HAMMERTECH

The Future of Safety Management

March 2019

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Executive Summary

Worldwide, construction has long been one of the most dangerous sectors in which to work. However, the tragic impacts of worker deaths, injuries and illnesses have prompted numerous improvement initiatives. Construction fatality and serious injury rates are falling across most developed economies, partly due to tighter regulation of health, safety and environmental issues. New design and construction methods, including offsite fabrication and the adoption of information and communication technologies are also helping. Applying building information modelling (BIM) processes, for example, can help deliver built assets that are safer to construct, operate and maintain, while drones and other visualisation technologies can boost safety monitoring and inspection. And as digital transformation takes a grip across the industry, owner-operators and project teams will also be able to mine rich data from past and current projects to help them predict potential issues before they turn into risks – or worse!

Improving Construction Health and Safety Performance

In just about every economy, construction professionals have been concerned to improve the health, safety and environmental performance of the industry. In recent decades, the human, economic and social costs of fatalities, serious injuries and chronic health conditions have prompted action both within the industry, and from regulators and legislators.[1] In developed economies, clients and their project teams are increasingly required to actively identify and manage potential health, safety and environmental risks from the project inception stage forward.

> **Construction death rates in the US and Australia in the late 1980s/early 1990s averaged of 13.8/100,000 and 11.6**

The result, in most cases, has been a welcome downward trend in the numbers of deaths and reportable accidents on construction sites – though some countries are improving faster than others. In the UK, for example, the Health and Safety Executive has noted how the construction industry's fatal accident rate halved from an early 1980s figure of around 10 per 100,000 workers to around 5 per 100,000 in 2000, and has since more than halved again – the 2017/18 rate was 1.64 per 100,000 (though this is still around four times higher than the average for the rest of UK industry).[2] Construction death rates in the US and Australia in the late 1980s/early 1990s averaged of 13.8/100,000 and 11.6, respectively, more than double their respective national averages; 30 years later, the respective figures have fallen to 9.5 and 3.3,[3] both well above rates for other industries.

One driver has been legislation imposing special duties of care on construction professionals. For example, under the Construction (Design and Management) Regulations, UK engineers and architects will need to design assets that can be safely constructed and then safely operated and maintained throughout the asset's working life. Contractors and subcontractors will carefully draft method statements detailing site processes and will be scrupulous about creating and maintaining a strong safety culture across the project site. It is rare to walk past UK construction sites and not see posters routinely reminding workers about personal protective equipment; many sites will have managers with dedicated H&S responsibilities to ensure compliance with regulations and with project-specific processes.

The potential to deploy technologies to improve safety management has also been recognised, and perhaps the most prominent technological development in the early 21st century has been the digitisation of construction processes, notably through the deployment of building information modelling (BIM), alongside complementing technologies on mobile devices, reality capture tools, and even wearables. These should further contribute to reducing health and safety risks.

[1] In the UK, the Corporate Manslaughter and Corporate Homicide Act 2007, which came into force in April 2008, clarified the criminal liabilities of companies including large organisations where serious failures in the management of H&S result in a fatality.

[2] Construction statistics in Great Britain, 2018

[3] US Bureau of Labour Statistics, 2017; Safe Work Australia 2016.

BIM and Emerging H&S Standards

To date, global adoption of BIM has proceeded at different paces in different countries. However, sustained government promotion of BIM in the UK has encouraged extensive adoption to the point that UK BIM processes and standards, also widely accepted in Australasia and Africa, are becoming the building blocks of international approaches. The first elements of ISO 19650 – based on draft British standards in the BS or PAS 1192 series – were published in January 2019 and should, eventually, be extended to cover health and safety.

Published in 2018, PAS 1192 Part 6[4] specifies requirements for the collaborative sharing of structured H&S information throughout project and asset life-cycles. It provides guidance on how H&S information should be initially produced and then developed through design and construction and into operation and maintenance of assets. It also sets out a framework (risk information cycle) for the application of H&S information through BIM processes and applications (importantly, the principles and requirements can be applied equally to non-BIM projects). It specifies how H&S information should be used to:

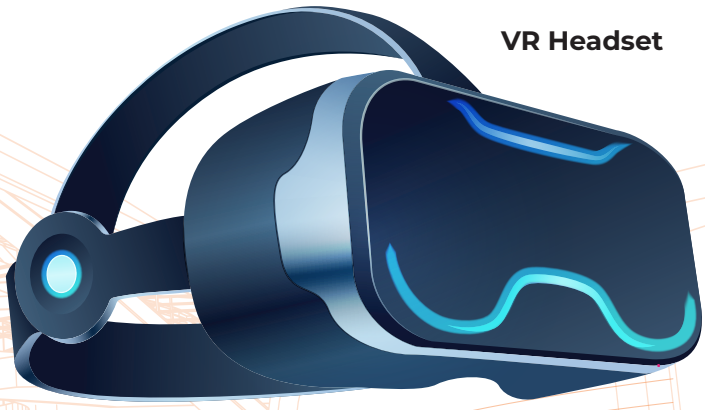
BIM (February 2018)

[4] PAS 1192-6:2018: Specification for collaborative sharing and use of structured Health and Safety information using

BIM, Digital Working and Construction H&S

BIM can certainly play a key role in safe delivery of projects. For instance, during design and pre-construction work, 3D visualisations of a building can be shared with end-users to get feedback on how business activities, including safe asset repair and maintenance processes, might be undertaken. In such virtual prototypes, 3D walk-throughs and fly-throughs familiar from gaming-type environments are now common-place, but some projects are also using immersive virtual reality (VR) technologies – these range from "3D caves" where the model is projected onto the floor, walls and ceilings of a specifically created space, to the use of headsets such as Oculus Rift or Hololens.

One area particularly applicable to H&S management is the use of rule-based model checking of the designs for compliance, especially from a regulatory perspective. Software applications can test designs' compliance with building regulations or codes – Belgium's Xinaps, for example, has devised a cloud-based service, Verifi3D, that will check models for compliance against national regulations and/or client-specific requirements in relation to fire safety and accessibility for people with disabilities.



VR Headset

In 2017-2018, falls account for 38% and 26% of construction fatalities in the U.S. and Australia

Ahead of the construction phase, 4D BIM can be used for logistical purposes and to model different construction sequences, including the location of cranes and other plant, temporary support structures, materials and tools stores, emergency evacuation routes, etc. Clash detection can identify potential issues – eliminating the need to cut holes in concrete or re-route piping to remedy clashes, for example. On-site processes can also be modelled to eliminate potential H&S risks, particularly relating to personnel working at height (in the UK, for example, almost half of the 38 construction industry fatalities in 2017-18 were due to falls; falls are also the highest contributor to construction fatalities in the US and Australia, accounting for around 38% and 26% respectively).[5]

Design for Manufacture and Assembly (DfMA) also complements BIM well, mitigating the safety and quality risks often associated with traditional labour-intensive onsite working. Prefabrication of components and systems in controlled environments tends to provide workers with safer working conditions and better welfare facilities. As well as delivering factory-grade quality, DfMA approaches can also simplify site processes – components may be craned into position and fixed in place, reducing onsite labour and the need for scaffolding and other temporary works – significantly mitigating H&S risks.

Of course, almost as soon as the metaphorical first spade hits the soil, onsite construction project teams can start to use standard mobile devices (smartphones and tablets) to access and to update information. From applications integrated with 2D project extranets or BIM 'common data environments' (CDEs) through to software solutions focused on particular processes or issues, personnel can capture data and share it with colleagues in seconds. Site diaries, timesheets, progress photographs, permits, deliveries, and quality or H&S inspection reports can quickly be added to project records, providing project and safety managers with raw data to monitor and report on trends.

Beyond standard consumer-grade technologies, digital tools can be used to safely visualise work in progress, perhaps using information gathered through reality-capture tools such as drones, laser-scanning and photogrammetry.

Monitoring H&S risks on site may involve a combination of both virtual and real-life visualisation. An immersive headset would rarely be safe to use on-site (impairing the user's awareness of the surrounding site), but mixed or augmented (AR) reality hardware and software solutions – the Daqri site helmet, for example – provides users with additional contextual information 'overlaid' on their view of the real-life site. The recent (February 2019) launch of Microsoft's latest Hololens 2 mixed reality product, showcased at the Mobile World Congress in Barcelona, saw coordinated announcements of two related products by AEC software vendors Bentley Systems and Trimble.

[5] Construction statistics in Great Britain, 2018; US Bureau of Labour Statistics, 2017; Safe Work Australia 2016.

Drones in Construction

Uncontrolled use of drones can, of course, present H&S risks, and regulators have moved quickly to limit where, when and how drones are deployed. UK use of drones is subject to Civil Aviation Authority rules, for example; in the US, construction use of drones falls under the Federal Aviation Administration's Small Unmanned Aircraft System (UAS) Rules – vital as construction has become the fastest growing market for drone use.

Controlled by trained pilots, drones equipped with cameras, laser, or infrared scanners can be used for a range of aerial observation and inspection tasks. Drones can rapidly capture data that might otherwise be both time-consuming and hazardous to gather – from tall or unstable structures, for example, or under bridges or along busy highways. Site progress and H&S monitoring are other obvious uses, and – in the event of an accident – drones can also provide visual support to search and rescue operations. Drones can also be equipped with more than cameras: drones have been used to transport tools and materials, and to undertake small maintenance or repair tasks, while researchers have also demonstrated how 'drone swarms' can be used to construct basic structures.

BIM for Safe and Efficient Operation and maintenance of Assets

The delivery of a built asset using BIM also presents opportunities to integrate data provided by manufacturers and suppliers. Increasingly, components and systems are being created as standardised BIM objects that can be incorporated into models, with data helping to populate data sheets, installation and commissioning method statements, and forming part of the information handed over to owners and their facility managers upon completion to enable safe operation and maintenance of their built assets.

BIM may also support a wider cultural shift across the built environment industry towards a focus on delivering best whole-life outcomes rather than – as is currently often the case – the lowest initial capital cost. In the UK, government and the Construction Leadership Council are both advocating approaches to construction procurement based on best whole-life value. This shifts the focus away from short-term cost-cutting towards ensuring the finished asset performs at least as well as, if not better than it was designed to work, and that it can continue to perform safely, reliably and cost-effectively. Critical to this evaluation are technologies that can measure asset performance, and which can share data with owner-operators and their built environment partners.

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Using the “internet of things” and incorporating sensors into the built environment, and connecting raw data about the asset to internal business systems, means clients and their partners can get real-time insights into the actual performance of their buildings and other assets. This feedback can then be used to continuously improve the design, construction and business operation of the next generation of such assets, while also ensuring the assets pose no H&S risks to their occupants or end-users.

And, of course, if problems do arise – say, a particular component or system is found to have a manufacturing fault posing a risk to the asset and/or its users – then having a detailed “digital twin” means every instance of that item can quickly be identified and a planned process of replacement can then be quickly implemented.

Platform SaaS:
Safety as Operations.

H&S is seeing a shift from what was once inspections and incident management to an operational approach. Construction is now understanding that H&S must be tightly intertwined with operations to achieve success. This shift is paving the way for software platforms to focus on process-based solutions, versus point solutions born from document management-based approaches.

Companies are starting to look at their application footprint and determine if digital siloes are creating more harm than good; if singular apps (point solutions) are creating operating siloes that increase risk.

Point solutions, born from document management needs, have historically focused on digitising manual paper forms (like inspections, permits, or SWMs), within an app. This digital form replication was designed to reduce the liability and burden of paper. While the benefits of accessibility, centralised documentation, and mobility are good, these digital replications have created issues with siloed data, lack of standardisation, and reporting complexities.

Instead of following the path of document management, new software platform solutions for H&S are beginning to look at the "how" and the "why" behind the documents that are used on site. This approach enables key information, like inputs from permits (i.e. request/submission of permit, check-in, check-out and monitoring), to tightly integrate and populate within various operational modules (like enrolments, inductions, SWMs, inspections) creating better workflows, communication and collaboration between teams, processes, and data. Within a process-based H&S platform, data that is entered can be intertwined between functions, teams, and processes without having to be duplicated for each separate function.

In addition to understanding the process behind the documents, H&S platforms are becoming equally aware of their need to be configurable to conform to the operating company's processes and not the other way around. Given that these systems are designed to support construction's H&S regulatory requirements, system flexibility is built in, ensuring that companies who need to meet different state, regional, vertical, or global requirements can do so easily within their software. And that the software itself will not create obstacles for conformity.

These new operational platforms for H&S are shifting traditional cost centres to potential profit centres by reducing risks, closing operational gaps, and protecting a company's bottom line.

Data for Safety Management

While BIM has been something of a buzzword for the past 10 years or so, there is growing hype about other digital developments including robotics, 3D printing, Big Data, artificial intelligence (AI), machine learning and predictive analytics. Automation, along with related trends such as prefabrication, can reduce health and safety risks by replacing or relocating worker activities, while the proliferation of rich data from every stage of the built asset life cycle offers potentially valuable insights from both historic and real-time information to enhance H&S performance.

With software platforms and eco system integrations (for example with Power BI), data is quickly becoming an integral part of comprehensive H&S processes. Knowing your leading indicators helps to support and infuse a strong safety culture, while identifying your lagging indicators can help you pinpoint your risks and close gaps in your existing frameworks. As data takes on bigger roles within construction, smarter decision-making around your operational processes will enable workers and managers to increase efficiencies, performance, productivity, and support safe behaviours.

Summary

The sheer scale and complexity of many construction projects make it difficult to completely eradicate health, safety and environmental issues. However, at least in the more developed economies, industry, regulators, and technology providers are combining to reduce the human, economic, social, environmental and reputational impacts of work-related deaths, injuries and illnesses. Shifts towards offsite manufacture of key elements of built assets will change the nature of some site-based working; drones are improving site inspection and monitoring activities; and mobile technologies are increasingly a key part of project and safety management.

Growing adoption of digital technologies should help maintain recent improvements. And as technology adapts more to the robust and complex needs of construction, there will be widescale changes in how technology supports H&S requirements globally. Construction is already starting to see those changes as they witness the evolution of safety as an operational practice and the agility of platform technologies to configure to the operational needs of the contractor. The more adept at understanding construction's needs technology becomes, the more accepting contractors will be at implementing these new solutions for successful outcomes.

HAMMERTECH

About Us

HammerTech is a cloud-based, mobile performance and productivity platform, ensuring operational efficiency, quality, & safety. If you're looking to promote safety & quality on your jobsite, it's time to focus on operations. HammerTech is the ONLY operational platform to cover pre construction operations, daily operations, safety & quality. Manage online registrations & inductions, employer management, equipment induction & monitoring, permit management, SWMs and SDS management, audits, compliance, observations, defect lists and more within one mobile, configurable platform. Consolidate your apps, and go all in one.

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