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Adapting to COVID-19 on construction sites: what are the lessons for long-term improvements in safety and worker effectiveness?

PLEASE CITE THE PUBLISHED VERSION

<https://doi.org/10.1108/JEDT-11-2020-0473>

PUBLISHER

Emerald Publishing Limited

VERSION

AM (Accepted Manuscript)

PUBLISHER STATEMENT

This paper was accepted for publication in the journal Journal of Engineering, Design and Technology and the definitive published version is available at <https://doi.org/10.1108/JEDT-11-2020-0473>. This author accepted manuscript is deposited under a Creative Commons Attribution Non-commercial 4.0 International (CC BY-NC) licence. This means that anyone may distribute, adapt, and build upon the work for non-commercial purposes, subject to full attribution. If you wish to use this manuscript for commercial purposes, please contact permissions@emerald.com

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REPOSITORY RECORD

Jones, Wendy, Alistair Gibb, and Vivien Chow. 2021. "Adapting to COVID-19 on Construction Sites: What Are the Lessons for Long-term Improvements in Safety and Worker Effectiveness?". Loughborough University. <https://hdl.handle.net/2134/14402342.v1>.

Adapting to COVID-19 on construction sites: what are the lessons for long term improvements in safety and worker effectiveness?

- Purpose

Substantial changes were made on many UK construction projects in response to the COVID-19 pandemic. This study explores the unanticipated positive consequences of some of these changes, and the scope for longer term learning and developments within the sector.

- Design/methodology/approach

A qualitative approach was employed using semi-structured interviews across six major project sites. Interviewees (n=33) included site and senior managers, supply chain representatives and occupational safety and health (OSH) professionals. The interviews explored their experiences of working on site during the pandemic, the changes made to work practices and their perceived impacts of these changes.

- Findings

Improved planning and work sequencing were part of the revised process to make sites COVID-secure. This increased worker effectiveness and housekeeping/tidiness. The view on some sites was that this would improve OSH performance. The changes were perceived to be beneficial but may not be accepted by clients in the long term as they could result in projects taking longer to complete. The ways in which COVID-19 risk has been communicated and perceived also provides longer-term lessons for the sector's OSH management and training.

- Originality/value

Construction has adapted rapidly and effectively to new ways of working during the pandemic. This research captured in real time some of the changes made and presents an argument for embedding and adopting the changes to improve working arrangements and OSH within the construction sector.

Keywords

COVID-19; Productivity; Construction; Safety; Health; Site Management; Client

Introduction

As the COVID-19 pandemic developed early in 2020, construction projects across the globe introduced new practices to protect the health of their workforce and reduce the spread of the virus. As measures such as social distancing, improved hygiene and the use of personal protective equipment were introduced, there were reports of projects being delayed or abandoned completely, costs rising and workers being laid off (Al-Deen Bsisu, 2020; Ogunnusi *et al.*, 2020; Osuizugbo, 2020). However, there were also reports of positive impacts from new working practices. There are, for example, accounts of enhanced use of technology (Ogunnusi *et al.*, 2020), improved productivity amongst some construction engineers (Al-Deen Bsisu, 2020) and an improvement in self-reported health for many (Recchi *et al.*, 2020).

This research explored the impact of COVID-19-led changes on construction sites in the UK. It was commissioned by a cohort of major construction companies, following anecdotal reports that some sites had experienced positive impacts. It sought to address the following questions:

- Have COVID-19-led changes affected productivity in construction?
- Have improvements in OSH management been seen?
- Are there lessons for construction OSH management?

The core research findings were initially published in an industry-facing report focusing on the practical implications for the sector (reference removed to preserve anonymity). This paper draws out further learning for the research community. Whilst acknowledging that changes during COVID-19 extended to office-based staff that moved to home working, this paper focuses on the impact of changes on construction worksites.

Literature

Construction and COVID-19

COVID-19 is a coronavirus which is spread by close contact between people: through respiratory droplets, aerosols or through contact with contaminated surfaces (WHO, 2020b). There is therefore a high potential for spread on construction projects, even where most work takes place outdoors. Large construction sites often employ several hundred workers, starting and finishing work at the same time, and using common access routes such as turnstiles, stairways, and hoists. Employees work closely together, often on sites which are physically constrained by limited space, and where multiple trades operate in a single space. Some projects involve work which is largely indoors or enclosed, particularly in the later stages of projects or where work involves refurbishment.

Guidance about COVID-19 risk management from the UK industry body, the Construction Leadership Council (CLC), was first published on the 24th March (Construction Leadership Council, 2020). This followed a nation-wide lockdown announcement on the 23rd March 2020 (Gov.uk, 2020). Residents were instructed not to leave their homes, although they were still allowed to travel to their place of employment if unable to work from home. Some construction sites closed following this announcement and remained closed for several weeks whilst they assessed the risks to their workers and put new control measures in place. Others remained open throughout, with some being criticised for remaining open but failing to manage COVID-19 risk adequately (BBC, 2020). Similar restrictions on construction were implemented in many countries, although the detail varied between them. For example, in Spain, construction work was banned completely for a period of time (EL PAÍS, 2020). In Scotland, additional rules were put in place where work was permitted to continue only where it was required to support 'essential industries' such as energy, health and defence (Gov.scot, 2020).

A key requirement for UK workplaces in March 2020 was to ensure that workers maintained a distance of two meters from their colleagues whenever possible. This was commonly referred to as 'social distancing' (although some have advocated for terms such as 'physical distancing' or 'spatial distancing' (Abel and McQueen, 2020; Aminnejad and Alikhani, 2020)). Similar rules were established in most countries, although the exact distances involved varied between one meter (as advocated by the World Health Organization, (WHO, 2020a)) and two meters. This need for distancing reduced the number of workers who could occupy a particular space and has been reported in the literature as having negative impacts on project productivity (Esa, Ibrahim and Kamal, 2020; Ogunnusi *et al.*, 2020). Worker shortages and increased costs of construction materials

(Osuizugbo, 2020) during the pandemic have also had negative consequences for projects. Accounts from multiple countries reported financial impacts, worker insecurity and job losses as a result (Al-Deen Bsisu, 2020; Brown, Brooks and Xiuwen, 2020; Esa, Ibrahim and Kamal, 2020).

Numerous reports found that worker health suffered as a consequence of COVID-19, both in construction and elsewhere (Shaukat, Ali and Razzak, 2020). Although self-reported health purportedly improved for many in the early stages of the pandemic (Recchi *et al.*, 2020), those in blue collar jobs such as construction have seen deteriorating health as well as suffering higher risks of COVID-19 infection (Amoah and Simpeh, 2020; Koh, 2020; Recchi *et al.*, 2020). Anxiety and depression were reported to be widespread as a consequence of uncertainty and worry about financial stability, personal health and family health (Newby *et al.*, 2020).

There is also evidence to suggest some positive impacts were borne as a consequence of COVID-19. Bsisu *et al.* (2020) reported that some office workers increased their work productivity, although others in the same study saw a deterioration or no change. Ogunnusi *et al.* (2020) interviewed construction engineers and found experiences of improved planning, enhanced collaboration and adoption of newer technology. Increased use of offsite construction was also reported as a positive mitigation strategy (Alenezi, 2020; Ogunnusi *et al.*, 2020). Overall, however, the limited literature relating to the impact of COVID-19 on construction draws largely negative conclusions.

Health and safety in construction pre-COVID-19

The need to manage COVID-19 risks has added to longstanding challenges in managing health and safety hazards on construction sites. UK construction has long been recognised as a high-risk industry in terms of OSH and similar challenges exist worldwide. Up to one fifth of workplace accident fatalities occur in the construction sector as reported in Europe (Eurostat, 2019), the United States (OSHA, 2017), Australia (Safe Work Australia, 2019), and South Africa (van Heerden, Musonda and Okoro, 2018).

The UK has seen substantial improvement in recent decades, with annual fatalities in the sector falling from around ten per 100,000 workers in the early 1980s to around 1.5 per 100,000 in 2008-09 (HSE, 2020). However, there has been a plateauing in these numbers since then and construction still accounts for around one quarter of workplace fatalities in the UK, despite employing less than 7% of its workforce (Rhodes, 2019). There are particular challenges in the smaller companies which employ the majority of workers (Pinder *et al.*, 2016). The management of health risks such as noise, dust, and vibration is especially problematic, because of poor knowledge, low hazard visibility and the long latency between exposure and impact (Jones *et al.*, 2019). Common health conditions such as work-related musculoskeletal conditions and stress-related ill-health are particularly prevalent in construction and extremely costly (Gibb, Drake and Jones, 2018; HSE, 2018).

Managing OSH risks has been seen as an integral and critical aspect of managing construction work for many years. The seminal construction sector report 'Constructing the Team' (Latham, 1994) recommended sharing the burden of ensuring OSH among all parties and identified the client to be of key importance in setting standards. Subsequently, 'Rethinking Construction' (Egan, 1998) advocated more and better training for worker OSH and challenged the industry to consider the wider ramifications of having a healthy workforce. In the ten years following 'Rethinking Construction', improvements have been found to be only incremental and commitments tended to be 'superficial and expedient' (Wolstenholme, 2009). Most recently, the UK government published 'Construction 2025' (HM Government, 2013), calling for reduced construction costs, faster

construction time and improved professionalism, and evidence-based and coordinated approaches to OSH. The Construction Leadership Council (CLC) was established to drive this agenda. The Considerate Constructors scheme was introduced in the UK in 1997 to improve the image of the UK construction industry and has grown in influence, albeit with some contestable benefits (Watts, Higham and Alotaibi, 2020). In summary, the last three decades has seen an increased emphasis that cultural change in the industry is necessary for individual interventions to be effective and long lasting.

Methodology

Research design

This research was designed to explore the experiences of those working in construction in the early stages of the COVID-19 pandemic. It had to be planned and undertaken in a short period of time during June and July 2020 to enable lessons learnt to be captured and fed back to organisations in real time. Participant projects were selected jointly by the funders and researchers, and were chosen to explore the scope for positive change and impact as a consequence of COVID-19. A case study approach was used, facilitating the exploration of issues surrounding a research problem in specific contexts (Creswell, J.W. and Poth, 2016). The research was done on behalf of companies which pride themselves on operating high standards of OSH and taking good care of workers, which was hoped would lead to a higher chance of capturing examples of best practice and consequent positive impact.

To facilitate rapid mobilisation under strict COVID-19 remote working guidelines, all interviews were conducted virtually by phone or video call. The interview questions followed a semi-structured interview template which promoted open-ended responses to capture the individualistic points of view of research participants (Bryman, 2008). An initial interviewee (typically a senior manager) for each site was chosen by the main research contact. Additional interviewees were then identified using a snowball sampling technique (Noy, 2008), seeking to ensure representation from the principal contractor (known as 'Tier1') and the supply chain (subcontractors, known as Tier 2 or Tier 3), and a range of seniority and experiences. The research followed Loughborough University's Ethical Policy Framework.

Data collection

Six large project sites participated in the research. Three sites were in London, one was in the North East of England, one in the North West and one in the Midlands. They were a mix of public and privately funded projects. Some had remained open throughout the pandemic, while others had been closed for periods of two to nine weeks.

Up to six individuals were interviewed from each site. Most interviewees had management or supervisory responsibilities and were therefore able to comment on the working practices and behaviours of those working for them as well as share their own personal experiences. In addition, two OSH professionals from specialist subcontractors were interviewed. The 33 interviews, each lasting 30-60 minutes, were conducted by the lead author who has substantial experience of construction safety research. Table 1 shows the key job roles of interviewees.

Table 1 Interviewees by job role and employer

		Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Other
Interviewees by job role	Project director, construction director or similar	1	3	1	2	2	1	
	Site manager, project manager or similar	1	3	2	3	3	1	
	Supervisor	2						
	Frontline	1						
	OSH professional	1		1	1	1	1	2
Interviewees by employer	Supply chain	4	1	1	3	1	0	2
	Tier one	2	5	3	3	5	3	0

The interview questions addressed the following topics:

- Site-wide and organisational changes implemented to make the site 'COVID-secure' including changes to working patterns, site layout, and workplace facilities
- Specific changes to work operations and tasks to ensure compliance with the two-meter rule
- The perceived consequences of these changes for the interviewee and others working with or for them
- Personal experiences of working during COVID-19
- Personal views on COVID-19 risk

Analysis

Interviews were recorded and detailed notes taken. Common themes were identified using content analysis techniques (Hsieh and Shannon, 2005) and interview notes were coded using this framework. A second researcher reviewed the themes and independently coded the data against the agreed themes. The coded findings were then consolidated upon discussion among the three researchers. Additionally, key findings for each interview were gathered and condensed to generate a summary document for each study site. Commonalities and differences between sites, between job roles, and between work tasks were also explored within the dataset through discussion between the researchers.

Results

Practical changes to site

The changes made in response to COVID-19 on the sites studied were substantial and included both physical and organisational changes. Physical changes to sites included designing one-way routes around sites (one project constructed a temporary staircase to facilitate this); installation of additional hand washing facilities; redesign of welfare facilities (e.g. installing booths in canteens and changing rooms, or removing chairs to reduce capacity); redesign of site entry points to eliminate the need for touch screens; and procuring extra car parking space to reduce reliance on busy public transport. Most sites had engaged additional cleaning staff (one site increased from four cleaners to 26) and some shift times were adjusted to improve worker flow through facilities and to reduce the need for peak time travel.

Worker perceptions and experiences

On all sites, it was reported that workers felt safe and were reassured that COVID-19 risk at work was well managed: *"people saw we were putting in a big effort"*. They were often pleased to be able to go to work, and appreciative of efforts made to keep them safe. However, it was also

acknowledged that COVID-19 risk management had been poor in some parts of the construction sector. Many interviewees commented that management of COVID-19 on site was made harder by lack of clarity such as unclear or contradictory government policies. Inconsistency and mixed messages across society made it harder to enforce rules about social distancing. For instance, during the period of the research, pubs and restaurants reopened after a three-month closure, and this was interpreted by some as indicative of a return to 'normality'. Many reported a constant need to remind and re-educate workers. The most reliable control measures were those where the risk of contact had been designed out, for example by using physical barriers, by rearranging furniture and by reducing the number of people in an area.

Interviewees were asked about their own and others' perceptions of COVID-19 risk. Some were very anxious and had been reluctant to return to work. Others observed that some people took risk less seriously than they did, with one interviewee commenting that, *"I've learnt that some people don't think it [COVID-19] is real"*. For self-employed workers who would lose income if they were not at work, there was often a strong drive to return to work for financial reasons, regardless of perceived risk.

Some interviewees were personally anxious about being infected with COVID-19 and took precautions against the disease. However, concern for close family was a far greater driver of compliance with control measures amongst interviewees and the wider workforce. For example, one young manager commented that *"both my parents have serious health concerns so my concern was always going to be about my parents"*. Another said *"if I was going back home to see my grandparents I would have been more scared. But I'm not, so I'm not really fazed by it"*

Improved planning

On all project sites there was an increase in time spent planning work and tasks, to ensure there were not too many workers in each area. The measures taken included:

- Better forward planning. For example, one site conducted a regular six-week look-ahead, with detailed discussion around the order of work and the times at which different specialist subcontractors would have access to an area.
- Work sequencing to reduce overlap between trades. For example, one senior manager noted that *"we have to plan it so it's in a proper sequence and there is one trade in each area at a time"*.
- A reduction in the number of workers from each trade permitted to work in each area. This is a change from current practice and several interviewees observed that usually *"when someone is running behind on their programme, the first thing we say is 'we need more labour'"*.
- Increased and more detailed liaison between trades where they both needed access to an area.
- More detailed planning. For example, one site revised several hundred RAMS (Risk Assessment/Method Statements) to take account of the need for social distancing. The improved understanding from this level of detail also led to tasks going more smoothly, as issues were addressed in advance which would usually have been dealt with *"on the hoof"*.

There was widespread agreement that these changes were positive; that *"this is how we should have done this in the first place"*. The improved planning was often mentioned as best practice, despite it not always being done. A senior manager who had used formal planning tools in a previous company

commented that *“it’s the most efficient way to work”*. The improved sequencing of trades that reduced iterative interfaces and overlapping of different subcontractors was also overwhelmingly seen as a positive change which all interviewees commented would like to maintain longer term. One interviewee observed that such changes were aligned with the principles of Lean Construction, which seek to streamline work and eliminate sources of waste.

Despite these positive views, there was also a recognition that the additional planning was very time consuming for those in management roles. Many interviewees considered it unrealistic in the longer term as it would lead to construction projects taking longer to complete due to the reduced workers on site, and it was considered unlikely that clients would tolerate a longer programme. As one senior manager observed, *“you wouldn’t get the job because you’d be two or three months out [in your tender], so you are pushing water up the hill, and [the sector] will revert back to where we were before”*.

Improved housekeeping

Housekeeping, or site tidiness, was perceived to have improved on five out of the six project sites (on the sixth it had worsened, possibly due to the absence of senior managers on site). Interviewees suggested that improvements were partly a consequence of improved planning and of trades working alone:

- Work sequencing and smaller number of workers made it more obvious who was responsible for waste and increased ownership and motivation amongst workers to keep tidy. One manager remarked: *“[workers] see how tidy it is...do the work... clear up after themselves”* and another commented that *“there’s a smaller crew out there, there’s more ownership from these guys to clean up after themselves”*. The improved visibility also made it easier for sites to enforce housekeeping rules.
- Fewer materials were stored on site. This was partly due to having a smaller workforce, but also due to improved planning, so that materials could be scheduled for ‘just in time’ delivery rather than being ordered in advance and stored on site, often obstructing work areas.
- The requirement to keep walkways clear to support social distancing increased obligations to tidy away materials and plant.
- Tidiness in welfare facilities improved on most sites, partly due to enhanced cleaning regimes, and partly due to greater personal responsibility being taken for disposing of rubbish.
- Interviewees suggested that improved housekeeping contributed to improved productivity, higher worker motivation and reduced risk of incidents.

Productivity and worker effectiveness

Several sites fell behind the scheduled programme as a result of COVID-19, although there was variation in how big the impact had been. Programme delays had arisen from having fewer workers on site, difficulty getting materials, and the closure of specialist suppliers and manufacturers under lockdown conditions. Some tasks such as erecting scaffolding or excavations took longer than usual due to the need for workers to maintain social distancing.

A range of mitigating measures were put in place in attempts to keep projects to programme. One site introduced a second shift to boost construction whilst maintaining fewer workers on site at any one time. This had the added advantages of offering flexibility to the workforce to fit in with family

commitments and was generally well received. Another very spacious site brought in additional workers, reallocated from closed sites, to speed up work on specific tasks. One site used offsite manufacture to reduce the number of workers on site and the need for workers to be in close proximity. This proved an effective response to COVID-19 but was not deemed a suitable long-term solution due to increased initial costs.

Although some sites had reduced productivity overall and fell behind schedule, there was a strong feeling amongst almost all interviewees that the productivity or effectiveness of individual workers and individual gangs had improved. In other words, there was higher output per worker, even if total site output was reduced by having fewer workers. One senior manager commented that *"with the productivity and the new ways of thinking we believe we only need 7½ people to do the same as 10 people"*, while a specialist contractor observed that there had been a *"50% workforce reduction but only 30% reduction in output."*

Besides the increased planning and improved housekeeping as discussed above, a range of factors were seen to have contributed to this improvement:

- Because there were fewer people overall and less overlap of trades in the workplace, there was more space for each worker, and they could operate more effectively.
- Reduced materials storage on site reduced the need for double handling which saved time and improved the space available for working.
- Workers had less non-productive time. For example, one site which had introduced staggered shift starts to reduce congestion found that the working day started more promptly as a result. One interviewee commented, *"they used to come in, get changed, go to the canteen, sit around then come back to their toolbox. Now there is a flow, they come to site, get changed, go to their workstation... people are forward thinking, there is no dilly-dallying"*.
- There were reports of less social chat between workers as a result of the increased distancing and one-way systems. The reduced numbers of workers in each gang or from each trade meant that workers spent less time *"hanging around"* waiting to start work/tasks: *"[previously] there was always someone on the phone or having a cigarette break"*.
- On one site there was a perception that those who had returned to site were the more motivated workers, the 'team-players'; workers who were not comfortable with the expectations of the new COVID-secure regime quickly left or were asked to leave. This was not mentioned explicitly on other sites but, given that workers were widely reported to be pleased to be able to work, and many had been unhappy while on furlough, this may have also contributed to them being more motivated and committed to their work.
- Some workers reportedly planned their work better, for example by making sure they picked up the right tools and materials, because they knew they had an allocated time to complete their task, or because one-way systems and longer walking routes motivated them to pick up everything they needed before starting work.

Occupational safety and health

There was no clear evidence of improvements in general OSH compared to pre-COVID-19 levels. Most considered that it would be too early to see evidence of this in any statistics even if there had been a change. Some interviewees reported seeing no impact, but others were confident that there had been improvements which could, in time, reduce accident rates; or that improvements over time could logically be expected as a result of changes made to site operations. One example of

improved OSH due to COVID-led changes was explained as follows: *“we have a one-way system, everyone is going in the same direction... before people could be carrying things... bumping into each other, stopping to talk to people... zigzagging around materials. Now it’s just a clear walkway”* and the reduced number of workers on site overall and in each work area were all cited as having the potential to improved safe working. One senior manager noticed that *‘the noise levels have completely dropped, there are not so many vehicles picking materials up, putting them down...it feels as if there is more of a plan, more of a structure, it feels as if there is cleaner air.’*

A small number raised concerns that OSH might have deteriorated, and one reported seeing evidence of this on other project sites. Possible explanation for this viewpoint included distraction or reduced focus on ‘ordinary’ OSH (for individuals and projects) due to the attention paid to COVID-19, low visibility of senior managers on some projects, and workers coming back from furlough and not being ‘site-ready’. One company OSH specialist had seen falling OSH standards on some of his project sites: *“I don’t know whether it’s because everything was COVID, COVID, COVID; it has taken the focus off safety...and there’s a lot of senior people furloughed or working from home, visibility of senior management has fallen”*.

Communication and engagement

Many interviewees observed that engagement between site managers and the frontline workforce was of a high standard pre-COVID-19 and had not substantially changed as a result of COVID-19. However, there were also examples of increased or improved engagement resulting from COVID-19-led changes. As one OSH professional said, *“the workforce has never been so consulted!”* For example, on one site, there was a substantial increase in the use of an incident reporting app by frontline workers, with submissions being both COVID-19 related and concerned with more general OSH issues. This was attributed to increased encouragement to use the app, high responsiveness to worker suggestions and providing good feedback on site noticeboards.

Two sites reported an increase in on-site meetings, which replaced office-based meetings between Tier 1 and the supply chain. This improved engagement with the frontline workforce, as they were now likely to be present at such meetings. One senior manager commented that *“I’ve taken to walking out [on site]... you can do an ‘at the coalface meeting’, I’m doing a lot more of those... instead of saying ‘there are three gangs’, [we can say] they are ‘Jim and Bob and Sue’; so you have that personal side... And the operatives can see you with their manager, so it’s that human side of it.”* Tier 1 attendance at supply chain/point of work briefings was also frequently cited as being helpful, although some interviewees said this had been usual practice pre-COVID-19.

There was variability in the level to which those working on site felt supported by their parent companies. Some interviewees commented that templates and guidance from their parent organisation had been very helpful when they were planning adaptations. One site reported that a number of senior managers from a subcontractor had worked on site alongside frontline workers for several weeks. Consequently, they developed a better understanding of some of the challenges faced by their workforce and were able to redesign office systems to make life easier and improve efficiency.

However, there were also negative comments made about senior management in some situations. Since government guidelines required workers to stay home if it was not deemed ‘essential’ to travel to site, the resulting low visibility caused by senior leaders working from home led to some interviewees feeling unsupported, and commenting that the challenges faced on site were not

recognised by the senior staff. On one site the senior management was referred to as the 'bedroom brigade'. In some cases, senior managers working from home and not visiting sites was mandated by company COVID-19 protocols. However, while some suggested that low visibility of senior managers may have had an adverse impact on site behaviours (such as a negative effect on housekeeping or safe working), others observed there may be benefits in the reduction of non-operational senior managers visiting site as this reduced distraction from getting work done.

Supply chain

On almost all sites, there were increased expectations on the supply chain (e.g. companies who supplied workers from particular trades) and particularly on their supervisors, known as 'black hats'. Supervisors act as an important conduit for worker engagement and, as a result of COVID-19 changes, they took on additional responsibilities for conducting worker briefings and inductions, and for monitoring that COVID-19 rules were being followed. Several interviewees commented on the importance of having supervisors take on these responsibilities as they had the right combination of skills and authority to operationalise this effectively.

There was also increased engagement with and from the supply chain more generally. There were many reports of subcontractors visiting sites to assess whether they were safe enough for their workforce to return to work. *"We had project leads from the supply chain, their H&S managers, come, wanting to look at the place before they sent people back, which was brilliant, I've not seen that for any other workplace risk, that they would come and assess us."* The onus was on subcontractors to have their own procedures and judgements in place with regard to COVID-19, and to demonstrate to the Tier 1 contractors that they had suitable COVID-secure work plans in place.

Induction

All sites had made changes to how they carried out induction in response to the COVID-19 constraints and most of these changes were noted to be beneficial. For example, some sites briefed smaller groups than usual. This was seen to improve worker engagement, although it was less efficient for the manager, and therefore considered unsustainable longer term. Other sites made induction shorter, moved it on-line or replaced parts of it with site-based discussions. One site introduced a special COVID-19 briefing for all new or returning workers. This was given by the Construction Director to supplement normal OSH briefings. In it, he emphasised the expectations on the workforce to comply with the rules and that the consequences of not doing so was removal from site.

Discussion

Have COVID-19-led changes affected productivity in construction?

Although some sites had fallen behind programme, there was a widespread view amongst interviewees that worker effectiveness had improved because of COVID-19-led changes, with increased planning and improved housekeeping being important contributory factors. Figure 1 summarises the factors and relationships presented in the results section.

introduced were sustained over a long period of time, and this is plausible. For example, it is reasonable to assume that improved housekeeping would have a positive impact. Previous evidence suggests a causal link for up to a fifth of accidents in UK construction (Haslam *et al.*, 2005), and research studies from Norway and Iran also confirm an association (Ahmad *et al.*, 2016; Soltanzadeh *et al.*, 2017; Winge, Albrechtsen and Mostue, 2019). However, longer term collection of data would be needed to assess changes in incident occurrence or safe working and to fully evaluate the possible causative factors.

Are there lessons for the management of health and safety in construction?

A common thread through the changes made to adapt to COVID-19 was their similarities with recognised ‘good practice’. They rarely involved new techniques or methods, rather they showcased site managers and engineers working to a high standard; with sites adopting measures already common amongst the best in the sector. Therefore, a key lesson from COVID-19 is the importance of the sector continuing to focus on cascading best practices from high performing companies and projects to those where OSH management is less satisfactory (Brace *et al.*, 2009; Gibb *et al.*, 2015). There are also some lessons from the ways in which COVID-19 risk has been understood and communicated which accord with commonly recognised good practice in OSH. This section will continue by highlighting these and reflecting on how they are or could be implemented in construction more widely.

The importance of prosocial motivation

Although some workers were anxious about becoming ill themselves, their motivation to manage their exposure more commonly reflected concern for family and friends. This is supported in the COVID-19 literature, where Newby *et al.* (2020) found that 26% of respondents were anxious about contracting COVID-19, whilst 50% were anxious about their loved ones becoming ill. This reflects the known tendency for individuals to be overly optimistic in their interpretations of themselves and their health risks (Dunning, Heath and Suls, 2004); they typically also see themselves as invulnerable to the risks of accidents (Caponecchia and Sheils, 2011). Behaviour change is therefore more often successful if consequences for others are emphasised, rather than consequences for an individual (Grant and Hofmann, 2011). This approach uses ‘prosocial motivation’, defined as “the desire to protect or improve the well-being of other people” (Grant & Berg, 2012, p. 28) and has been used in the UK to promote safe behaviours during the pandemic. For example, people were encouraged to ‘*Stay home, protect the NHS, save lives*’ (NHS: National Health Service). Later communications took a similar approach with signage such as ‘*I wear my mask to protect you; please wear yours to protect me*’.

A similar approach is sometimes used to influence construction workers on leading projects and could potentially be extended. For example, on the construction of London’s Tideway Tunnel, induction is built around a one day event called EPIC (Harvey *et al.*, 2020). The format of the induction event employs actors to immerse workers in a hypothetical ‘incident’ which results in a death at work, and highlights the impact on friends, family and emergency services. The powerful message of the impact of a fatality on the family, and the emotions invoked by that are then used to increase worker motivation to take OSH seriously. Induction training more generally, though typically run on a much smaller scale, could still take opportunities to remind workers of the impact that poor OSH could have on their loved ones.

Risk communication must be consistent, frequent, and widespread

COVID-19 has been unusual as a workplace hazard in terms of the scale of the communication surrounding it. Whereas hazards such as falling from height or exposures to noise and dust are typically specific to a workplace (or at least, the focus on reducing the risks is mostly workplace-specific), the messaging about COVID-19 was universal. The workforce saw widespread communications on national media, social media, at home, at work, about the risk from the virus and the need to take steps to reduce its impact. There was rolling news footage of rising cases, of tragic family stories, of the NHS being overwhelmed. This far outstrips the scale of messages which workers get on a day-to-day basis to remind them of the need to use dust extraction, to secure ladders or to wear safety boots. Perhaps for this reason there was, at least early on in the pandemic, a strong motivation amongst the construction workforce to follow the rules and to protect against COVID-19 spread. Many workers were alert to the infection risk associated with returning to work and sought reassurance that good control measures were in place. It is unrealistic to expect this level of communication about work-related OSH, but it demonstrates the benefits of widespread, consistent information. For example, sector-wide campaigns by bodies such as the HSE (Health and Safety Executive) and BOHS (British Occupational Hygiene Society) have been run in recent years. These highlight specific topics, providing accurate and meaningful information to workers throughout the sector, and strengthening the messages that they receive even if they move between projects or employers.

Designing-out risk

Despite the substantial communications about COVID-19 risk, there was evidence that compliance and motivation were starting to fade several months into the pandemic, particularly as social rules were relaxed outside of work. The most effective measures were those which involved structural changes to design-out sources of risk, conflict or concern. For example, the use of one-way systems to enforce worker separation, and the installation of physical barriers, reduced reliance on individuals to actively take precautions to maintain social distancing. This aligns with the emphasis on hierarchy of control in construction. Control measures which eliminate or reduce hazards at the design/pre-construction stage, or which reduce exposures through engineering controls (such as on-tool dust extraction or water suppression) are preferable to those which rely on training, safe systems of work or Personal Protective Equipment.

The importance of income

Another finding of this research was that workers returned to work for financial reasons even though they were anxious about COVID-19 risks: contracting the virus was perceived as a lesser risk than not being able to support their families. This is consistent with the recognition in construction OSH more generally that workers may tolerate unsafe environments or practices to ensure continued employment (Roelofs *et al.*, 2011; Jones, Gibb and Bust, 2018). In the context of OSH risk communication, this may be a powerful motivator for them to take risk seriously for practical or financial reasons, counter to the reluctance to admit a fear of injury or ill-health in light of the 'macho' culture which often prevails in the sector. Emphasising the financial cost of poor OSH is an approach which has been used in the industry to influence employers (Zand *et al.*, 2016; Gibb, Drake and Jones, 2018; HSE, 2019) but is less commonly used to directly influence employees.

Workplace induction: a work in progress

Changes made to induction to ensure COVID-19 compliance were almost all considered to be an improvement on previous arrangements. This highlights the ongoing challenges of designing and

implementing good induction programmes. They often need to accommodate large number of workers passing through, for relatively short periods of time, and with a wide range of background and prior knowledge (Daskalaki, 2012; Lamm *et al.*, 2017). Cultural and language challenges add additional complexities (Bust, Gibb and Pink, 2008). Further, Pink *et al.* (2010) reported conflict and confusion in the sector over whether the key purpose of induction is to be a briefing, a training opportunity or an occasion to gather information about the workforce such as completing paperwork.

Despite industry guidance on this topic (Build UK, 2019) and substantial efforts on larger projects (Healey and Sugden, 2012; Harvey *et al.*, 2020) induction in construction is often of poor quality, with the role of ‘inductor’ delegated to an individual who is lacking either expertise to answer questions or the ability to make the session engaging and interactive (Tutt *et al.*, 2013; Campbell and Gunning, 2020). Further research is therefore needed to identify how the way induction programmes were adapted during the lockdown period can be used to improve the messaging and format of induction practices in a resource effective way in the long term.

Supervisor skills and knowledge are key

Supervisors were highlighted in this research as being key individuals tasked with implementing and enforcing COVID-19 rules on a day-to-day basis. In many cases their role had been extended, for example to take on increased responsibility for briefings or inductions. The importance of the supervisor in construction is widely discussed in the literature, and in particular their contribution to improved OSH practice (Gibb *et al.*, 2015; Oswald *et al.*, 2018; Sommovigo *et al.*, 2019; Talabi, Edum-Fotwe and Gibb, 2019; Winge, Albrechtsen and Mostue, 2019).

Supervisor training was introduced in the UK by the Construction Industry Training Board following acknowledgement of ‘the highest levels of supervision on site internationally but one of the poorest records of training for supervisors’ (Egan 1998). Similar courses such as the American ‘OSHA 30-hour training’ are available in other countries. However, Hardison *et al.* (2014) has raised a concern that supervisors need more than practical OSH knowledge: they also require skills to enable planning, job flow and effective communication. This shortfall has been addressed in two UK megaprojects to good effect. For example, during the construction of the London 2012 Olympic Park in the UK the importance of good competence among supervisors was recognised and subsequently relevant training was provided (Cheyne *et al.*, 2012). The training scope included softer skills such as communication in addition to technical knowledge of OSH. Similarly, the Crossrail project introduced the Frontline Leadership Programme (Hails, 2014; Crossrail, 2016) to support supervisors to develop their leadership skills. The current research has confirmed yet again the importance of the supervisor role, and the need for supervisors to have the skills to influence behaviour in addition to knowing what good practices they are seeking to encourage. Further action is needed to embed training at this level more consistently throughout the sector.

The importance of the client

The unique position of the project client to drive the project agendas has been highlighted by key construction reports in the UK over the last three decades (Latham, 1994; Egan, 1998; Wolstenholme, 2009; HM Government, 2013). There is also strong evidence of the impact that clients can have on OSH standards, both positive (Cheyne *et al.*, 2012; Jones, Gibb and Bust, 2018; Lingard, Wakefield and Walker, 2020) and negative (Olawale and Sun, 2010; Votano and Sunindijo, 2014; Oswald *et al.*, 2020). Accordingly, if there are to be changes to how construction operates

which build on the learning from COVID-19, clients will need to drive this. Particularly, they need to avoid the 'race to the bottom' which remains prevalent in a competitive fixed-price, lowest first cost, tender-led culture (Egan, 1998). For example, this research has illustrated the potential benefits of 'building slower but better' where clients may need to accept later project starts and longer build times to achieve higher quality, improved OSH and lower costs in the long-term.

Limitations

The key limitation of this study has been its small and selective sample size, which was designed to produce rich data from a timely 'snapshot' of changes made in response to COVID-19. The projects studied were chosen to ensure research access whilst covering a range of projects but not necessarily to be representative of the whole of UK construction; the findings may paint an overly optimistic picture of the changes made across the wider industry. Nevertheless, they provide examples of positive actions, and more importantly what might be achieved in the longer term with sufficient commitment. A second limitation is that interviews were conducted predominantly with those working at site manager and above, or in professional roles. The voices of the frontline worker and the first line supervisors are largely absent. This was unavoidable given the need for rapid mobilisation of the research, and the constraints of COVID-19 lockdown. The site managers and project managers interviewed were working closely with frontline workers and considered themselves to have a good understanding of the experiences of the wider workforce. However, follow-up research to assess the impact of changes made, for example through focus groups with frontline workers, is recommended to more fully inform future working practices.

Conclusions

This research has illustrated how the changes made in response to the COVID-19 pandemic resulted in increased worker effectiveness, improved housekeeping and a potential for improved OSH. Ultimately it has highlighted that the sector already has within its armoury the best techniques to make construction safe and effective. The research findings showed that a high nominal standard in OSH provided the best defence against sudden extraneous and drastic changes to work practices on construction sites. The challenges post-COVID will be to ensure that these positive changes are captured, and the new ways of working embedded into work practices. The temptation, of course, is to slip back into old models of operation once the immediate risk is perceived to have subsided. Additionally, the sector needs to persevere with its commitment to capture the good practice from high performing projects and companies and cascade these down to the wider industry.

Acknowledgements

This report was funded by:

Balfour Beatty, Mace, Skanska, Kier, Morgan Sindall, GK Scaffolding.

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