

WHITE PAPER

A Guide to Digital Construction

Why contractors are going paperless, one site and one project at a time



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The composite elements of the contractor's role are changing fast. So are expectations from all other stakeholders in any project, on how contractors manage projects and participate in the rapidly evolving digital value chain.

If construction professionals assume that the wave of technology flowing through modern society, business, industry and every aspect of public and personal life is of no immediate concern to the construction sector, they will soon find themselves missing out.

They will see new project opportunities, long-term growth, and participation in a more vibrant, varied, and collaborative ecosystem slip away. There is no cause for alarm. Construction is in transition. Businesses that keep pace with change will not only retain their relevance; they will enhance it.

The move to a digital world cannot be resisted and, indeed, why should it?

Purpose of this paper

While a construction project was once seen to be complete when it was built, this is no longer so. A built asset has a life going forward which unfolds as much in the digital as in the physical world. Understanding how to collaborate with, and share, data is now an essential pillar of operations. This paper investigates the essential first stages of putting that pillar in place.

In conjunction with a raft of technologies sweeping through the industry, mobile communications, and digital technologies such as laser scanning for setting out, are making construction more efficient, more collaborative, more transparent and capable. This paper looks at the concept of 'paperless construction' for contractors, which is precisely how digital construction manifests itself; simply replacing the old with the new.

A Note on the Author

The author of this paper is Nick Simpson, Consultant at Symetri, the UK leader in technology and services for the construction sector. Nick's experience in the sector spans more than 40 years, and his specialist areas range across the many constituent disciplines within Building Information Modelling (BIM). Nick has worked for some of the UK's biggest and most progressive construction companies. Over the last ten years, he has developed and honed his digital capabilities and strategic insights into the future of construction. He is an advocate of the theory that every journey starts with one step, particularly in the area of embracing technical and technological innovation; from modular construction, through to understanding the role of data and sharing information, to drive a more efficient industry.

Nick's primary areas of expertise are in Mechanical, Electrical, and Plumbing (MEP) design, detailing, design management, on-site construction management, and Operation and Maintenance (O&M) handover. His other specialist skills include CAD, BIM, digital fabrication, office-to-field implementation, Design for Manufacture and Assembly (DFMA), and structured information exchanges. Nick has considerable experience relating to the practical deployment of Autodesk's BIM 360 Field on all types of projects, having worked with the product since its inception. He is currently supporting the implementation of BIM 360 across the construction sector.

"The Construction Industry is going digital one site and one project at a time," says Nick, "There is no better feeling than seeing the expression on somebody's face when you've shown them how to do something in half the time it normally takes and with a better-quality output."

Exploring Digital Construction: Contents

- **Introduction and overview:** The construction value chain and the ability to work with data
- **The paperless construction site:** How does it work?
- **Today's site office:** Educate, inform, and enable your workforce

Introduction and overview: The construction value chain and the ability to work with data

Data is pivotal to collaboration. Using data is not just about responding to the information it carries, but also about analysing it to slice and dice the information and see it in different ways depending on the job requirement of the user.

The volume and variety of data pertinent to any construction project dictates a digital capability. Contractors need to know not just how to work with it but also how to contribute to it, passing information along the chain. Once you acknowledge and accept this essential connection between how you will increasingly receive information and how you will need to change progressively to leverage it, you're on the paperless trail.

The Common Data Environment (CDE)

Contractors are now frequently facing the challenge of participating in Common Data Environments; centralised repositories of all data pertinent to all aspects of a project. The CDE is one of the fundamental pillars of BIM Level 2, supporting the sharing and transfer not just of drawings and graphical models, but also of all important non-graphical documentation and information. This can include cost information, Quality Assurance (QA) and Health and Safety (H&S) information, Request for Information (RFI) submittals, in short, anything that informs decisions and actions associated with the built asset.

Contractors are today in a chain within which there are chain reactions, increasingly played out and identified to the benefit of all stakeholders and greater efficiency in driving project outcomes.

Without interaction with the CDE, incipient errors can be passed along this chain; hidden away to manifest themselves in operational problems or clashes at a point that nobody expects. The creation, flow and exchange of data through the CDE is helping to squeeze such eventualities out of existence.

Reducing risk and improving outcomes

The key reason for taking paper out of the business is that it helps ensure that everybody involved in a project has access to the information they need at every project stage, and for every task; that changes are transparent, that robust and reliable records are kept (audit trails), and misunderstandings are prevented or at least identified earlier on. In sum, risks are reduced. The common data environment is common sense. Like the lottery, you have to be in it because you can never win if you're not.

Greater expectations placed on contractors

The information flow in construction, from design through to build, through to operation, cannot run to maximum efficiency if it depends on modes and formats of information presentation (drawings, documents, spreadsheets) that can now be regarded, at best, traditional, and at worst, out-of-time. Such practices, despite best intentions, create their own problems:

- Difficult to share easily
- Cannot be dynamically changed or used in real-time
- Do not adhere to industry frameworks such as Building Information Modelling (BIM) and Construction Operations Building Information Exchange (COBie).

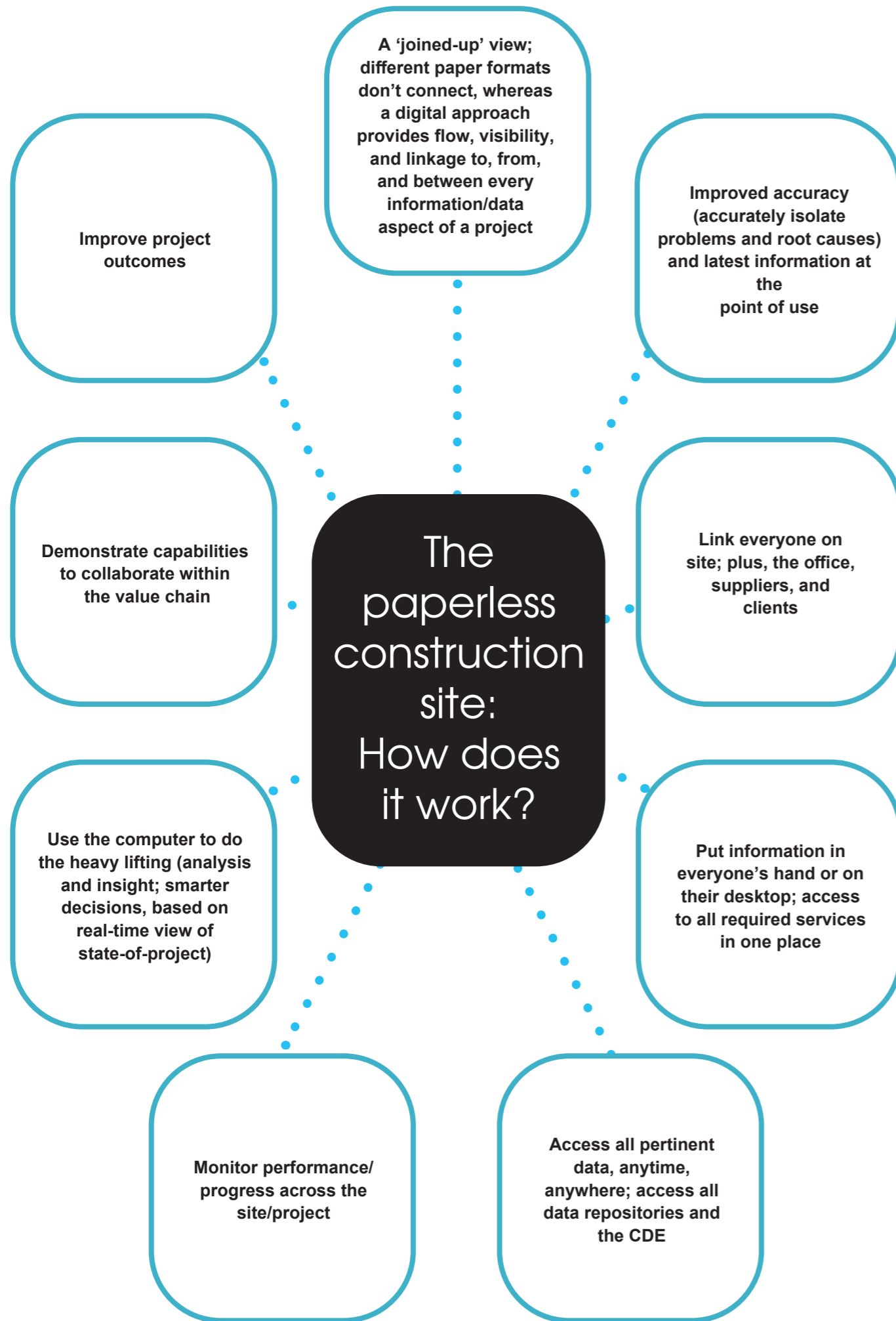
Embracing data: The benefits to contractors

As new, data-assisted roles consolidate, contractors stand to benefit in many different, but connected, ways.

The benefits likely to accrue include:

- **Project efficiency:** in areas such as streamlined task management
- **Complete understanding:** clearer interpretation of architects' and clients' intents and vision
- **Faster outputs:** less wasted time on site, leading to greater productivity
- **Greater accuracy:** more mechanisms in place to monitor project progress and spot problems, leading to faster and more timely remedial actions.

Contractors going paperless can also benefit from more robust audit trails when mistakes are made.



Digitisation is not a big deal, but what it enables is

The rule-of-thumb is to digitise everything.

The essence of technology is simplicity. It speeds things up. It makes actions possible, in a click or a swipe, that used to involve piles of paperwork, searching, cross-referencing and double-checking, and phoning round to validate that you had the right version with the right changes (often a call that might well lead to other calls; "I'll have to get back to you on that.")

If actions are really to be made simpler, then so too must the way in which they're performed. User interfaces are mostly intuitive; software companies devote endless time and effort to making them so because if their target users have problems in using their solutions, the software doesn't take off.

The smartphone has made us all tech-capable, but further than that every part of our lives involves a touchpoint with technology somewhere along the way. These can often be actions that we have so readily and naturally assimilated into our lives that we think nothing of the giant leaps forward they represent. Technology is becoming second nature.

Digitisation is not a big deal, but what it enables us to achieve is. To provide an overview of how the paperless construction site works, I've focused on the most immediate entry points; starting with mobility and accepting the data imperative, through to integrated 'project homes' and BIM kiosks and on to some of the prime examples of other practical on-site efficiencies such as laser setting-out.

As with all technology adoption, there are levels of maturity and sophistication; contractors just starting out on the journey, through to those who border on becoming masters of the art. Major construction organisations are able to invest more in digital transformation. From total communication onsite via tablets they will already be accomplished users of QR codes, BIM kiosks, laser scanning, photogrammetry, smart sensors and many other technologies. Contractors do not have to run at all of it all at once, however.

The new collaborative construction sector working environment is a place where change is catalysed by Building Information Modelling, the use of CDEs, the essential role of data, and evolving industry standards.

The best approach for contractors looking to make sure they're included in digitally-led construction projects is to look at where the big wins can come fastest; to help shape the change rather than be swept aside by it.

Become data-capable

Being able to make sense of the data coming your way dictates that you have the tools for the job. This capability demands a mobile culture across the workforce, across the business. Going paperless is more than just digitising paper-based workflows, it is about digitising everything on-site. There is no implication here that good processes are any less good simply because they are on paper; rather that good processes will work well when digitised, poor processes will work better when subjected to the same change.

Go mobile

Using devices on-site facilitates the 'democratisation' of access to information simply through a browser. It stimulates and enables the full involvement of the entire team. It extends this involvement, and visibility/transparency to clients and inspecting bodies and across the supply chain. A consideration with the use of onsite devices is around their durability; can they withstand the potentially harsh environment of a construction site. Do employees wish to expose their own expensive devices to this sort of treatment? Ruggedised handheld devices can be sourced which are purpose-designed for site conditions (dust, temperature changes, damp, vibrations and so on).

Drive control and better outcomes through the project 'home': See everything through a dashboard glance

The project home is a central repository for all information and a central control point. In a product like BIM 360 this capability can be delivered through a configurable dashboard where users can access all relevant project information concerning their role and tasks; eliminating the need to refer to different information sources, often in different locations or held by different people. A dashboard glance enables:

- Easy-to-use means of collaboration; users can see all current issues, RFIs, and the project BIM model
- Effective and timely issue management.
- RFI prioritisation.
- Root cause analysis.
- Control; see real-time worker numbers to better organise the flow of teams versus tasks and priorities.
- Site cameras allowing all-round visibility into what's going on, including the capability to automatically spot Health and Safety infringements and QA issues; returning stats and summaries for efficient planning and reporting.

Through a central project home, you can see if the project is improving or degrading and assess whether or not remedial measures have the intended effect. This level of visibility leaves more time to focus on priorities and risk areas, rather than constantly being one step behind problems, with all the wasted time entailed. Furthermore, you can evaluate how the supply chain is performing; deliverables compared to plan. Once again, recurring problems can be identified, together with root causes, enabling alternative approaches to enrich overall capabilities for the next big win.

The BIM kiosk

Contractors have gradually been adopting BIM kiosks (or stations) to support the information flow on site. A portable ruggedised central location housing a computer, the BIM kiosk removes the necessity for operatives to keep moving between site and office to check models and data. All operatives can use the kiosk as needed or many can converge at the same time to gain the same view as a focal point for discussion and decision-making. They can take measurements from it, check specifications, and share ideas at precisely the moment the ideas are needed. Such practical, and innovative, approaches signal the beginning of the end of A1 and A0 print-outs on-site.

Demonstrate operational excellence: Harness the smartest software on the market

The advent of BIM 360 is having the same transformative effect on construction that was experienced when Revit came along. Capabilities are elevated to a higher level of completeness, excellence and improvement. From quality control to jobsite safety management, through to commissioning and handover, collaboration, and daily reporting, BIM 360 is empowering. It works through smart project dashboards available to all (democratisation of access) through the Internet, delivered by the Cloud.

Harness new practical efficiencies

Turning to the practical day-to-day tasks of a construction project there is abundant choice on where to begin. Here are three examples and, of course, they are but a snapshot of the digital capabilities that can improve project outcomes:

- **Check faster: QR codes**
QR (Quick Response) codes are being used in construction to inspect materials and equipment arrivals on-site in a reliable and recordable fashion, ruling out human error. Used in conjunction with BIM 360, they can be used to capture operational information about managed assets; one click, and the information passes straight into BIM 360. On an ongoing basis, contractors can then go immediately to the correct record whenever they need to. They can be used to track the handover of rooms by applying a code to the location, and applying codes also to the issues associated with that location.
- **Smart use of photography and videos to avoid expensive problems: Photogrammetry** ("the science of making measurements from photographs"¹) is enabling the capture of 'as is' views of the site to enhance team understandings of where to go next with the project. Often the process need be no more complicated than using the camera function on a smartphone to assess spatial relationships via photographs.
- **Get rid of the tape: Lasers**
Reliance on human accuracy can be a risk. Reliance on computerised accuracy isn't.
 - **Setting out:** Lasers can be used for setting out of holes for service (MEP) brackets, on-site verification.
 - **Point clouds:** Laser scanning digitally captures dimensions and spatial relationships by recording millions of data points to create a 'point cloud'. To see an example of a point cloud in action take a look at the work Excitech did for the Royal Clarence Hotel, Exeter².

¹ <http://www.photogrammetry.com/>

² www.excitech.co.uk/point-cloud-donation-to-Royal-Clarence-Hotel

Today's site office: Educate, inform, and enable your workforce

Resistance to change

Pockets of the construction sector are still resisting any technology other than a mobile phone. All demographic groups are familiar with smartphone usage; it's not the exclusive domain either of the young or the technologically inclined.

As operatives arrive on site, you'll see them checking their messages or flicking through pages of information on their phone screens. They're on the threshold of being digital, so it should be just a small step to cross it. Why should they turn off their phones when they arrive on site to walk into a technology-free zone?

A digital, paperless approach alleviates the workload involved in paper-based information sharing and interpretation. The approach makes it easier to work. It facilitates the monitoring of projects, not people (although it can present valuable tools for driving productivity improvements); keeping the business at peak performance, improving its competitive advantage, its productivity and, when you take these benefits all together to their logical outcome, safeguarding jobs, not threatening them.

Final Thoughts

Connected means never having to say you're sorry

The multiple facets of digital construction – going paperless – can put you in a better position to bid for, and successfully complete, projects in the way clients and other stakeholders are increasingly coming to expect. If you have already started to make the transition, the benefits will be apparent to you.

There is time to make the change. ISO 19650 will not be revised for another five years. This is about the transition period by the end of which time the bulk of construction will be largely paperless. I have mentioned some of the associated on-site technologies such as laser scanning. These are the tip of the iceberg, and much more will rise to the surface at an increasingly rapid pace. We will see automated vehicles and robotics playing a greater part in construction. Behind the scenes of digitisation, we will be able to leverage artificial intelligence (AI) and machine learning (ML) more and more. This will enable continuous improvement and ceaseless progress.

It is an exciting time to be working in this sector. It can also be a little nerve-wracking; being sure about where the priorities lie, and where the focus of change should be. Excitech help construction companies of any size to identify direction and best practice in going paperless and adopting the digital technologies that will reap the biggest rewards relative to the type of projects on which, and the type of clients with whom, they work. If you feel at any time you might benefit from an exploratory conversation on where to begin, or where to go next, one project and one site at a time, please get in touch.



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