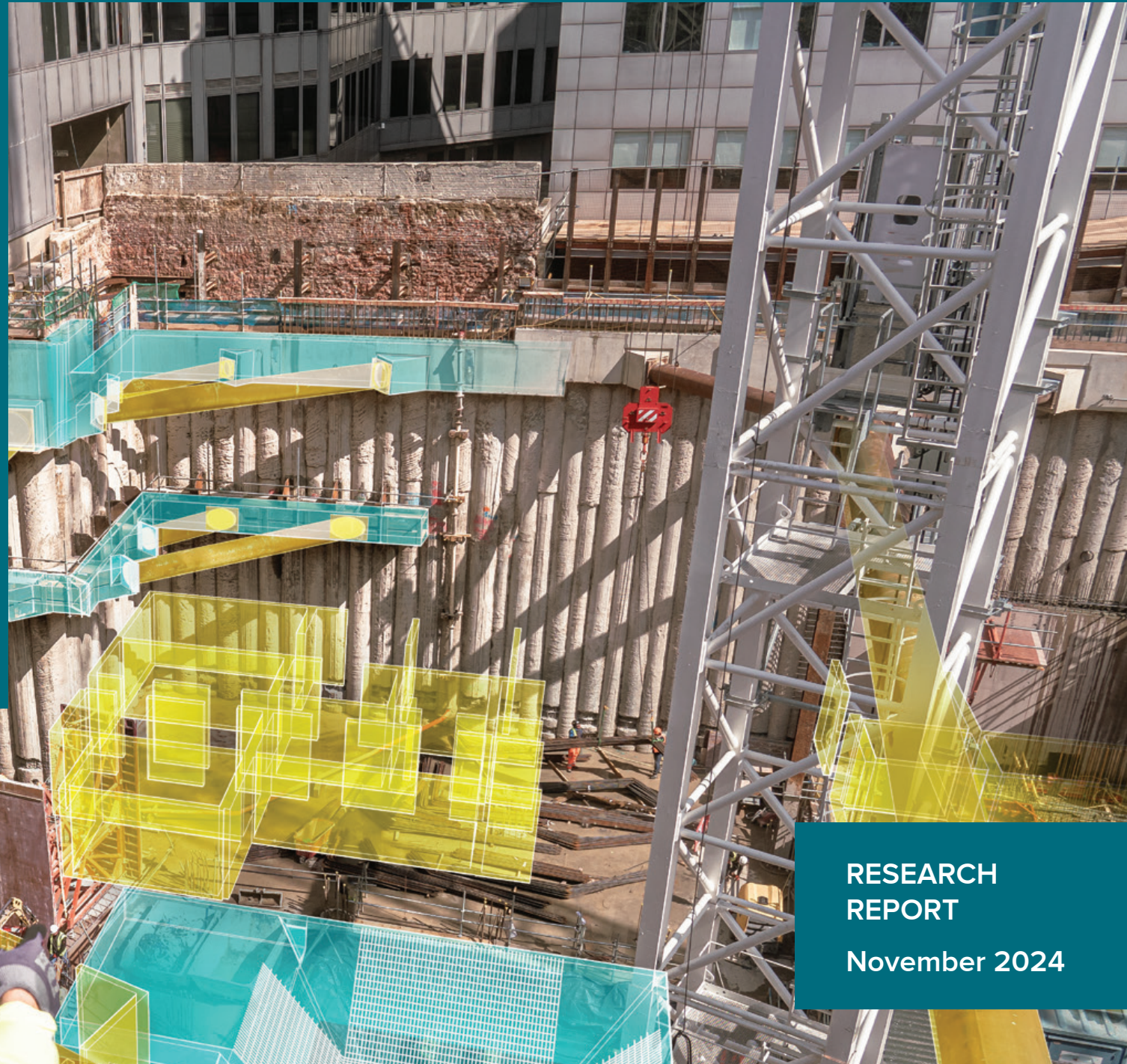




**THE USE OF
TECHNOLOGY TO
REDUCE ERRORS
IN DESIGN AND
CONSTRUCTION
BEST PRACTICE
CASEBOOK**



**RESEARCH
REPORT**
November 2024



Photo credit: Amorn Suriyan

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FOREWORD

FOREWORD BY CLIFF SMITH, EXECUTIVE DIRECTOR, GET IT RIGHT INITIATIVE

GIRI was founded in 2015 to create a culture within the construction industry that is committed to getting it right first time. We work to improve productivity, safety and competency, and to reduce waste and rework, by equipping people with the practical knowledge and tools they need to eliminate error and its associated consequences.

The 2016 GIRI Research Report identified and ranked 17 root causes of error and in 2023 we produced a Technology Report that linked those causes to possible technology solutions. At the same time, we reformed our Technology Working Group to bring together technology providers and industry leaders who understand the practical challenges faced in construction. This is a valuable melting pot in which problems and solutions can be discussed and lessons shared, helping to foster a proactive commitment to error reduction.

This new document builds on the 2023 report by including case studies from recent projects. These demonstrate that digital tools must be combined with people and processes, and fed with the right information, to be implemented effectively. We hope that this report will inspire other design and construction firms to adopt digital tools, as well as encourage technology providers to continue to develop new solutions.

Cliff Smith
November 2024

**DIGITAL TOOLS MUST BE
COMBINED WITH PEOPLE AND
PROCESSES, AND FED WITH
THE RIGHT INFORMATION,
TO BE IMPLEMENTED
EFFECTIVELY.**

INTRODUCTION

ABOUT GIRI AND THIS REPORT

The Get It Right Initiative (GIRI) is a not-for-profit membership organisation that has adopted a multi-disciplinary approach to tackling error. Its members include clients, consultants, contractors, regulators, educators, professional institutions and trade bodies who are working together to raise awareness about the challenges of error – and to eliminate it at source.

Its goals are to:

- Create a culture and working environment to get it right from the start.
- Change attitudes and harness leadership responsibility to reduce error and improve construction quality, productivity and safety.
- Engage all stakeholders in eliminating error from inception, through operation, to completion.
- Share knowledge about error reduction processes and systems.
- Improve skills across the sector, creating a positive approach to pre-empting error.

WHAT ARE ERRORS AND WHY DO THEY OCCUR?

GIRI's definition of an error is any action or inaction that results in a requirement for re-work, a requirement for extra work or produces a defect. (A defect is any failure to meet the project requirements at a handover.)

Errors can occur across the whole construction lifecycle: from upstream processes including raw materials processing and manufacturing, through to construction, commissioning and handover.

In 2016, GIRI produced a research report¹ on improving value by eliminating error. The research team used a 'Grounded Theory Method' to collect and analyse information on error in the UK construction industry. It identified the most financially significant causes of error and the most effective methods for avoiding or minimising the consequences of error. Figure 1 below, taken from the report, shows the 17 most prominent, ranked by importance.

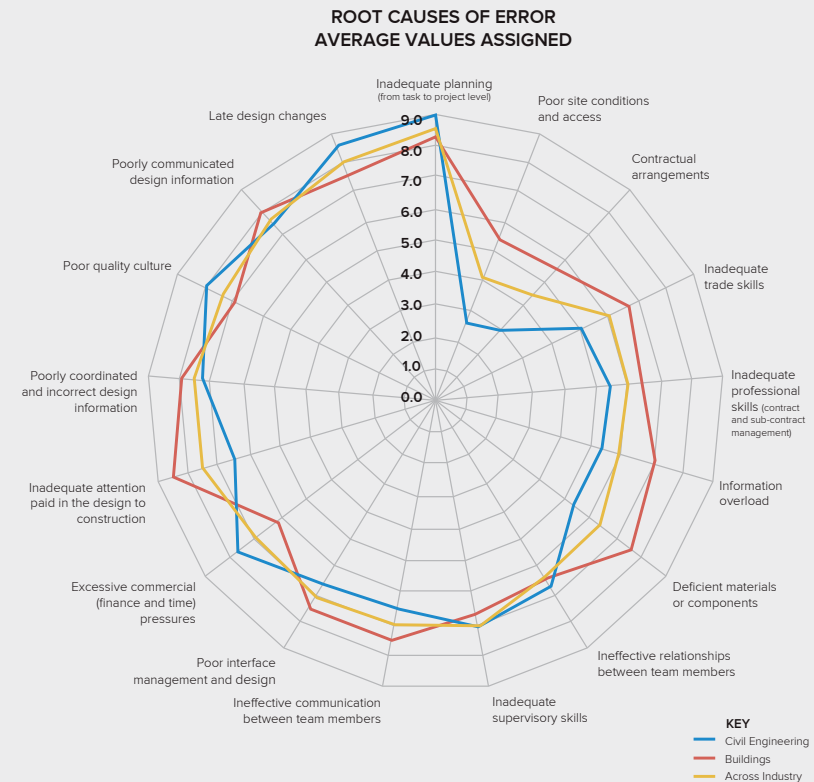


Figure 1 - 17 root causes of error – from the 2016 GIRI report

¹Get It Right Initiative - Improving value by eliminating error. Research Report, April 2016. www.getitright.uk.com/live/files/reports/3-giri-research-report-revision-3-284.pdf

NINE CATEGORIES OF TECHNOLOGY TO REDUCE ERROR

In October 2023, GIRI produced a report² on the use of technology to reduce errors in design and construction. It worked with the C-Tech Club, which is a global community of founders and CEOs of construction technology start-ups across 31 countries.

The C-Tech Club produces an annual Catalogue of Construction Technology Types³ and so the 2023 GIRI report assessed the root causes of error alongside the C-Tech Club Technology Categories to identify the types of technology that were most likely to contribute to error reduction. This analysis was developed further through discussions with asset owners, contractors, design consultants and start-ups themselves, to produce a more granular and detailed list of technology types, set out in Figure 2.

THE GIRI TECHNOLOGY WORKING GROUP

The GIRI Technology Working Group was reformed in the light of the 2023 Technology Report with a more practical focus. This meant creating a forum for quality managers, construction managers and design managers to engage with technology providers from both large AEC (Architecture, Engineering and Construction) software vendors and start-ups alike.

Speakers at meetings in recent months have included the founders of Morta, Contilio and Revicheck, as well as representatives of Microsoft, Google and Procore. The idea is that members of the Technology Working Group should share best practice and learn from each other and trial potential new solutions on behalf of the group. That way, the benefits of technology can be shared quickly and effectively.

TECHNOLOGY TYPE	SUB-TYPE	WAY IN WHICH ERROR MAY BE REDUCED	EXAMPLE TECHNOLOGY PROVIDERS
CHECKING TECHNOLOGY	BIM checkers	Identifies incorrect or omitted design information, allowing early correction of errors	<ul style="list-style-type: none"> Solibri Autodesk Model Checker
	Schedule checkers	Identifies inconsistencies and risks in project schedules	<ul style="list-style-type: none"> Nodes & Links Schedule Reader
	Data checkers	Identifies incorrect or omitted project information, allowing early correction of errors	<ul style="list-style-type: none"> Glider Technology Morta
	Checklists	Pre-empts errors by clarifying roles and avoiding human mistakes	<ul style="list-style-type: none"> CONQA Datamyte
AUTOMATED GENERATION TECHNOLOGY	Design configurators	Designs automatically according to rules, avoiding human error	<ul style="list-style-type: none"> Testfit Hypar Spacemaker (Forma) SiteSolve (Vu.City) Digital Blue Foam Archistar Laing O'Rourke Bridge Configurator
	Automated scheduling systems	Produces schedules automatically (before optimising them), based on recipes and production rates, avoiding human error	<ul style="list-style-type: none"> ALICE Technologies
WORKFLOW ENGINES		Captures and manages processes, avoiding errors between steps	<ul style="list-style-type: none"> ProcurePro Archdesk Applied Experience ProTenders Simple Construction
VISUALISATION SYSTEMS	Virtual Reality (VR) and Augmented Reality (AR)	Supports collaboration and greater precision between design models and on-site working	<ul style="list-style-type: none"> Fologram Argyle XYZReality RealWear
	Digital rehearsals	Allows teams to practise tasks before undertaking them on site	<ul style="list-style-type: none"> Rehearsive asBuilt Digital
COLLABORATION AND COMMUNICATION TOOLS		Allows tasks to be co-ordinated better, improving interface management	<ul style="list-style-type: none"> Symterra Letsbuild CoConstruct Mobilis Labs
COMPUTER VISION		Allows work undertaken to be captured and checked automatically	<ul style="list-style-type: none"> GenieVision Buildots Openspace Contilio
IOT SENSORS		Allows real-time data collection from sites to be monitored to avoid rework later	<ul style="list-style-type: none"> Ynomia Zerokery
DIGITAL SETTING-OUT TOOLS		Links live layout information from the field to digital models	<ul style="list-style-type: none"> Dusty Robotics Rugged Robotics Tiny Mobile Robots
DOCUMENT MANAGEMENT SYSTEMS		Improves version control document review, and document coordination	<ul style="list-style-type: none"> Qualomate Shapedo

Figure 2 - Nine categories of technology that can contribute to error reduction

²<https://getitright.uk.com/live/files/reports/11-giri-brochure-layout-d014-singlepages-212.pdf>

³<https://www.c-techclub.org/wp-content/uploads/2024/06/M19-C-Tech-Brochure-A4-2024-WEB.pdf>

DIGITAL MATURITY

In construction, digital tools are not used for their own sake. Rather, they enable projects to be designed and delivered safer, faster, cheaper and better (including, for example, with lower carbon).

They also help to join the stages of a project together more effectively, so as it progresses from design through to construction, assurance, commissioning and operations, the data needed for each subsequent stage is maintained consistently (the so-called 'golden thread').

Realising the full potential of digital tools requires a combination of:

Technology - tools must make a difference in the way in which tasks and activities are undertaken. Ideally these tools do not just work in isolation, but rather in combination. (A 'connected toolbox', rather than individual, isolated tools.)

Information - the right information must be provided to create the records needed to allow better decision-making and intervention. (The term 'information' is used rather than 'data', because information is data that has been processed, organised, and interpreted to add meaning and value.)

Processes - tools and information must be combined with processes for the way in which people carry out tasks and undertake their work. This is the point at which tools and information move from being an abstract idea to being central to normal working practice.

People - people working on the project must be trained and motivated to use the tools and information and to follow the processes. Of the four, people, or culture change, is perhaps the most important factor.

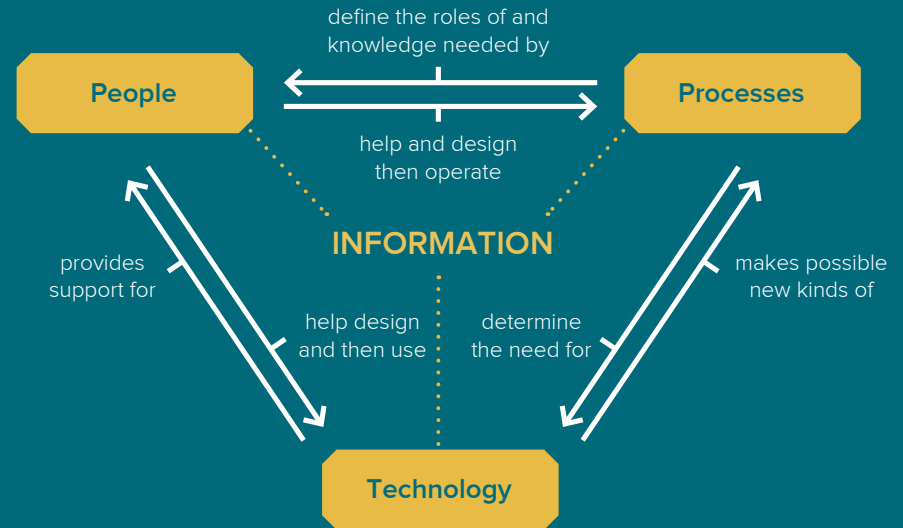


Figure 3 - The importance of people, processes, information and technology to support the development of digital maturity

THE STRUCTURE OF THIS REPORT

This report builds on the approach of the Technology Working Group of sharing best practice and learning from other organisations. To this end, it is essentially a case study document, built principally around the nine categories of technology that support error reduction as set out in the 2023 Report. (There are some additional case studies on pages 24 to 29 that illustrate lessons and benefits beyond the nine categories.)

GIRI welcomes recommendations and feedback about the use of technology to reduce errors, including any of the problems, solutions and other ideas set out in this document. We plan to produce additional versions of the report on a regular basis, since the technology will improve and change, and there will be new examples of successful best practice case studies. Please send your comments and ideas to admin@getitright.uk.com.

**THIS REPORT IS BUILT
PRINCIPALLY AROUND CASE
STUDIES THAT ILLUSTRATE
THE NINE CATEGORIES OF
TECHNOLOGY SUPPORTING
ERROR REDUCTION, AS SET
OUT IN THE 2023 REPORT.**



Photo credit: Sculpies

BEST PRACTICE CASE STUDIES

1a. Checking technology – BIM checkers

BIM CHECKERS ARE DATA VALIDATION TOOLS THAT AUTOMATICALLY DETECT MISSING OR INACCURATE DESIGN INFORMATION, ENABLING EARLY ERROR CORRECTION.



Project:

San Francisco International Airport T1 renovation

Contractor:

Hensel Phelps

Technology provider:

Invicara

> The challenge

The SFO T1 renovation project included extensive data handover mandates in the BIM execution requirements. These included gradual BIM data entry throughout the project lifecycle which, if done manually, would have been laborious and time-consuming. Validation would have been a monumental task.

> The technology solution

Invicara's BIM Assure allowed the team to generate rules and evaluate the model content using an automated checking approach.

> The benefits

Data quality went from a 60-70% initial success rate at the first deliverable check to a 90% success rate for the second delivery. It reduced data management efforts considerably: typically, a week's work to gather and check data for a milestone can be undertaken in half a day.

> The lessons learned

At first, the design and subcontractor teams were hesitant about the amount of work and effort that would be involved in the process, so good communication was essential. Once they saw how easy it was to enter the data with the specifically defined assets, attributes and values (determined ahead of time with the help of BIM Assure), they were prepared to embrace the new approach.

“ Data quality went from a 60-70% initial success rate at the first deliverable check to a 90% success rate for the second delivery. ”

1b. Checking technology – schedule checkers

✓ **Project:**
A303 Sparkford to Ilchester upgrade
Contractor:
Galliford Try Highways
Technology provider:
Nodes & Links

SCHEDULE CHECKERS ARE TOOLS THAT AUTOMATICALLY IDENTIFY INCONSISTENCIES AND RISKS IN PROJECT SCHEDULES.

> The challenge

To manage both internal teams and nine external subcontractors, along with dozens of monthly schedule updates, on the upgrade of a 3-mile section of the A303.

> The technology solution

Nodes & Links' Schedule Health Tool automates complex schedule integrity workflows and verifies each submission against predefined quality benchmarks. Every schedule update is automatically scrutinised for compliance with pre-defined quality criteria. If compliant, the data is integrated into the overall programme plan. If not, any discrepancies or errors are flagged instantly, and the tool generates correction reports.

> The benefits

A significant reduction in the time spent on manual reviews, ensuring that schedules remain consistently accurate. Moreover, the ability to identify and resolve issues in real-time strengthens the programme's responsiveness to change.

> The lessons learned

Working with high-quality data is crucial to the success of any project. In the past, achieving consistent data quality across a complex project like the A303 upgrade seemed nearly impossible. However, intelligent automation has made this achievable, streamlining the process and ensuring data accuracy across multiple inputs. This helps minimise the risk of errors and misinformed decisions.



“ The ability to identify and resolve issues in real-time strengthens the programme's responsiveness to change.

1c. Checking technology – data checkers

DATA CHECKERS ARE TOOLS THAT IDENTIFY INCORRECT OR OMITTED PROJECT INFORMATION, ALLOWING EARLY CORRECTION OF ERRORS.



Image courtesy of Ministry of Justice



Project:
New Prisons Programme - HMP Millsike, York
Contractor:
Kier Group
Technology provider:
Morta

> The challenge

Historically, Kier's information delivery processes were manual, error-prone and difficult to scale, particularly when relying on Excel for task information delivery plans (TIDPs) and master information delivery plans (MIDPs).

> The technology solution

Morta is a database-driven platform for managing information delivery plans that brings spreadsheets and documents into one central hub. For this project, it automated the tracking of planned versus actual by connecting information delivery plans hosted on Morta with metadata from Trimble's Viewpoint Common Data Environment.

> The benefits

Automation of data handling has eliminated manual data processing to save time and, crucially, to reduce errors. Morta has enabled Kier to standardise its reporting mechanisms across multiple projects, improving consistency and reliability, and reducing setup time. Real-time dashboards have enabled faster decision-making and better project oversight.

> The lessons learned

Bringing the team on board with the new system required training and a shift in mindset from traditional manual processes to digital workflows. Approaching improvements iteratively also helped ensure buy-in and minimised change management.

“ Automation of data handling has eliminated manual data processing to save time and, crucially, to reduce errors.

1d. Data technology – checklists

CHECKLISTS PRE-EMPT ERRORS BY CLARIFYING ROLES AND AVOIDING HUMAN MISTAKES.



Photo credit: architect Ashley Muir, Mason & Wells Architects

“ The improvements to the QA process have had added benefits in terms of culture and morale.



Project:

Fisher & Paykel Stewart Building, New Zealand

Client:

AE Smith

Technology provider:

CONQA

> **The challenge**

Mechanical and HVAC services contractor AE Smith was losing up to 10% of each project's value to rework because of errors. Its existing paper-based quality assurance process was proving difficult to audit, so AE Smith sought a robust and easy-to-use digital QA tool to help to drive and deliver improvements.

> **The technology solution**

CONQA enables AE Smith staff to complete Inspection and Test Plans and associated checklists on their phones while working on site, even if they are offline. QA information is captured digitally and stored centrally to be accessed by anyone, anywhere in real-time.

> **The benefits**

The platform has improved communication and feedback, helping to ensure work is right first time. The project illustrated was delivered with zero defects, ahead of schedule and under budget. There are also benefits in terms of more detailed and timely QA reports and the capability to plan and forecast more accurately.

> **The lessons learned**

The CONQA tool has encouraged accountability and reduced conflict, particularly given the significant time saved on rework. As a result, QA procedures that were once perceived as time-consuming administration are now seen as key to high-standard project outcomes – and therefore to the success of the business.

2a. Automated generation technology – design configurators



Project:
Lot 2, Severn Trent AMP-7 framework
Contractor:
Forkers Ltd
Technology provider:
GHD Automation Studio

DESIGN CONFIGURATORS CREATE DESIGNS AUTOMATICALLY USING RULES, AVOIDING HUMAN ERROR AND REDUCING TIME AND COST.

> The challenge

Forkers is delivering the design and construction of clean water infrastructure and sewage treatment schemes for Severn Trent under its AMP-7 framework. This has involved multiple, repeatable design tasks where they wanted to drive efficiency and accuracy.

> The technology solution

GHD's design automations connect the stages of the design process, automating these where possible. GHD Automation Studio starts with streamlined design calculations that are then used to drive the creation of a 3D model and drawings. The output is a custom Revit model, specific to each design.

> The benefits

Design tasks that used to take days can now be done in a few minutes, with the rules-based system producing designs and design calculations that are 100% accurate every time. Automation also refines the design, minimising material use, carbon and labour to optimise the project.

> The lessons learned

Some design tasks are ideal for a configurator; others require more customisation or human input. GHD Automation Studio therefore works best as part of an overall approach to design efficiency, rather than as a complete design solution.



“ Design tasks that used to take days can now be done in a few minutes – the rules-based system produces 100% accurate designs. ”

2b. Automated generation technology – automated scheduling systems



Project:

HS2 Colne Valley Viaduct

Contractor:

Align JV (Bouyges Travaux Publics, Sir Robert McAlpine, VolkerFitzpatrick)

Technology provider:

ALICE Technologies

AUTOMATED SCHEDULING SYSTEMS APPLY RULES-BASED SOLUTIONS TO GENERATE SCHEDULES IN WAYS THAT AVOID HUMAN ERROR.

> The challenge

Align JV was appointed to deliver a package of the HS2 high-speed rail project including a 3.4km viaduct. The Oracle Primavera P6 Standard for Planning and Scheduling had been mandated by HS2, so the construction schedule was in place, but Align wanted to test its assumptions and look for improvements.

> The technology solution

ALICE is a generative planning and scheduling system that captures the steps involved in construction processes in a series of ‘recipes’, along with production rate information. New scenarios can be explored, and schedules rapidly developed: because the recipes are rules-based, they will be right every time.

> The benefits

The Align team generated four months of duration savings on the finishes works. This was achieved by optimising the sequences, resources and calendars for the viaduct construction.

> The lessons learned

Evolutionary algorithms underpin ALICE, so what is key is to get the whole team to contribute data to help create the most accurate model possible. By ensuring that the project construction processes are captured accurately, the subsequent schedules will be error-free and fit-for-purpose.



“ New scenarios can be explored, and schedules rapidly developed: because the recipes are rules-based, they will be right every time. ”

3. Workflow engines

WORKFLOW ENGINES ARE SYSTEMS TO CAPTURE AND MANAGE PROCESSES AND HELP AVOID ERRORS BETWEEN STEPS.



Project:
NEXTDC Data Centres, Australia
Contractor:
Kapitol Group
Technology provider:
ProcurePro

> The challenge

Data centres are large-scale facilities requiring the integration of numerous systems, so procurement of the various suppliers can be particularly complex. As a major builder of data centres in Australia, Kapitol Group sought an innovative procurement strategy for its NEXTDC contract.

> The technology solution

ProcurePro tracks budget, tender and contract status, providing automated reporting and real-time visibility. It is based around a workflow engine system that tracks every step in the procurement and contracting process, clarifying where responsibility for each step lies and following up any delays or omissions.

> The benefits

Data is aggregated across all projects, which enables knowledge sharing and facilitates comparisons on price and performance. Lead times and completions are auto-tracked and contracts auto-generated, minimising human error on data entry. Kapitol has seen time savings of 25-50% in contract administration and 10-20% savings in project management across the NEXTDC contracts.

> The lessons learned

It was important that ProcurePro integrated seamlessly with Kapitol's existing construction management and finance software.

“ Kapitol has seen time savings of 25-50% in contract administration and 10-20% savings in project management across the NEXTDC contracts.

4a. Visualisation systems – Virtual Reality and Augmented Reality

VR AND AR SUPPORT COLLABORATION AND GREATER PRECISION BETWEEN DESIGN MODELS AND ON-SITE WORKING.



“ EVE demonstrates the value of early collaboration and the benefit of considering temporary works early on in a project’s lifecycle.



Project:

Scottish Water renewal project, Happendon

Contractor:

George Leslie Ltd

Technology provider:

EVE (Engineer; Visualise; Explore) developed by Mabey Hire

> The challenge

The site was close to a busy dual carriageway, with differing ground levels and existing live power cables. The project involved relaying 1,200 metres of new water main pipe, connecting this to the old cast iron mains, and casting a large concrete thrust block within a cofferdam. The highly constrained location meant that available working space was extremely limited.

> The technology solution

EVE enabled the engineering design team to visualise the site context (including the existing infrastructure) within the immersive environment. This allowed the team to carefully consider the proposed temporary and permanent works design and assess its constructability, access issues and any potential safety concerns.

> The benefits

EVE reduced the likelihood of errors or design clashes, as well as improving the overall site health and safety. Once works had commenced, EVE enhanced communication with site operatives, providing a visual brief on what was to be excavated and installed and the related risks. The EVE metadata was used to create project-specific Risk Assessment Method Statements (RAMS) to further improve health and safety.

> The lessons learned

The project showed how immersive technology can deliver improved accuracy, site safety and time savings. It also demonstrated the value of early collaboration, particularly the benefit of considering temporary works early on in a project’s lifecycle.

4b. Visualisation systems - digital rehearsals

DIGITAL REHEARSALS ALLOWS TEAMS TO PRACTISE TASKS BEFORE UNDERTAKING THEM ON SITE.



“ The team inducted over 900 personnel using the Igloo system in less than two weeks.



Project:

Major construction project, Newfoundland, Canada

Contractor:

AtkinsRéalis, as part of the SDP joint venture

Technology provider:

Igloo Vision

> The challenge

In 2022 the SDP joint venture was faced with onboarding a workforce of 1,200+ to complete the most technically challenging operation of the major project. They sought a solution that could provide a virtual training environment of multiple unique work areas, illustrate the stages of operations, convey the importance of safety protocols, and the experience of working at height.

> The technology solution

Igloo Immersive Space is a 6-metre cylinder with floor projection, powered by 8 Epson projectors, an IMPII (Igloo Immersive Media Player) and Igloo Core Engine operating system.

AtkinsRéalis' Creative Design team used the Unity game engine to create interactive training scenarios using the project's BIM data to create a series of virtual walkthroughs. These were integrated with the Igloo Core Engine and the floor projection seamlessly stitched together the content across the walls and floor of the space for a fuller immersive experience.

> The benefits

Igloo Vision was chosen because it could support high volumes of training, with fifteen inductions possible in each session. At one stage, the team inducted more than 900 personnel using the Igloo system in less than two weeks.

> The lessons learned

Enabling the project workforce to be properly trained and ready to go in such a short time frame significantly reduced risks and helped prevent costly mistakes.

5. Collaboration and communication tools

✓ **Project:**
Grantham Southern Relief Road - Phase 2
Contractor:
Galliford Try Highways
Technology provider:
Eave

TECHNOLOGIES THAT SUPPORT TASK COORDINATION AND TEAM MANAGEMENT ARE ESSENTIAL TO REDUCING HUMAN ERROR.

> The challenge

Risk assessments on this A1 junction and underpass scheme led to the recommendation that team members should be equipped with passive ear defenders and foam earplugs. However, team leaders were concerned that this traditional form of hearing protection inhibits effective communication, exacerbating the risk of errors.

> The technology solution

Eave FocusLite ear defenders offer level-dependent hearing protection that automatically adjusts to combat rising noise levels whilst offering advanced sound amplification to enable effective communication. These are supported by the Eave Peak platform, to profile individual noise exposure and manage equipment across the whole team.

> The benefits

Traditional devices block all sound indiscriminately, reducing situational awareness and increasing the risk of accidents. As the Eave defenders have electronic noise filters, blocking harmful noise but not conversation, they dramatically reduce the risk of errors resulting from miscommunication.

> The lessons learned

The hard data that the Peak platform provided transformed Galliford Try's ability to educate operatives. It meant that project leaders could talk meaningfully about harmful noise on the project, which drove up wear rates, improving health and safety on site.



“ As the Eave defenders have electronic noise filters, blocking harmful noise but not conversation, they dramatically reduce the risk of errors resulting from miscommunication.

6. Computer vision

COMPUTER VISION ALLOWS DEFECTS TO BE SPOTTED, WORK TO BE CHECKED AND PROGRESS TO BE TRACKED AUTOMATICALLY.

> The challenge

Local authorities have a statutory responsibility to inspect defects on the road network, which is typically done through manual inspection. Ringway Jacobs, working for the Essex Highways Department, wanted a technology system that was safer and more effective than manual inspection.

> The technology solution

Route Reports uses a proprietary camera system mounted in vehicles to take a continuous feed of the road in front of it. Its algorithms are trained to spot defects, faded white lines and damaged or obscured signs. Processing is local to avoid large flows of data to the cloud, and the results are uploaded to a 'digital twin' dashboard linked to a workflow management tool.

> The benefits

The system takes human inspectors away from the risky live road environment. Because it monitors defects every time a vehicle drives by, it can assess how quickly they are degrading, helping to prioritise the works programme. This gives Essex County Council an increasingly accurate record of the state of its roads, which helps with the management of claims and resource prioritisation.

> The lessons learned

The system does not replace human workers: rather, it helps ensure that they focus on higher value tasks.



Project:

Highways Term Maintenance, Essex County Council

Contractor:

Ringway Jacobs

Technology provider:

Route Reports



“ The council now has an accurate record of the state of its roads, which helps with the management of claims and resource prioritisation. ”

7. Internet of Things sensors

'INTERNET OF THINGS' MONITORING SENSORS PROVIDE REAL-TIME DATA TO HELP AVOID LATER REWORK TO CORRECT MISTAKES.

> The challenge

Western Yards is a 49-storey residential tower in a dense urban environment, constructed with post-tensioned slabs and a self-climbing jump form system for the core walls. As traditional concrete monitoring methods are inefficient and prone to inaccuracies, Keltbray sought an innovative solution to ensure the concrete reached the required strength for both initial and full stressing in a short timeframe.

> The technology solution

Converge's Helix system employs advanced IoT sensors with long-range wireless technology that allows safe and secure placement across a construction site. This enabled the strength development and thermal profile of the concrete to be continuously monitored. Data-driven decision-making on when to strike forms was made possible, and the system also helped optimise the concrete pour cycle by reducing the risk of premature strikes or excessive curing times.

> The benefits

Automated continuous monitoring cut the risk of human error while ensuring that concrete was struck at the optimal time, preventing structural issues. The system also improved efficiency, optimising pour cycles and reducing the downtime associated with traditional testing. This in turn cut costs and supported safer working.

> The lessons learned

The benefits of digital technology are multifaceted: on this project the use of sensor technology enhanced accuracy, efficiency, safety, cost and carbon.



Project:

Western Yards Development, Bankside Yards, London

Contractor:

Keltbray

Technology provider:

Converge



“ Automated continuous monitoring cut the risk of human error while ensuring that concrete was struck at the optimal time, preventing structural issues.

8. Digital setting-out tools

DIGITAL SETTING-OUT TOOLS LINK POSITIONAL INFORMATION FROM THE FIELD TO DIGITAL MODELS.



“ Mistakes and deviations were quickly apparent when the ‘living’ 3D visualisation was compared to the BIM360 model, reducing human error and the time spent on corrective work.



Project:
Heathrow Cargo Tunnel Refurbishment
Contractor:
Mace Group
Technology provider:
BuildingPoint UK and Ireland

> The challenge

The Heathrow Cargo Tunnel is a high-risk working environment in a border-controlled airside zone and is only accessible between 9pm and 5am to avoid disrupting cargo operations. There are limited up-to-date records of site conditions.

> The technology solution

BuildingPoint UK & Ireland supplied the Boston Dynamics Spot® - Agile Mobile Robot; a Trimble X7 3D Laser Scanner; a Trimble RTS873 Robotic Total Station for mechanical set out; and Trimble CloudEngine 3D Point Cloud Processing Software.

The mobile robot and scanner were deployed to measure and visualise inaccessible and unsafe areas of the tunnel. The data was exported directly into BIM360 to give all project stakeholders access to the survey. As the project progressed, the Trimble CloudEngine software effectively created a ‘living’ document using point cloud data to monitor and track progress.

> The benefits

Mistakes and deviations were quickly apparent when the ‘living’ 3D visualisation was compared to the BIM360 model, reducing human error and the time spent on corrective work. In total, the project saw a seven-week reduction against all milestones.

> The lessons learned

The strategic placement of control points is very important to maintain spatial accuracy. Avoiding obstructions or closures was essential.

9. Document management systems/ Common Data Environments

DOCUMENT MANAGEMENT SYSTEMS IMPROVE VERSION CONTROL, DOCUMENT REVIEW AND CO-ORDINATION AS PART OF THE FUNCTIONALITY OF COMMON DATA ENVIRONMENTS (CDES).



“ A single source of shared project data enables better decision-making at project gateways, reducing wastage and the need to resurvey existing information.

✓ **Project:**
Capital portfolio management
Contractor:
Heathrow Airport
Technology provider:
Autodesk Construction Cloud

> The challenge

Heathrow needed a robust, centralised source of asset information to avoid people working with the wrong information, especially at the interface of construction and maintenance. This is essential for safe and efficient operations.

> The technology solution

Autodesk Construction Cloud (ACC) organises, distributes and shares files as a single, connected environment. Its access and permission tools and customisable sharing options improve version control and compliance. All documentation can be accessed through a web or mobile browser with no need for specialist tools, allowing the team to monitor the status of deliverables, and enabling project managers to track project and programme performance more effectively.

> The benefits

Enhanced information makes it easier to co-ordinate working between projects and operations. Having a single source of shared project data enables better decision-making at project gateways, reducing wastage and the need to resurvey existing information. At a day-to-day level, the result is fewer errors and wasted effort. At a macro level, the higher-quality and better assured data leads to improved investment decisions.

> The lessons learned

Training and the use of clear and consistent messaging is important to get colleagues to change their behaviours. Following document management procedures is everyone's responsibility and needs to become business-as-usual.

10. Quality management systems (1)

QUALITY MANAGEMENT SYSTEMS SUPPORT AND ENHANCE COMPANIES' QUALITY ASSURANCE PROCESSES USING DATA AND DIGITAL TOOLS.

> The challenge

Excellerate faced several challenges in its quality control processes for the assembly of modular electrical buildings (MEB) for data centres. Where out-of-calibration torque wrenches were used, or paperwork related to torque logs and QC signoffs was lost or inaccurate, rework and re-documentation was both time-consuming and necessary.

> The technology solution

The Cumulus Quality Execution System integrates the client QA and contractor QC into a single workflow.

Excellerate deployed Cumulus with Bluetooth-enabled (BLE) torque wrenches to accurately record applied torque values. Field workers used the Cumulus mobile application to follow guided workflows, ensuring proper documentation of each torque application. Integration with BIM 360 software ensured seamless documentation upload.

> The benefits

As well as faster module production, Cumulus eliminated issues with lost paperwork. Document Control personnel could easily review and upload Cumulus PDFs to the client's BIM360 software, saving time and reducing errors.

> The lessons learned

Wider adoption requires the support of senior management and integration with existing client systems. A trial period helped build trust.



Project:

Data centre module fabrication

Contractor:

Excellerate, a division of Faith Technologies

Technology provider:

Cumulus Digital Systems



“ Wider adoption requires the support of senior management and integration with existing client systems.”

10. Quality management systems (2)

QUALITY MANAGEMENT SYSTEMS ALSO HELP TO REDUCE ERRORS ACROSS SUPPLY CHAINS AND WHERE TRANSPORTATION AND LOGISTICS ARE INVOLVED.

> The challenge

For off-site pre-cast production, errors made during production and installation are often missed or only identified at a late stage, causing scheduling issues.

> The technology solution

Visibuild generates unique QR codes that are then affixed to each pre-cast concrete panel. Icon and the supply chain were able to complete over 2,400 individual quality checks throughout the production and installation process.

This was based around the implementation of a fabrication checklist to verify that each panel was produced in accordance with approved shop drawings, with the correct reinforcement detailing and concrete mix. After the panel was placed into position, an installation checklist was used to ensure that all elements had been grouted, panel junctions were sealed and stitch plates welded.

> The benefits

This unique QA process resulted in a high standard of workmanship and a reduction in error and rework, with just one offsite production defect and 18 minor install defects across 200 individual panels.

> The lessons learned

This enhanced communication and coordination between Icon and the supply chain not only reduced errors, but also produced a positive cultural change towards quality assurance.



Project:

Kingston Residential Aged Care Development, Melbourne

Contractor:

Icon

Technology provider:

Visibuild



“ The enhanced communication and coordination between Icon and the supply chain not only reduced errors, but also produced a positive cultural change towards quality assurance.

11. Digital twins (1)

‘DIGITAL TWINS’ IS A BROAD TERM; IN THIS CASE WE MEAN SYSTEMS THAT CAN STORE AND MANIPULATE 3D INFORMATION ABOUT BUILDINGS.



“ Workers placed a sticker with a QR code on each panel and installation site and took photographs at each stage of the replacement process, uploading these to form a digital record.



Project:

Combustible cladding panel replacement project, Adelaide

Contractor:

Hindmarsh Construction

Technology provider:

asBuilt Digital

> **The challenge**

The Adelaide project was a 26-floor high-rise commercial building with 3,100 identical façade panels that did not meet current safety standards. Hindmarsh needed to ensure that every panel was replaced and verified in accordance with strict regulatory standards. Traditional, paper-based checking processes would have been cumbersome and bureaucratic.

> **The technology solution**

Hindmarsh used asBuilt’s Vault platform, featuring its spatially intelligent Status Tracker solution, with Microsoft Azure cloud-based data storage. Workers placed a sticker with a QR code on each panel and installation site and took photographs at each stage of the replacement process, uploading these to form a digital record.

> **The benefits**

The digital workflow reduced errors as workers simply scanned the QR codes and uploaded photos instantly. The spatial and time stamp metadata of these enabled Vault to guide users to the precise location of each. Duplicates, anomalies and corrupted files were automatically detected. AI offered enhanced data-driven insights into project productivity when correlated with ingested sensor weather sensor data. Overall, the system provided a comprehensive audit trail, and a complete and accurate handover record.

> **The lessons learned**

Compliance and sub-contractor performance is enhanced when there are clear, transparent and open mechanisms for reporting and checking progress.

11. Digital twins (2)

‘DIGITAL TWIN’ CAN ALSO BE USED TO DESCRIBE TOOLS THAT ENABLE THE COMBINATION AND VISUALISATION OF DATASETS, INCLUDING THOSE FROM BIM AND PHOTOGRAMMETRY.



“ The technology allowed multi-disciplinary planning, issue tracking and geometrical control, all within a single digital environment.



Project:
Nygårdstangen Bergen-Fløen project (NBF)
Contractor:
Bane NOR
Technology provider:
Novorender

> The challenge

The scope involved doubling the capacity of the Nygårdstangen freight terminal and expanding the railway between Bergen and Fløen from single to double track. Bane NOR wanted to deploy Virtual Design & Construction principles but lacked a structured approach to data management. It sought an easy-to-use and fast-loading unified 3D visualisation tool and a Project Information Model (PIM) to bring the benefits of model-based construction to the NBF project.

> The technology solution

Novorender served as the viewer and integrator of all 3D models and associated data within the project, allowing multi-disciplinary planning, issue tracking and geometrical control, all within a single digital environment.

> The benefits

The NBF project successfully established a ‘single source of truth’ in line with ISO 19650 standards, thanks to Novorender’s Common Data Environment (CDE) and Project Information Model (PIM). Its 3D visualisation tool enabled errors to be caught and corrected before construction. Overall, Bane NOR reduced construction costs by more than EUR 20m, construction time by 40% and railway closure time by 67% by fully adopting BIM in Novorender.

> The lessons learned

It is important to define fully software requirements from the project outset and investing in digital training is essential. The link between the BIM model and commissioning systems – the ‘digital handover’ – is also often not considered as early and fully as it should be to effectively close the loop from construction to operations and maintenance.

12. Forms and databases



Project:
Usher Institute, Edinburgh
Contractor:
McLaughlin & Harvey
Technology provider:
Lessonflow

‘LESSONS LEARNED’ SYSTEMS CAN MAKE IT EASIER TO IMPLEMENT PROCESSES AND CORRECTIVE ACTIONS TO ENSURE CONTINUOUS IMPROVEMENT.

> The challenge

McLaughlin & Harvey faced challenges in managing lessons learned because, although this knowledge was captured, it was not centralised or effectively shared across the wider business.

> The technology solution

Lessonflow is a customisable ‘Lessons Learned’ management system that includes analytics, a powerful search function and an auditable action system.

McLaughlin & Harvey is using Lessonflow to capture lessons from tenders; to investigate one-off situations ensuring either that best practices are repeated, or errors are prevented in the future; and to conduct project close-out reviews with site teams.

> The benefits

The whole business now benefits from the intelligence gathered from individual projects and business functions, reducing the errors endemic to siloed behaviours. Collaboration and communication have improved with the system making it easier for information about improvements to pass from owner, to sponsor to head of function. The system also supports the requirements of McLaughlin & Harvey’s ISO9001 certification on lessons learned.

> The lessons learned

Engaging department heads early on to tailor the Lessonflow system helped to meet the practical needs of its users. This, in turn, facilitated smoother adoption.



Photo credit: McLaughlin & Harvey

“ Collaboration and communication have improved with the system making it easier for information about improvements to pass from owner, to sponsor to head of function.

13. Change management

SUCCESSFUL IMPLEMENTATION OF TECHNOLOGY REQUIRES A COMBINATION OF TECHNOLOGY, PEOPLE, PROCESS AND INFORMATION – ALL COMBINED THROUGH CHANGE MANAGEMENT.



“ Involving end users early in the process not only helped foster buy-in but also supported the acceptance of subsequent changes.



Project:
CARA Brickwork change management
Client:
CARA Brickwork
Change management partner:
RED Jam

> The challenge

CARA Brickwork wanted to strengthen its on-site quality assurance as providing regular, real-time updates to clients was becoming increasingly important. It wanted a solution that streamlined on-site processes, reduced reliance on paper and enabled real-time communication with clients.

> The technology solution

Trimble Viewpoint Field View is a field management tool that enables users to create snag lists, tasks and workflows and to capture and share live on-site data via dashboards.

Its implementation was managed by RED Jam who undertook a thorough review of existing paper-based processes, engaging with project teams to understand pain points and areas for improvement. Based on the findings, key processes were redesigned and streamlined before being automated within the system. All new forms and processes were then piloted on a live project.

> The benefits

The introduction of standardised processes, customised forms and image capture has led to improved site quality and compliance. Additionally, access to both historical and live digital records support the ‘golden thread’ of information necessary for compliance with the Building Safety Act.

> The lessons learned

Involving end users early in the process not only helped foster buy-in but also supported the acceptance of subsequent changes, demonstrating the crucial role of user involvement in the digital transformation process.

NEXT STEPS

THIS REPORT SETS OUT PRACTICAL EXAMPLES OF TECHNOLOGY SUCCESSFULLY DEPLOYED TO HELP REDUCE ERRORS IN DESIGN AND CONSTRUCTION. A KEY MESSAGE IS THAT THE TECHNOLOGY EXISTS AND IS AVAILABLE.

The categories of technology in this document form part of a possible digital toolkit available to quality managers and others within asset owners, contractors and consultancies. The first question is – which types of tools are most suitable for your projects? Then – how can you best implement that technology to bring about successful change? We hope that the examples in this report will be of relevance to both questions.

GIRI will continue to support the sharing of best practice around technology, bringing together technology providers and those who need and benefit from their digital tools. Our Technology Working Group has nearly 30 members from across utilities, housebuilders, contractors, consultants, large AEC software vendors and start-ups. It is open to all GIRI members to join. If you are interested in learning more about the Group, then please email admin@getitright.uk.com.

A PARTICULAR FOCUS FOR THE TECHNOLOGY WORKING GROUP IN 2025 WILL BE THE USE OF AI TO REDUCE ERRORS AND, CONVERSELY, ITS POTENTIAL TO BE A CAUSE OF ERROR.

ACKNOWLEDGEMENTS

GIRI IS VERY GRATEFUL TO THE FOLLOWING WHO HAVE CONTRIBUTED TO THE PREPARATION AND PRODUCTION OF THIS REPORT.

Claire Penny (Invicara), Brooke Wandler (Nodes & Links), David Lowery (Galliford Try Highways), Mohammad Shana'a (Morta Technology), Thomas Crossley (Kier Strategic Projects), Ashley Dawson (Kier Strategic Projects), James Franklin (Kier Group), Daniel O'Donoghue (CONQA), Jeff Wright (AE Smith), Joe Charles (GHD), Dylan Marshall (ALICE Technologies), Nick Podevyn (Align JV), Alastair Blenkin (ProcurePro), Andrew Deveson (Kapitol Group), John Wrigley (Mabey Hire), Scott McCaw (George Leslie), Jessica Davey (Igloo Vision), Darren Grears (AtkinsRéalis), Claire Taylor-Allen (AtkinsRéalis), David Greenberg (Eave), Edward Wells (Galliford Try), Connell McLaughlin (Route Reports), Lizzie Toole (Converge), Jamie Tew (Converge), Yeganeh Mazaheri (Keltbray), Sam Hough (BuildingPoint UK and Ireland), Cameron Johnson (Mace Group), Tim Pritchett (Autodesk), Nigel Stroud (Heathrow), Matthew Kleiman (Cumulus Digital Systems), Dom Pound-Palmieri (Visibuild), David Burton (asBuilt Digital), Pål-Christian Njølstad (Novorender), Ralph Young (Lessonflow), Derek Geyer (McLaughlin & Harvey), Andy Almey (RED Jam), Neil Allen (CARA Brickwork), David Mitchell (XYZ Reality).

COMPANIES FEATURED:

Invicara (invicara.com) • **Hensel Phelps** (henselphelps.com) • **Nodes & Links** (nodeslinks.com) • **Galliford Try Highways** (gallifordtry.co.uk) • **Morta** (morta.io) • **Kier Group** (kier.co.uk) • **CONQA** (conqa.com) • **AE Smith** (aesmith.com.au) • **GHD Automation Studio** (ghd.com) • **Forkers** (forkers.com) • **ALICE Technologies** (alicetechnologies.com) • **Align JV** (alignjv.com) • **ProcurePro** (procurepro.co) • **Kapitol Group** (kapitolgroup.com.au) • **Mabey Hire** (mabeyhire.co.uk) • **George Leslie** (georgeleslie.co.uk) • **Igloo Vision** (igloovision.com) • **AtkinsRéalis** (atkinsrealis.com) • **Eave** (eave.io) • **Route Reports** (routereports.com) • **Ringway Jacobs** (ringway-jacobs.co.uk) • **Converge** (converge.io) • **Keltbray** (keltbray.com) • **BuildingPoint UK and Ireland** (buildingpointukandireland.com) • **Mace Group** (macegroup.com) • **Autodesk Construction Cloud** (construction.autodesk.co.uk) • **Heathrow Airport** (heathrow.com) • **Cumulus Digital Systems** (cumulusds.com) • **Excellerate** (faithtechinc.com/divisions/excellerate) • **Visibuild** (visibuild.com.au) • **Icon Construction** (icon.co) • **asBuilt Digital** (asbuiltdigital.com) • **Hindmarsh Construction** (hindmarsh.com.au) • **Novorender** (novorender.com) • **Bane NOR** (banenor.no) • **Lessonflow** (lessonslearnedsolutions.com) • **McLaughlin & Harvey** (mclh.co.uk) • **RED Jam** (redjam.co.uk) • **CARA Brickwork** (caragroup.co.uk)

The research for the report was carried out by John Priestland and Donnathea Campbell from **Priestland Consulting**.

Nick Robertson from **DesignBySmith.com** was responsible for the document design and layout.

Cover image courtesy of **XYZ Reality**. xyzreality.com

GIRI research has shown that errors in design and construction contribute to between 10 and 25 % of project cost, depending on size and complexity, amounting to roughly £10-25 billion annually in the UK construction sector. Technology and data can play a significant part in reducing this. But which types of technology are most relevant, and how can they best be deployed? This report, produced by GIRI, is intended to help answer these questions. Based on interviews with users and technology providers, with input from start-up founders from the C-Tech Club, it is a valuable reference source for quality managers and technology directors alike.

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Company Number: 10532177.

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