B was an alliance between a government-owned statutory water authority, a major construction company, a commercial landscaping company and a consulting company. Organisation B was responsible for designing and delivering waterways and undertaking quality improvement projects for the management of storm water.

Ankle injuries had become a serious concern to Organisation B. Three lost time injuries had occurred due to ankle injuries in a twelve month period, two of which required surgical treatment. However, the physical work environment was difficult to control. Workers were required to work in an inherently challenging topographical work environment in which they were routinely exposed to hazards, such as unpredictable weather conditions, rabbit burrows hidden in undergrowth and the natural bushland environment.

What was the change/improvement?

Organisation B engaged CodeSafe in 2013 to achieve a more engaging and efficient communication approach for their WHS procedures. Through a number of consultative workshops with the workforce, the hazardous nature of work was understood. A physiotherapist and a WorkSafe Victoria ergonomics specialist were engaged to contribute to the development of the improved WHS procedures, which included important information about manual handling, chemical safety and equipment maintenance. However, importantly, the video also contained information about stretching and strengthening exercises to assist workers to work safely in demanding physical environments.

The CodeSafe videos were routinely shared with workers via smart phones at Organisation B's toolbox and prestart meetings. The QR Codes which linked to the videos were also posted in and around Organisation B's worksites and on critical equipment to ensure the information could be accessed easily when needed.

With approximately 80% of the workers in Organisation B carrying their own personal smart phone, the CodeSafe system worked well. However, initial challenges observed by Organisation B were that mobile network coverage is not always adequate to view procedures in some remote locations, and workers were sometimes reluctant to use their personal mobile phones to access the material.

To overcome these challenges, Organisation B supplied the visual procedures to workers on a Universal Serial Bus (USB). The videos could then be viewed on demand on a laptop carried by Organisation B's managers/supervisors.

Organisation C

What was the problem/challenge?

Organisation C was an alliance between a major construction company, engineering design firm and a government-owned statutory water authority. Organisation C was responsible for improving, maintaining and expanding water storage systems and the distribution network for reliable and high-quality water.

Organisation C developed a cultural change program designed to encourage people at all levels within the organisation to act as drivers for improved WHS. A survey undertaken with the workforce revealed that workers preferred to receive information about WHS requirements and procedures by having these demonstrated, rather than being provided with written procedure documents or SWMSs. The organisation engaged CodeSafe Solutions to develop some visual WHS procedures as a means to communicate WHS information more effectively.

What was the change/improvement?

The CodeSafe system was used to develop a visual procedure for the use of a demolition saw. Organisation C's WHS incident data was carefully examined to identify other areas in which visual procedures could be implemented to reduce the risk of accidental injury. Organisation C developed a series of procedure-specific short videos that were made available to workers via their smart phones. These procedures included asbestos removal, dealing with chemical spills, working in a confined space, building a mobile scaffold tower, WHS aspects of electrical installations in construction, and the provision of site emergency information. All material was distributed to workers using QR codes placed on relevant equipment and in the site sheds. Social media, the organisation's intranet and USB sticks were also used to disseminate the visual procedures within Organisation C.

In 2012, Organisation C received the Australian Water Association Water Industry Safety Excellence Award. The award submission described the positive feedback received from field-based workers about the visual procedures.

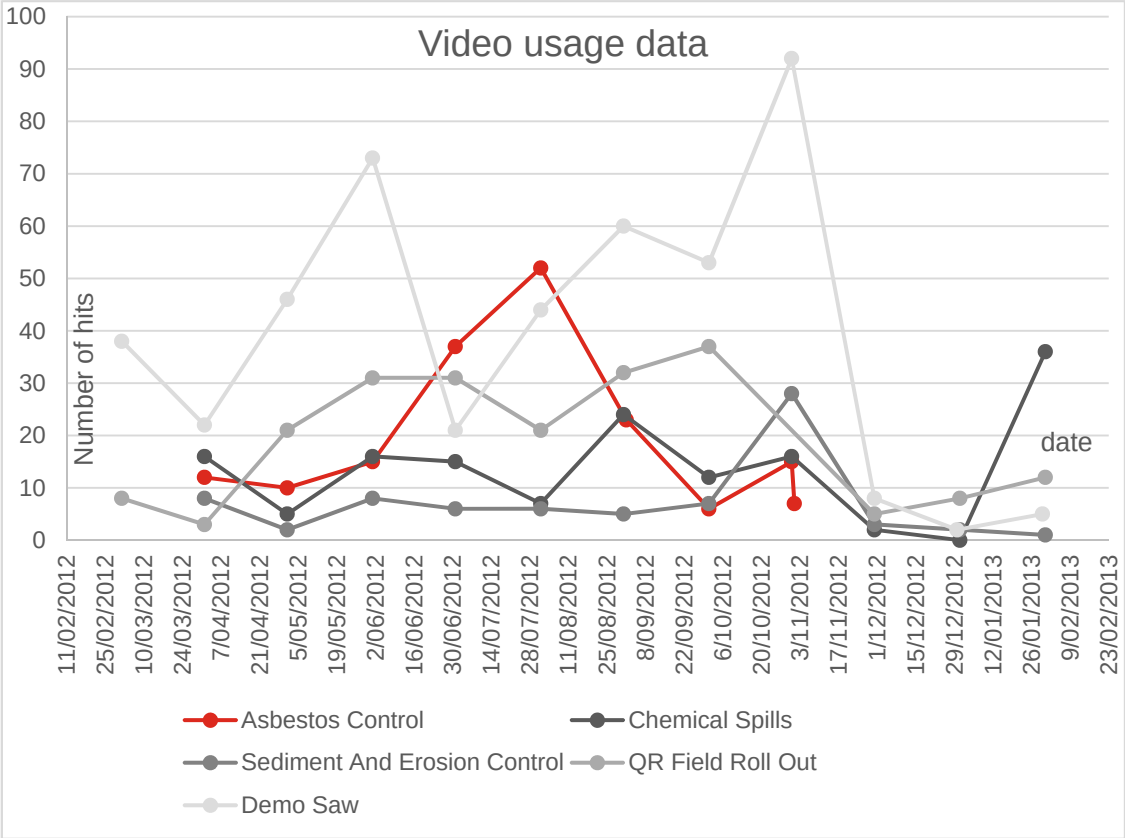

Figure 1: Video usage data in Organisation C

Figure 1 shows the number of times each of the visual procedures video was viewed to completion using a mobile device via scanned QR Codes during the implementation period. It is noteworthy that video usage fluctuated over time and some videos were viewed more frequently than others. Reasons for this are unclear. The peak usage of the demolition saw video in November 2012 coincides with the receipt of the Australian Water Association Water Industry Safety Excellence Award which may have prompted renewed interest in the video.

In a post-implementation survey of workers at Organisation C, 56.7% of respondents indicated that the QR Codes and videos better helped them to understand the organisation's safety procedures and 85% believed that the use of QR codes to provide WHS information had direct relevance to their work.

Organisation D
What was the problem/challenge?

Organisation D is an Australian company which provides insulation and energy efficiency products for the residential and commercial building sectors. After reviewing organisational and industry incident data, Organisation D identified the top risk areas that had the potential to cause a workplace fatality. These areas were:

electrical safety,

working at heights,

traffic management,

mobile plant, and

working in hot conditions.

What was the change/improvement?

Organisation D used CodeSafe's consultative and collaborative approach in the development of visual procedures for electrical isolation and load restraint, trailer hitching and working in hot conditions. The system has been very well received by workers.

While it is not possible to draw any conclusions about causation, Organisation D has reported an improved WHS performance since the implementation of the CodeSafe system. Figure 2 shows the total recordable injury frequency rate (TRIFR) over a 12 months period. The figures show a steady reduction in TRIFR since the CodeSafe system was implemented at Organisation D (indicated by the green line). [3]

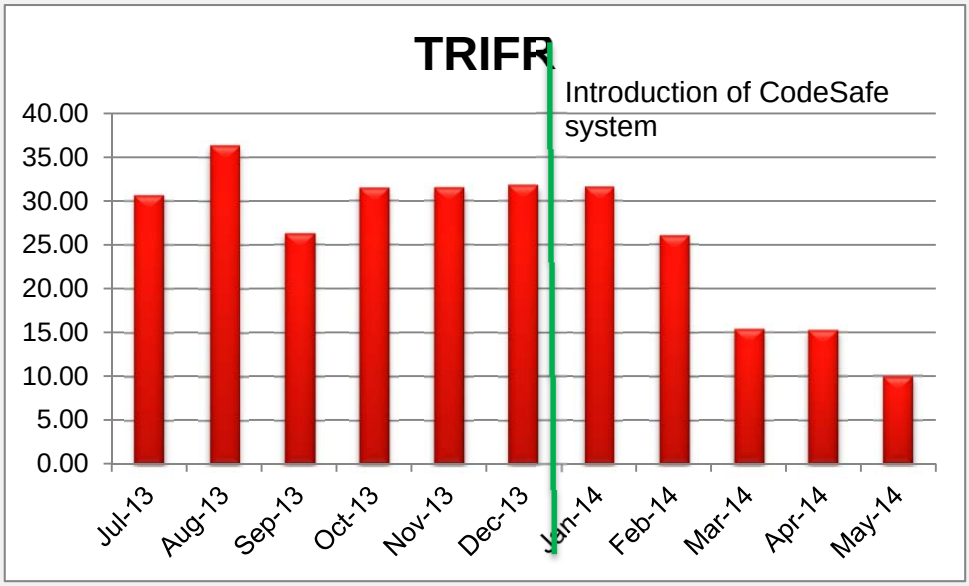

Figure 2: Total Recordable Incident Frequency Rate (TRIFR) for Organisation D per million hours worked from July 2013 to May 2014

[3] Without using a robust experimental design, it is not possible to establish a causal relationship between this reduction and the implementation of the CodeSafe system.

Part 4: Observation of the CodeSafe process

This observation piece highlights some of the benefits in the CodeSafe methodology and serves as an introduction to Part 6 of this report that presents the results of interviews conducted with workers who participated in the CodeSafe process.

This observation was drafted after spending a day on site with CodeSafe and eeFiT workers in Canberra. The eeFiT company installs insulation. This observation piece also links in with the themes that emerged as a result of interviews with workers. This part further explains CodeSafe and provides a context for the subsequent analysis of workers' engagement with the co-founder of CodeSafe, David Broadhurst, and the CodeSafe methodology.

When David talks to the workers, he speaks from a personal perspective. He looks them in the eye and talks about his time in the industry, how he once experienced a near-miss, and how this changed his approach to safety.

CodeSafe is a company that creates digital material that can be accessed through a smart phone by scanning a QR code. CodeSafe creates the material – video, online forms, photographs – and then uploads it onto a server where anyone with a QR scanner (preferably in a smart phone) can scan the codes and watch the material.

In this regard, CodeSafe is both the creator and distributor of the content. The point of difference for CodeSafe however is their method for developing the material. CodeSafe, through David Broadhurst, collaborates with workers to develop the final product – this includes scripts, storyboards, and filming. While this in itself is an effective way for the commissioning company and their workers to feel like they own the final product, the research for the script also comes from the workers. David spends time with workers enquiring about the way they do their jobs. He invites them to contribute by saying, "*Well I know you lads know the best way to do things because you're the ones doing it".*

The day starts at 6:30am at the offices of eeFiT, where most of workers (insulation installers) have gathered for breakfast and to hear from Rae Grech, eeFiT's National Safety Advisor, on several new procedures and processes. Rae is also the client of this CodeSafe project. She takes the installers through the new procedures and safety alerts, and has them sign each document to indicate that they understand the new material. She is introducing a new SOP (standard operating procedure) called **Isolate, Relocate and Identify**. This procedure should help installers work through potentially harmful hazards. A couple of years ago two workers were killed during what seemed to be a simple insulation job, when the workers cut through live electrical cables. Since that time, insulation installers in Australia have been identifying procedures to prevent a recurrence.

Isolate, Relocate and Identify is eeFiT's approach to ensure their workers understand the risk with 'live wire' so that they will never be in a situation where they are at risk of electrocution. Workers from other parts of eeFiT have come up with the phrase that is now part of a company safety video, "Don't tempt fate, always isolate". In response to this a worker, probably the oldest crewmember, commented, "*we just assume everything is live*".

At the end of Rae's presentation, she hands over to David for his introduction. There are five installers in the office this morning, with two already onsite, so David moves quickly onto the reason for his visit. The workers seem amenable but not terribly excited about what David is outlining. It is only when David starts talking about how he struggles with reading, and this has been the reason why he now works with video to detail safety processes, that some of the workers start to see the opportunities in making a video.

One of the sites we visit is a new apartment complex, where we are met by one of the installers. He tells us that he used to work in a kitchen, but moved out of that industry because he wanted to spend more time with his son, and he wanted his public holidays back. Working in kitchens involves long hours, and it is not family friendly. The worker became an installer to get a better work life balance, and it becomes evident as the day progresses that he is one of the leaders amongst the installers. He is bright, thoughtful and has life experiences.

David conducts the session at the apartment complex on an informal basis – chatting to the workers about the work they are doing today. An issue emerges almost straight away – a previous eeFiT crew had started work but not finished. The remaining work is difficult and the crew had left this type of work because it takes longer, and when you get paid by the amount of insulation installed, this reduces their daily paycheck. The current crew of three is made up of two employees and one contractor. The contractor is the only worker who is to be paid by the amount he installs, but he was able to negotiate a daily rate with eeFiT management. The result is that working on a site that requires customised installation will not financially disadvantage him (Image 18).

eeFiT will always try to be onsite prior to the installation of services as this encourages safe work practices and can save time. Being able to match the logistics with workers is a "*win/win for us*", according to Rae. She believes that "*it streamlines the process, and means the workers can make money and eeFiT can get in and out quickly before the sites become too busy or crowded with trades*". This approach is echoed by the workers who note that it is so much easier, "*if we can just get in first".*

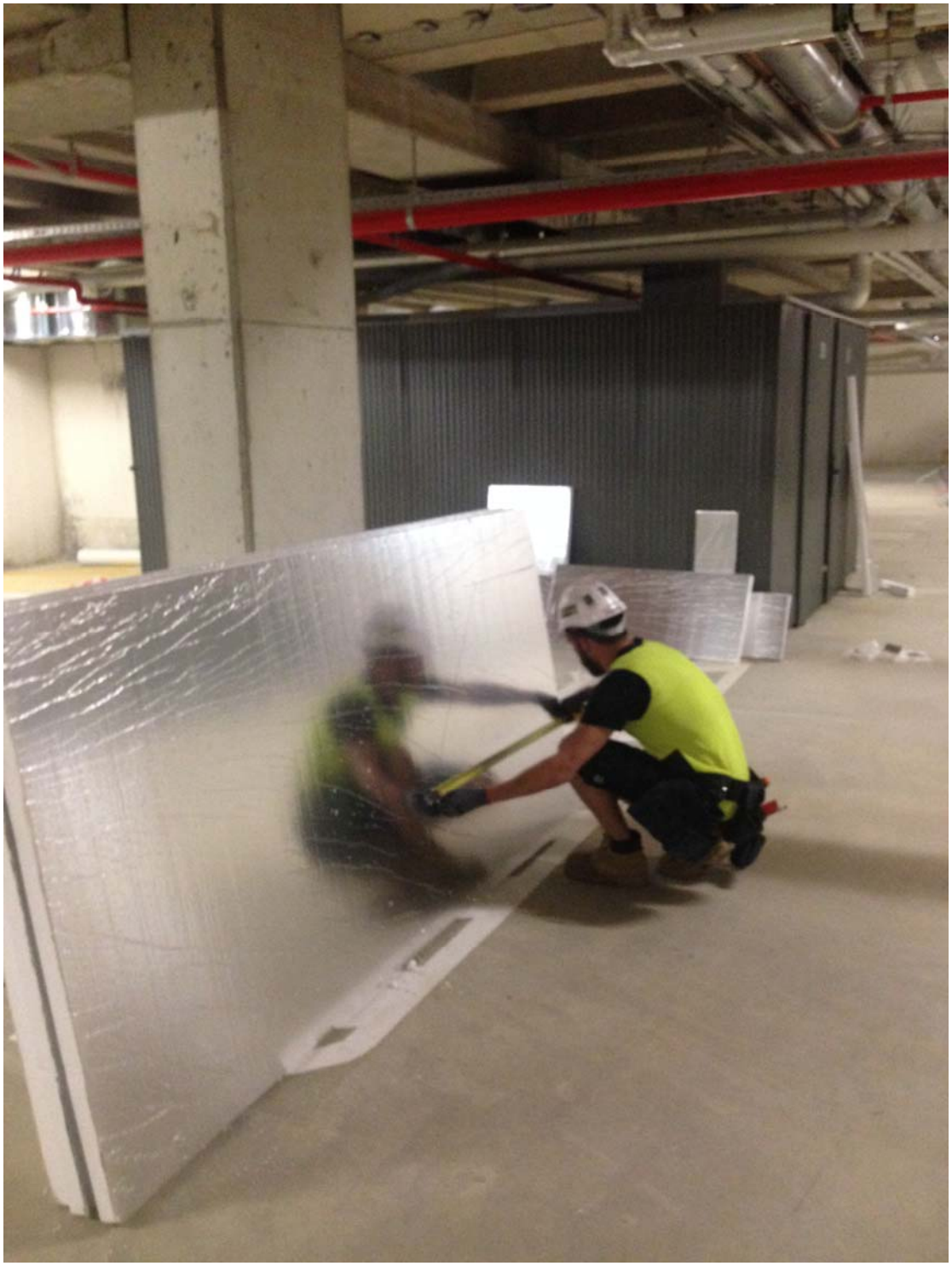

Image 18: a worker measuring insulation board in preparation for cutting to size.

Added to the bespoke approach needed for the site, the workers are installing onto a ceiling that poses several issues for them. They have arrived at the site after services have been installed - electrical, ducting, cabling - making installing the insulation sheets more complex. There are also galvanised plates sitting proud of the ceiling surface, and at regular spaces (about 300mm),

making it impossible to fit the insulation panels flush to the surface. The result is that the subsequent finished installation looks ugly and non-uniform, but also limits where the ceiling nails that hold the insulation panels in place can be positioned.

A further issue is that the worksite, an underground carpark of an apartment block, is powered. The presence of electrified (live) cabling reinforces the earlier comment of always assuming that all cables are live.

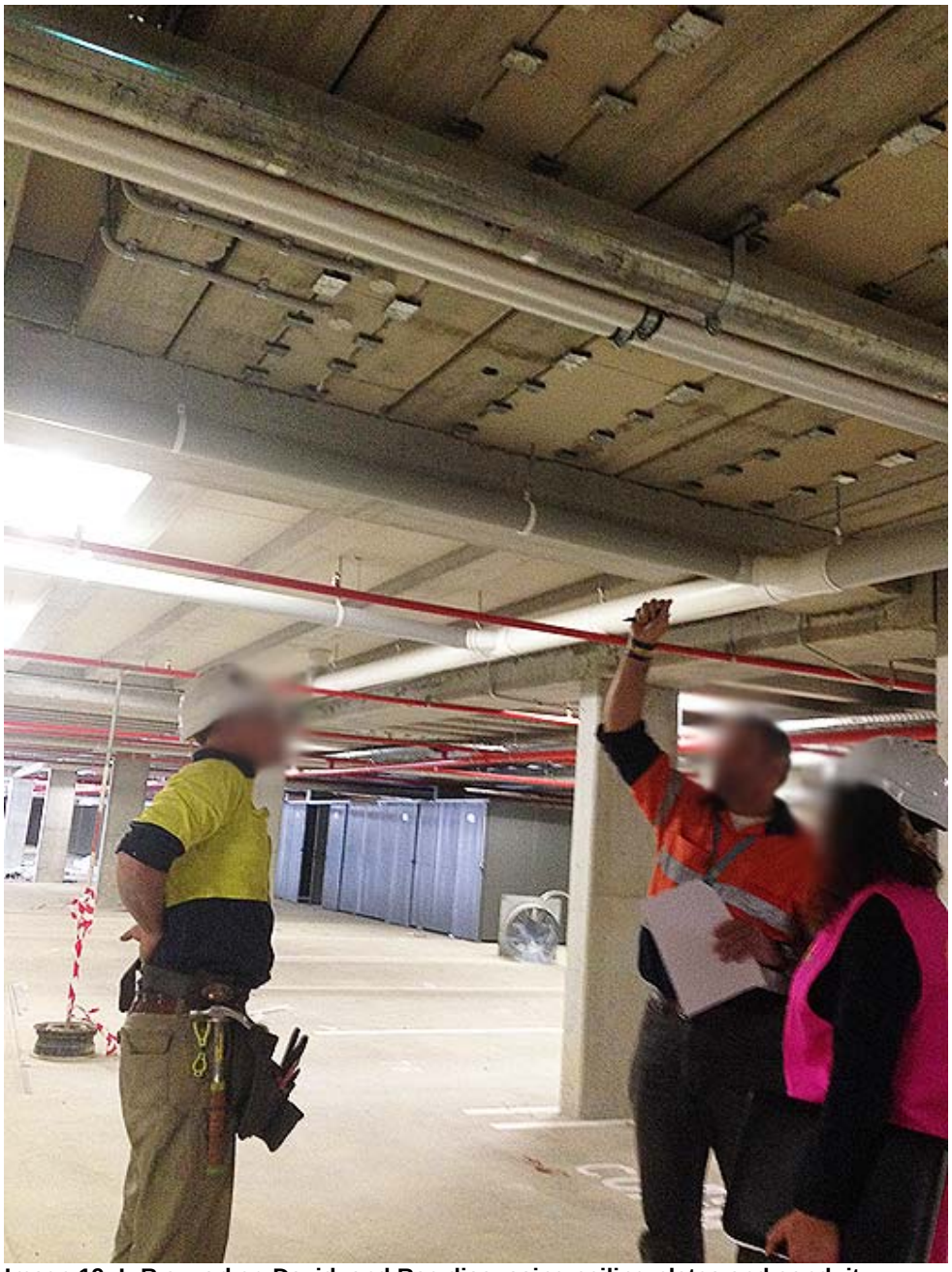

Image 19: L-R a worker, David, and Rae discussing ceiling plates and conduit

That the site has so many issues to consider is fertile ground for David's exploratory approach. He gathers the three crew members together, and while sitting on the ground, starts to talk to them about some of the challenges of installing on the site (Image 20). The workers are attentive and receptive.

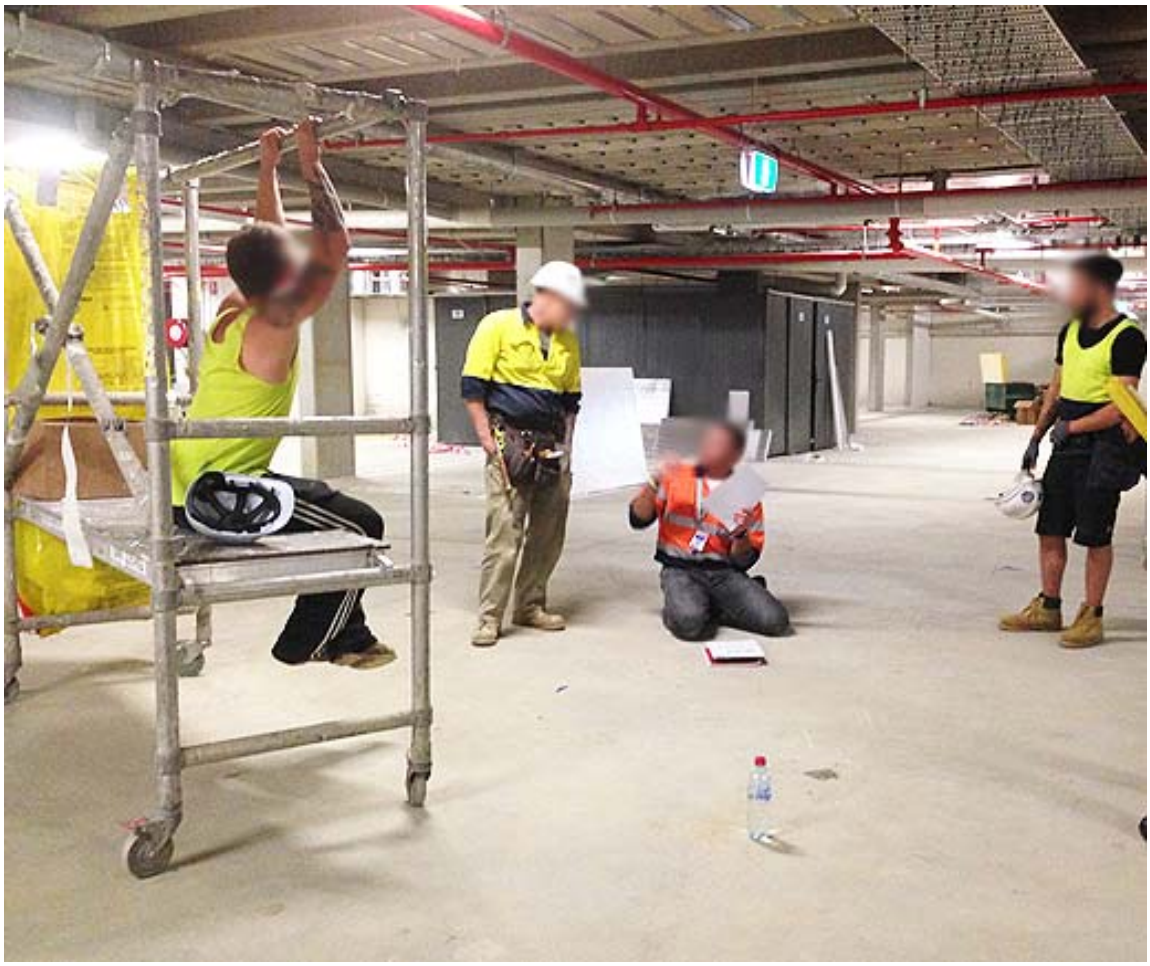

Image 20: the three workers and David – note the ceiling staples, and hanging frame for cabling – the insulation needs to be applied above the frame. Insulation boards in the background

David talks about the issues of the ceiling plates and, especially the cabling. David asks how workers know it is safe to shoot nails into the ceiling and wonders aloud if there are cables embedded in the concrete as well as attached externally. A couple of workers express surprise saying, "*if we're shooting into concrete with live wire, then you would think someone would say something, or show you a plan?"* It was later confirmed that cabling can be embedded in concrete, but in the instance of this apartment complex, it would be running top to bottom, rather than laterally.

David asked the workers about what they do if they arrive on a site that clearly has the power on, and after some discussion there is consensus that "*if you want to avoid all confusion, the best thing to do is find the foreman if you don't know what's live*". It emerged in this discussion that recently one of the workers had had problems with doing just that, because this request was made at time when the foreman and main electrical contractor were relaxing on site enjoying

Melbourne Cup day races. The contractor saw the request as inconvenient and he made his displeasure of the request known. David was able to capitalise on this anecdote to bring the group into a collective spirit about personal safety, and remaining committed to safety in the face of opposition.

Rae is also present at these discussions and mentions the SOP, in particular, the guidance material that notes installers should not shoot the nails closer than 600mm to any cabling. None of the crewmembers were aware of this and the discussion quickly turned to how to apply this on site.

This experience also demonstrated the importance and relevance of video driven instructions especially as they can be applied to SOP or SWMS. That the crew became aware of the SOP regarding 600mm standard was a good outcome of the process but also highlighted that the crew had not read this information; or if they had read it, had not retained the information.

David has a personable style to which workers relate. He speaks passionately and will often simplify his approach to draw out essential ingredients for his script. This trip to Canberra was to engage with the workers to finalise the storyboard for the shoot. David believes that videos are much more powerful, and resonate with the workers. If workers contribute to the creative process and guide the contents of the script, there is a greater ownership and understanding.

When David engages with site construction managers or safety representatives, his tact becomes more formal, but no less passionate. He reinforces his point that workers have the knowledge and expertise to show the safest way of working. He talks about how his approach can assist the older, more experienced workers to share knowledge with the younger less experienced workers, thereby helping to minimise foreseeable incidents.

Part 5: Worker interviews

Five in-depth interviews were held with a team of insulation installation workers whose organisation is implementing the CodeSafe system. Interviews were conducted as these workers were being consulted and providing feedback on the script of a video to be made about electrical isolation prior to the installation of insulation in the commercial building sector. These workers were purposefully selected because they were participating in the CodeSafe video production at the time of the interview and the intention was to gain rich insight into their experiences and responses to this process.

The interviews were audio-recorded and transcribed and subjected to thematic content analysis.

Table 5.1 illustrates the key themes that emerged from the interviews with workers who were using the CodeSafe system.

Table 5.1: Key themes - interviews

Theme
Benefits associated with visual communication
Ways of knowing about WHS
Workers' involvement and engagement
Opportunities to learn about WHS
Use of technology
Accessibility of information
Broader environmental and organisational impacts of involving workers in the CodeSafe process

Benefits associated with visual communication

All of the workers commented that capturing relevant WHS information and representing it visually was a more effective way to communicate WHS information in their work context. For example, one said: "*you see people doing it, see what has to be done or [what] you shouldn't be doing so it's better than reading*." Another commented of video: "*I think it's a better way than verbally or writtenly trying to tell someone safety methods…I think a visual is definitely the best way to get your point across*."

Several of the participants commented that workers would be more likely to engage with and understand the content of visual procedures than written procedures. In describing the potential benefits associated with visual communication the workers indicated that, while written communication can tell people what is required, visual communication actually shows them how to perform the work safely. One commented:

"*It's a lot easier to show someone what we're trying to say. We could just to sit here and verbally speak about it but if you put your verbal words into a video, people are going to sit back and go 'now I know what he's actually trying to say.'*"

He continued:

"*see how I can talk about stuff, this and that, and in your own head you'd get your own visual perception of what's meant to be going on, rather than someone actually going there, showing you, going 'okay look, I'm going to put this in between this and this and if I was to shoot a pin there'…so yeah, I reckon it's definitely a better way of getting your point across. Visually showing someone."*

The difference between knowing what (or what not) to do and knowing how to do it was reiterated by another worker who commented: "*I just think it's a lot easier to visually show that you're not to shoot a pin into this area, as to 500 words or something to describe the same thing*."

Another commented on the power of visualisation in enhancing comprehension and retention of WHS information: "*I'd soak it in a lot easier visualising and hearing as opposed to reading*."

Another commented: "*If you watch [something] that's it, that's going to be keeping in your brain. You remember more in one movie than one letter, paperwork or newspaper or whatever you read. You remember what you see."*

The construction industry context was often identified as a factor increasing the potential usefulness and impact of visual content. For example one worker commented: "*You get a lot of people, especially in the construction industry, a lot of people who sit there and don't take in what they see on paper. They're more 'hands on' like. The whole construction industry is. It's more 'hands on'*."

Another commented of video: "*I think it's the best way for people to learn. I mean, just from my point of view, being on a building site I don't read too much at all, especially when I get on site. I'm here to do a job, you know what I mean?"*

Another commented: "*from my personal experience, watching a video is a lot more effective than sitting in there reading."*

Communicating important WHS information visually was also perceived as overcoming one of the main problems with using SWMS and other written procedures that are intended to ensure workers' are appropriately informed and have received adequate instruction to perform their work safely. In particular the workers raised concerns that written information was too complex and consequently workers tend to "*skim over*" information and sign documents in order to commence work. The CodeSafe system seems to have simplified some aspects of the SWMS and other workplace documents, aiding in worker comprehension.

For example, one worker commented:

"*There's just so much information and it's just not practical to sit there for three, four hours because I'm not very good with the English language so for me to read a document like that would take me half a day and they're not going to let you sit there and do that…you're also going to embarrass yourself in a room with 20 other people…so there's pressures to sign them off*."

Another agreed that video would be more effective: "*Yeah, it's a lot easier than reading, specifically in this industry. Like I know guys only look on paper for where they have to fill some stuff in and they're not actually reading through their SWMS and stuff like that*."

Ways of knowing about WHS

Only one of the workers indicated he knew about how to do his job safely and without risk to health because he had spent time reading formal WHS procedures. He commented that "*inductions go for ages these days so you have time to read it and go through it [the method statement*]" However, he also commented that he would "*rather watch a movie than read a book*." He also acknowledged that many other people in his workplace would be more inclined to access WHS information using video and he suggested that one of the benefits of the CodeSafe system might that he and his co-workers will not "*have to worry about papers or anything*" if " *it can cut down*" on the requirements for documentation relating to WHS.

Most workers' comments indicated that the way that they knew about how to perform their work safely and without risk to their health was not through attending formal training courses or reading WHS procedures or documents but by observing and imitating those around them. One described how he knew about WHS by "*just sort of learning from the people that I was with*." Another described how "*the young learn from the old, don't they*?"

The potential limitations inherent in this informal on-the-job learning were evident when one worker described how information about the need to maintain clearance before shooting pins into masonry adjacent to conduits was discussed during the video scripting process. He commented: "*I thought it would have been something that someone would have told me in my whole learning process of being here…but it does not seem to be happening*."

However, another worker described how it is sometimes very hard for written and verbal instructions to fully capture every component of the WHS knowledge related to a task. He commented: "*We can't put everything in there [the WHS procedures] because sometimes it's something you can't write in there because it's knowing…. You can make a note but, yeah, it's hard to describe everything in words*."

This unspoken and intangible WHS knowledge is not necessarily well communicated or comprehensively learned through the informal on-the-job learning that takes place.

One worker described how the CodeSafe videos could be a powerful way to ensure that this knowledge is captured and shared. He commented:

"Yeah the video is going to help and it's clear, you show the way to do it and the way how you know how to do it and everyone will go 'oh easy'. And that's going to be more understandable than if you say something to someone, but maybe he can't understand different stuff."

Workers' involvement and engagement

A common theme in the worker interviews related to workers' engagement with the process of scripting the video. In particular, workers appreciated being involved and providing input into the content of the WHS video. When asked whether he had enjoyed himself during the scripting session, one worker responded: "*I certainly did, yeah. It's good to give people input, especially when you realise that it's going to improve something*." Another commented "*Yeah, it's good for everyone to throw their input in and you just learn a lot more about what could be done and it gets your mind thinking.*"

The workers described how they felt valued because the company had taken the time to really understand (from their perspective) the way that they work and the WHS aspects of their jobs. For example, one commented: "*It's good having a bit of a one-on-one with people who actually care about you…what could happen and possibly, you know. You can sit and have a talk with anyone, you know what I mean, like a foreman and they don't seem to really care. It's actually good to see that people actually care about people's safety and what could be the outcome of something actually happening."*

The same worker appreciated having an input into the development of the scripts, saying: "*It was good. It was actually good, you know, getting my voice heard and actually people sitting there and actually taking it in what I was saying, rather than just going over someone's head or they just turning a blind eye to it. It actually feels like something or progress can be made or people actually listened."*

Another commented*: "it's good to give people your input, especially when you realise that it's going to improve something."*

Several workers commented that the content of the videos was likely to be more appropriate and useful because workers with experience were consulted and allowed to have input into the development of the script. One worker commented: "*Yes, I think it's the best way because if [the material] is from people working on the site, it's going to be spot on. Exactly what is happening*."

Another worker, with six years of practical experience, commented "*I was [able to] pass on a few things, you know, a bit about noise so they can get it out there to everyone else*." Another worker who has extensive construction industry experience in another country also indicated he was very happy to be able to share his knowledge, commenting: "*I like they asked me because I can share what I know. It's good*."

Another worker cautioned that the usefulness of the content would depend on the people involved in the scripting and filming of the videos, suggesting the videos would be effective "*as long as you get a wide variety of opinions and sort of blend that all into one video so it can apply to all sorts of workers and sites.*"

Opportunities to learn about WHS

Several of the workers who were interviewed during the scripting of the WHS video commented that they had learned important new WHS information when reviewing and discussing the content of the video. Thus, participating in the process itself had provided an important learning opportunity for them. For example, one worker stated: "*Some things I didn't actually fully take into consideration before, got brought to my attention…so it was actually good…there was actually some points there I'm glad that got brought up and that would not normally be brought up*."

Another worker said: "*I got an email saying 'do you want to come to a breakfast meeting?' and I thought it was a good idea. He's talking about electricity and I've learned a couple of things today I didn't know."*

The same worker described how the different perspectives offered by the CodeSafe facilitator and the company's WHS Manager contributed to their knowledge and assisted them in thinking about and developing the video script:

"It's good having different points of view from people that have, you know, got different outlooks on different things…Like with guys [like us] we work on the site – and then getting like another vision from someone that's just come into it and you go 'okay, actually what about this then?' And you sit back and go 'oh actually we didn't take that into consideration.'"

For example, several of the workers described how they were previously unfamiliar with requirements to provide adequate clearance when shooting pins into masonry either side of conduits or that conduits could run vertically through a concrete slab. One commented: "*I learned that you're not to shoot a pin less than 300mmm from a live wire. Never knew that at all…and that's a big one. I also learned that conduit sometimes is running through the concrete slab. I didn't know that.*" Another also commented: "*I actually didn't know about shooting all the pins 300mm either side of the conduit. That's one of the things I didn't know personally.*" Another also said: "*Yeah, when he was talking about the wires being spread out through a slab vertically, that was new to me.*"

This was an important WHS learning raised through the script development and illustrates how the process of talking with workers about how to work safely can identify and address important knowledge gaps.

Use of technology

When asked about their use of smart phones and willingness to access the WHS videos using their phones, the responses were mixed. Some workers commented that the system would be effective because most people have smart phones and would be able and willing to access the WHS videos. One commented: "*I don't think I know anyone that doesn't have a smart phone these days. I think they have so I think it should be sweet*."

Others were more reserved. One worker commented that the willingness to use smart phones to access WHS information may depend on their age. "*It's something that's fairly new, you know. People have old habits and it's like trying to teach an old dog new tricks…for older people I don't*

think, especially on a construction site, they're not going to get their smart phones out and, look at this industry, a lot of older people don't tend to have smart phones as well."

However, the same worker believed the use of smart phone technology to provide WHS information would be very effective for younger workers: "*But for the newer generation coming into the business I think it's a perfect way. I think it's a good move forward to having safety in the comfort of your pocket pretty much to access*."

Another worker expressed the concern that a lot of people do not use smart phones at construction sites. He described how he "*had a smart phone and it got broken on a building site and they're very expensive*." He now uses a basic mobile phone and continued: "*so my only concern would be – and I know a lot of people who are the same – they don't use smart phones on construction sites because they are delicate things."*

However, the same worker described how this problem could be overcome because supervisors usually have smart phones and/or tablets could be provided for each workgroup to enable them to view WHS video content at toolbox sessions and as required.

Accessibility of information

The workers were positive about the accessibility and availability of WHS information at point of task. For example, one worker commented that although he had never considered accessing information in the field using his smart phone before: "*But it is a good way of – rather than trying to call up the office [for information] you've got it there in your pocket pretty much*." Another commented how:

"*because sometimes you're not sure, you just shoot at the phone. It's like part of you now, for everyone, so you can check every time*."

However, another worker commented on connectivity problems experienced on site as a possible limiting factor to workers being able to access CodeSafe content: "*It's a bit difficult sometimes being in this basement so you don't get any reception*." The same worker described having problems with his browser history and identified this as an impediment to using the online Job Safety Analysis (JSA) system implemented as part of the CodeSafe suite of services.

Part 6: Discussion and conclusions

The foregoing analysis reveals that the CodeSafe system has significant benefits when compared to traditional approaches to providing WHS information to construction workers.

The benefits of visual communication

The worker interviews revealed that the visual nature of presentation was favoured by many workers who, by their own admission, found written WHS policies and procedures difficult to read and comprehend. This reflection was mirrored by managers who felt greater confidence that workers were able to understand and act upon WHS information provided by organisations when it was presented in the visual CodeSafe format.

Although the CodeSafe system is unlikely to replace the established worksite WHS inductions, the videos are likely to be useful or even powerful contributions to the induction process. These videos may also be useful for WHS induction 'refreshers'.

Thus, the CodeSafe approach is likely to be useful in helping organisations satisfy their statutory obligations to provide WHS information in a format that workers find easier to understand.

Enabling process improvements

The examples suggest that the visual aspect of the CodeSafe system is also particularly effective in creating opportunities to analyse how work is performed and developing safer and better ways of working.

The CodeSafe process of engaging workers in the development of storyboards for each video, and then in filming the WHS processes provides a realistic picture of how work is performed in practice, as opposed to how it might be documented. The review stage of the video production provides a unique opportunity for collective reflection (by managers and workers) about how work is undertaken.

In the case of the scaffold erection sequence (Example 1) and access into the barge to work above aerated sewerage channel (Example 2), WHS problems in the original sequence of work only became apparent when workers and managers were reviewing the video footage. At this point they were able to recognise WHS problems associated with standard operating procedures that had hitherto not been recognised or acknowledged. The case studies suggest that the visual representation of work processes and the use of video can be a powerful tool for reassessing the WHS aspects of commonly performed construction tasks.

Posing the question, "Is there a safer way to do this?" at this review stage can challenge the operational status quo and stimulate creative thinking about how work processes can be made safer. Indeed, the CodeSafe approach to visualising and collectively reflecting on the adequacy and WHS of work processes provides a powerful tool to organisations striving for continuous improvement.

Understanding how to work safely

The examples also show how visual representation is well-suited to the depiction of knowledge relating to 'know how' rather than 'know what,' making it particularly useful as a method to represent ways of working safely. Example 4 illustrates this point where the script was correct 'in theory' yet practical challenges associated with the task of entry into a ceiling space (the 'know how') appeared during filming. The filming revealed a substantial gap between knowledge about what should be done (as documented in the safe operating procedure) and how the work was actually performed. Once this gap was understood, it could be addressed and a safer, practical and effective way of accessing ceiling spaces could be found.

Improving workers' engagement and morale

The examples show the benefits of the CodeSafe system extending beyond the development of instructional WHS videos and the delivery of these videos using Quick Response code technology. The real innovation and impact of the system lies in the social and cultural changes that can be realised through engaging workers in organisational safety improvement efforts. Rather than providing WHS information to workers (as is the case with conventional WHS training videos), the CodeSafe system develops content in collaboration with workers who represent the users of the videos. This provides access to important ideas for WHS improvement or video content that is based on experience. For example, workers who found that eating hydrating food during break time in hot conditions suggested this be included in a production on working in the heat. This shift from an enforcement to a collaborative approach to improving WHS could potentially improve morale and increase participation in WHS activities. Indeed, most of the workers who were interviewed commented that they would participate in the CodeSafe process again if the opportunity arose.

The interviews with past clients reflect the fact that workers who participate in the process generally find it to be fun. This was also reflected when observing the eeFIT workers in Canberra. Initially sceptical and embarrassed, these workers opened up to David Broadhurst (the CodeSafe founder and coach) and shared information about how they work. The interviews with these workers revealed they felt they had learned important, potentially life-saving WHS information through participating in the video development and were keen to share this learning with others. The interviews with both workers and managers highlight the significant benefits associated with engaging workers in the search for and development of safer and healthier ways to work. The benefits associated with this are immediately apparent in the WHS improvements that can be achieved through consultation and collaboration with the workforce. However, the broader environmental and organisational impacts of involving workers in the CodeSafe process also emerged as a key theme in the interviews. These benefits included improved two-way communication about WHS, increased worker involvement in WHS activities and elevated levels of trust in the organisations' WHS processes.

Mobile technology usage

Comments made during the worker and past client interviews indicate that the use of digital video and mobile technology was a convenient way to provide instantaneous access to WHS information to workers who needed to know it. The convenience of being able to view content in the field was noted.

Some also appreciated the discretion offered by the system in that they could view content privately without feeling embarrassed that they did not know something.

One limitation with the CodeSafe system was that some workers expressed reluctance to use their personal smart phones in the site environment and it was noted that older workers were less likely to want to access information in this way. For these reasons it is recommended that, prior to implementation in a workplace, workers' comfort levels in using digital and mobile technology should be assessed and sufficient support provided to workers who may not have used this technology before.

Several past clients recommended that by making the CodeSafe content available through a supervisor's work-owned smart phone or tablet was a way to ensure that everyone at a site could access the information. However, it is also noted that, as workers become more familiar with the use of this technology, and appreciate its usefulness, these barriers are likely to diminish.

Limitations and future research

The research was limited in a number of respects:

First, the sample size of the study was relatively small. Case studies were collected from organisations in specific industry sectors. The number of workers interviewed was also small and these workers all worked for a single client organisation. Thus, the findings cannot be generalised to the construction industry as a whole.

It is recommended that future research (possibly using large scale survey techniques) be undertaken to better understand the usage and WHS impact of the CodeSafe system.

Second, a very limited amount of quantitative performance data was available. It is therefore not possible to ascertain whether the use of the CodeSafe system produced an improvement in WHS performance in the organisations involved in this research (although the anecdotal accounts of managers suggested it did). Without using a robust experimental design, causal inferences cannot be made.

It is recommended that future research adopt a rigorous experimental approach to analysing the effectiveness and impact of the CodeSafe system. This research could examine the relative costs and benefits associated with using the CodeSafe system.

Finally, the focus of the research was on the CodeSafe system itself. No attempt was made to understand the social/organisational context in which the system was introduced. Several comments made by participants indicated that the CodeSafe system should be understood in the context of the broader program of WHS management, consultation and communication processes in a workplace.

It is recommended that further research be undertaken to understand the social, organisational and environmental conditions in which the CodeSafe system can be used for optimal effectiveness.

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