Developing Digital Competency in the Built Environment

Construction Leadership Council

Forewords

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The world around us is being digitally transformed, and the built environment is no exception. Digital capability in the built environment is no longer a specialist function, it is a core skillset that underpins how we plan, deliver, and operate the assets of tomorrow.

Yet across the sector, there is still no common understanding of what "digital competency" means. Without such a shared understanding, we risk fragmented progress at a time when coordinated action is essential.

This report, Digital Competency in the Built Environment, is a timely and strategic contribution to that conversation. Developed through the collaborative efforts of the Construction Leadership Council's 'Skills for a Modernised Industry' working group, this report offers a practical framework for organisations to assess their digital capabilities and identify areas for growth.

We need to build digital competency across the sector, from essential workers to the boardroom, building awareness of the ways in which digital solutions can be used to improve outcomes for the industry, whilst also investing in the necessary skills to make this happen.

The report does not advocate specific tools or technologies, instead it is a framework for building the right culture, mindset and behaviours, as tools alone will not transform our industry, but people will.

The rewards of building digital competency are tangible: improved productivity, enhanced safety (on-site and cybersecurity), and likely cost benefits. Additionally, it equips us to make improved decisions, collaborate with greater effectiveness, and deliver outcomes that benefit both society and the environment.

Our aim is to support leaders across the built environment in embedding digital competency into their organisations. I encourage you to explore the categories of competency, evaluate your own organisation's capabilities, and take action to embed these principles across your organisation. Together, we can create a digitally confident built environment where people are equipped to deliver better outcomes across the sector.

> Digital competency in the built environment is not the responsibility of a few, but is the shared mission of our entire industry. Leaders must champion this transformation by creating a digitally-enabled culture and empowering our people. By working together to raise digital competency across every organisation, we can deliver safer, smarter, more productive and sustainable outcomes for the industry.

***Mark Reynolds**, Executive Chairman, Mace;*
Co-Chair of Construction Leadership Council

EXECUTIVE SUMMARY

This report is aimed at organisations of all sizes across the built environment sector. The goal is to outline the core components of digital competency in organisations and provide a framework through which to evaluate maturity and identify areas for improvement.

Our aspiration is that the principles and competency statements set out are incorporated by your organisations, to enhance digital competency and expand the digital transformation of the built environment.

Opportunity statement

Core digital competencies across the built environment workforce enable organisations to use digital tools and technologies to achieve better outcomes for clients, businesses and projects, for example improved efficiency and productivity, better health and safety or lower whole life costs and carbon. This is not about advocating for the use of specific tools, technologies or software, but rather about building up foundational competency across the industry that supports an integrated, systems mindset in the use of digital solutions. However, there is no clear consensus about what constitutes core digital competency and how this applies across the sector.

This report provides information on:

- Context of digital competency in the built environment, understanding definitions, drivers and different tools and technologies
- Categorisation of core competencies that are applicable across the built environment
- Recommendations on what needs to be done by different stakeholders to support widespread upskilling in digital competence.

The goal is to support industry to upskill in data and digital competencies by illustrating why broader and enhanced digital competencies and more informed use of data are critical for an improved sector.

Understanding digital transformation

Investment in digital solutions by themselves do not necessarily deliver the intended benefits. Organisations need to ensure that the right people have the right competencies to maximise the value of investment in digital solutions. This should be driven from a mindset of digital transformation, with strong organisational leadership supporting investment in digital competence.

Digital transformation in the built environment goes beyond ‘digitisation’, which is simply transferring paper-based processes into digital formats, but instead refers to an outcomes-based mindset to transform industry through the integration of digital systems and technologies. This report highlights the importance of creating an integrated digital system and addressing the enabling factors to ensure that digital solutions deliver improved outcomes as expected instead of creating individual digital solutions that operate in siloes.

To provide the incentive for why investing in a core foundation of digital competency is critical for an improved sector, a summary section exploring the range of benefits is included. This gives some examples of the benefits that can be achieved across a variety of stakeholders, project stages and levels through implementing various digital tools, technologies or systems.

Developing the understanding of core digital competency

This report presents core data and digital competencies across the built environment workforce, covering all sectors and types of organisations. This classification of competencies helps organisations to understand the range of competencies that may be required for successfully implementing holistic, integrated data and digital solutions that support digital transformation. This helps organisations ensure that the right people have the right skills to implement both existing and new digital solutions effectively, and to identify what gaps in competence there may be, and what training and upskilling is needed to address these.

The competencies are described as organisational-level capability statements and can be used as knowledge, skill, or behaviour statements in competency frameworks. The emphasis is on broad, overarching competencies in all roles and not in digital-specific roles. They are grouped into two main categories:

Core transferable competencies: These are the foundational competencies that are applicable across the built environment. The level of expertise required will vary depending on the type of organisation and the type of projects undertaken.

Core specialist competencies: These explore the general competencies that are applicable for specific applications or use-cases, such as particular project phases or aspects of the built environment.

Actions and recommendations

To embed digital competencies effectively across the sector, organisations should begin by **assessing current capability levels** against the categories outlined in the classification. Use these to:

- Create a vision for digital competency in the organisation, addressing the ecosystem of people, processes and technology.
- Evaluate the current level of maturity or competency in each category, noting strengths and gaps
- Take action to address gaps by partnering with government and training providers to ensure appropriate training interventions are created

This assessment should be aligned with the organisation's strategic objectives, ensuring that digital upskilling supports business and industry outcomes such as improved productivity, safety, and sustainability.

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Acknowledgements

This report has been published under the Construction Leadership Council People & Skills workstream, by the Skills for a Modernised industry working group.

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Thank you to all those from industry who provided support in guiding, scoping, reviewing, and challenging this work.

SEPTEMBER 2025

The table below provides an overview of the categories of competence as described in this report

Core transferable competencies	Core specialist competencies
Digital Literacy and Fundamentals	**Design and planning**
Effective use of common digital tools and processes builds confidence in how these can be used to improve outcomes on projects and in businesses. This is the foundation for delivering improved performance through digital approaches.	Data and digital solutions are widely used to enhance project planning and design, for example in early stage optioneering, and evaluating projects against multiple parameters.
Digital Communication and Collaboration	**Modelling & Simulation**
Use of digital tools to support effective communication and collaboration across project stakeholders and within an organisation.	Virtual 3D modelling can facilitate better collaboration and stakeholder engagement as well as improving design accuracy, reducing errors or rework and facilitating resource management.
Legal and Ethical Considerations	**On site technologies, automation and robotics**
Understanding data privacy, cyber-security risks and legal requirements ensures digital practices are secure and compliant, protecting both business and client interests. This includes aspects such as copyright, intellectual property and ethical use of data.	There is a vast range of ways in which digital solutions support onsite delivery of construction projects, increasing productivity, enhancing safety and monitoring project progress and performance, for example through real-time data collection or health and safety innovation.
Exploring digital opportunities	**Asset management**
Driving digital transformation requires the ability to understand the problem that needs to be addressed and the desired outcome, evaluating available solutions that could be deployed and how these can be integrated into a system.	Monitoring in-use performance helps ensure assets (buildings or infrastructure) operate as intended. This can support activities such as planned and predictive maintenance, understanding operating costs, recording compliance with safety requirements and user satisfaction.
Data analytics and decision support	**Business management**
Effective data use involves understanding data types, managing and presenting data clearly, analysing data to generate insights and inform decisions, and using feedback loops to drive continuous improvement.	Digital business management tools streamline operations, improve insights into business performance, and help organisations run efficiently. This covers marketing and sales, employee management, invoicing and so forth.

Contents

1 Introduction

The Construction Leadership Council's vision as set out in the Industry Skills Plan was to "develop more widespread digital and data analytics skills to underpin future collaboration and productivity improvements in the sector"[1]. Core digital competencies across the built environment[2] workforce enable organisations to use digital tools and technologies and deliver digitally enabled projects that achieve better outcomes for clients, businesses and projects.

A competent workforce is the backbone of the built environment. This has been underpinned by the emphasis on competence in the Building Safety Act 2022, which follows the significant work in this area since the Hackitt Review and subsequent cross-sector working groups. However, competency is not only about technical capabilities. Competencies in essential non-technical aspects are equally important for a thriving industry.

This report focuses on the core data and digital competencies across the built environment workforce, covering all sectors and sizes of organisations. These are organisational level competencies that enable organisations to leverage data and digital tools and technologies to deliver better outcomes. The emphasis is on broad, overarching competencies in all roles and not in digital-specific roles.

A key challenge in encouraging digital competency in the built environment is the wide range of digital tools and technologies that are available and the rapid rate at which these are evolving. **There is no clear consensus about what constitutes core digital competency and how this applies across the sector.**

The goal is to support industry to upskill in data and digital competencies by illustrating why broader and enhanced digital competencies and more informed use of data are critical for an improved sector. To address this challenge, this report:

1 Outlines the categories of core transferable competencies needed in industry;

2 Illustrates practical examples of the application of these competencies at different levels of maturity; and

3 Explores examples of how digital tools and technologies can improve performance and lead to better outcomes.

1 CLC (2021) Industry Skills Plan for the UK construction sector 2021-2025

2 Note that a broad view of 'built environment' is taken in this report, encompassing all sectors and lifecycle phases of projects. This is not only about construction.

2 Why focus on digital?

Digital transformation in construction promotes modernisation of the industry and supports delivery of the industry's ambitions. Creating a foundation of competency in data and digital across the workforce is complementary to other strands of work in the CLC, for example encouraging diversity, improving industry's culture, and improving attractiveness of the industry.

Case studies across the sector demonstrate that there are pockets of excellence in the use of data and adoption of digital solutions to drive improvement in a range of business or project outcomes.[3] This highlights that whilst the technology and competencies exist, they are not yet embedded across the sector.

However, what is also evident in the sector is a data and digital 'overload'. For example, a project may use a wide range of technologies and software but may not have clear processes for integrating and analysing data or an understanding of how the systems can be integrated to improve outcomes or make better decisions. There are also generational and sectoral differences in willingness and ability to engage with the digital landscape.

Addressing these challenges requires a common understanding of the core data and digital competencies that are needed to ensure that digital tools, technologies, and systems deliver on the improvements that are expected.

This is not about technology, but about behavioural change and investing in digital competence:

> Technology itself is often the simplest part of the whole process. The difficulty is more around the people and the cultural change programme that comes along with it
>
> *Shojaei et al (2023)*

> The challenge is less about technology and more about clear leadership and soft-skills
>
> *Dr Bola Abisogun*

Barriers to digital competence include costs of investing in digital tools and training (especially for smaller firms), limited time for upskilling, and resistance to change within industry culture. Rapidly evolving technology can overwhelm workers, while uncertainty about measurable benefits discourages investment. Overcoming these challenges requires strong leadership supported by clear evidence of the benefits that can be achieved.

3 See the Appendix with examples of how digital tools deliver better outcomes

4 Shojaei, R.S., Oti-Sarpong, K. and Burgess, G. (2023) 'Leading UK Construction Companies' Strategies to Tackle BIM Training and Skills Challenges', International Journal of Construction Education and Research, 19:4, 383-404, DOI: 10.1080/15578771.2022.2123071

5 Dr Bola Abisogun OBE – Digital Twin Skills Academy; feedback received during report consultation process

3 Understanding the context

The definition of digital competence as used in this report is as follows

> Knowledge, skills, experience and behaviour required to leverage data and digital tools and technologies to enable better outcomes across the built environment value chain

3 Understanding the context

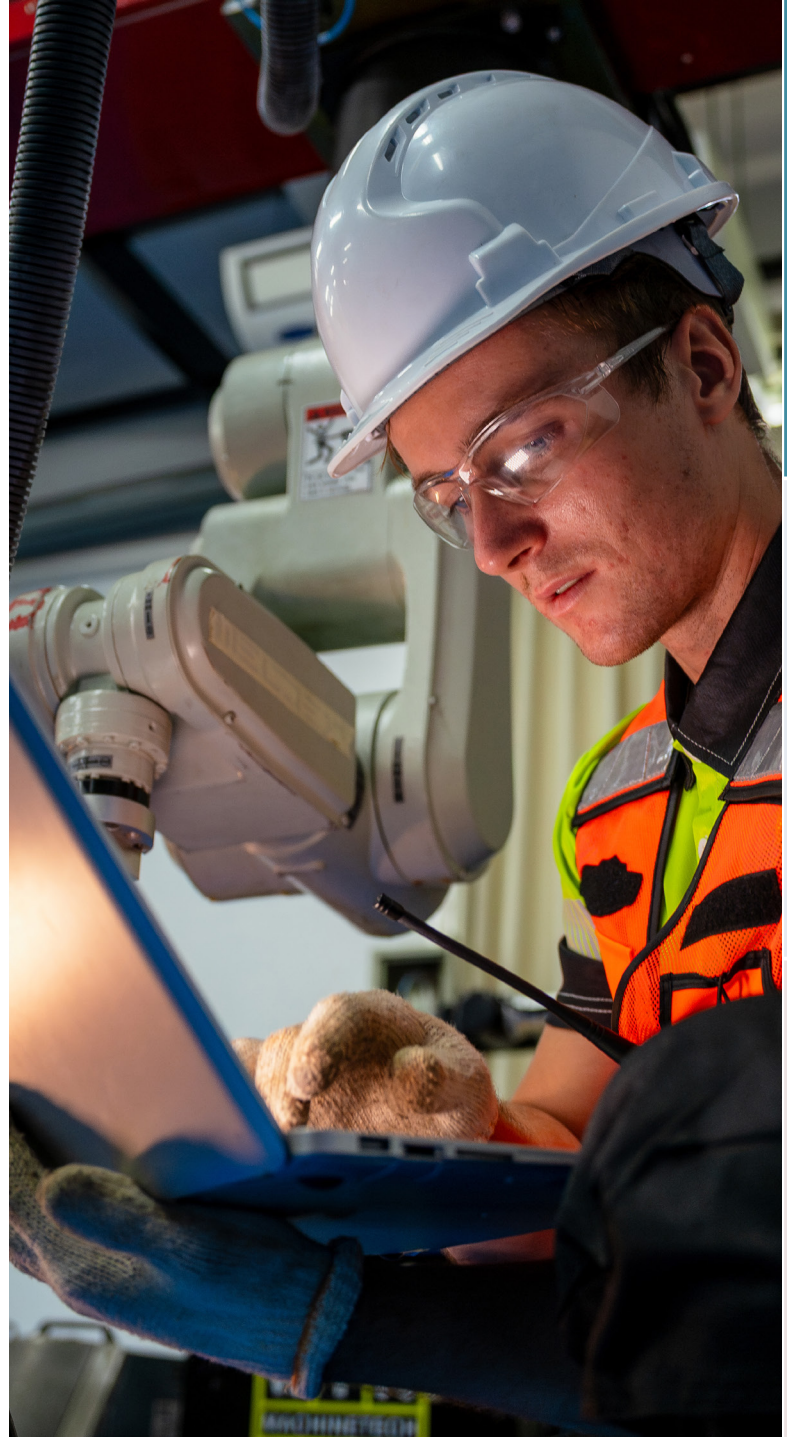
3.1 Definition – it is not all about technology

This about the underlying principles and transferable knowledge, skills, experience and behaviours[6] needed across the workforce to understand and apply data, digital tools and technologies to deliver desired objectives and improve outcomes in the whole spectrum of the built environment sector. This could be business objectives/outcomes, such as profitability, client relationships or talent management, or industry objectives/outcomes, such as productivity, cost effectiveness, quality, reducing carbon, or improving health, safety & wellbeing.

This is not about the use of specific technologies, tools or systems nor is it about specialist digital roles (such as developers, simulation modellers or data analysts), but instead about core competencies needed across the built environment workforce. This emphasises foundational skills, such as problem-solving and data literacy.[7]

This report addresses both office-based processes and construction or project related processes and systems. This is not just about having digital or online systems and processes for business (e.g. accounts, invoices etc.), but about the full spectrum of digital opportunities in running businesses and delivering projects, including technologies, automation and integration.

These competencies are much broader than simply 'digitisation', which is the transfer of analogue or paper-based data and processes into digital formats. 'Digitalisation' is the next step and is when digital technologies are used to change processes and systems, starting to create connections. 'Digital transformation' describes advanced integration of systems and processes encompassing technology, processes and cultural change as well as innovative business models to improve performance and delivery.[8] See Figure 1 for a visualisation of these concepts. Digital transformation is fundamentally about the mindset where data and digital processes are integrated across systems to transform businesses and projects. It is about the outcome and not about the tool or technology.



6 The definition of individual competence as per the Building Safety Act is "skills, knowledge, experience and behaviours". Since experience is difficult to define generically, experience is not included in the competence statements developed in this report.

7 A key finding of the report CITB report was the need for broad foundational skills. CITB (2018) Unlocking Construction's Digital Future: A skills plan for industry

8 Academic literature generally supports the view of 'digitisation', 'digitalisation' and 'digital transformation' as sequentially linked concepts. Examples include Papadonikolaki et al. (2020) Digital Transformation in Construction: Systematic Literature Review of Evolving Concepts ; Verina and Titko (2019) 'Digital Transformation: Conceptual Framework'

3.1 Definition – it is not all about technology *(continued)*

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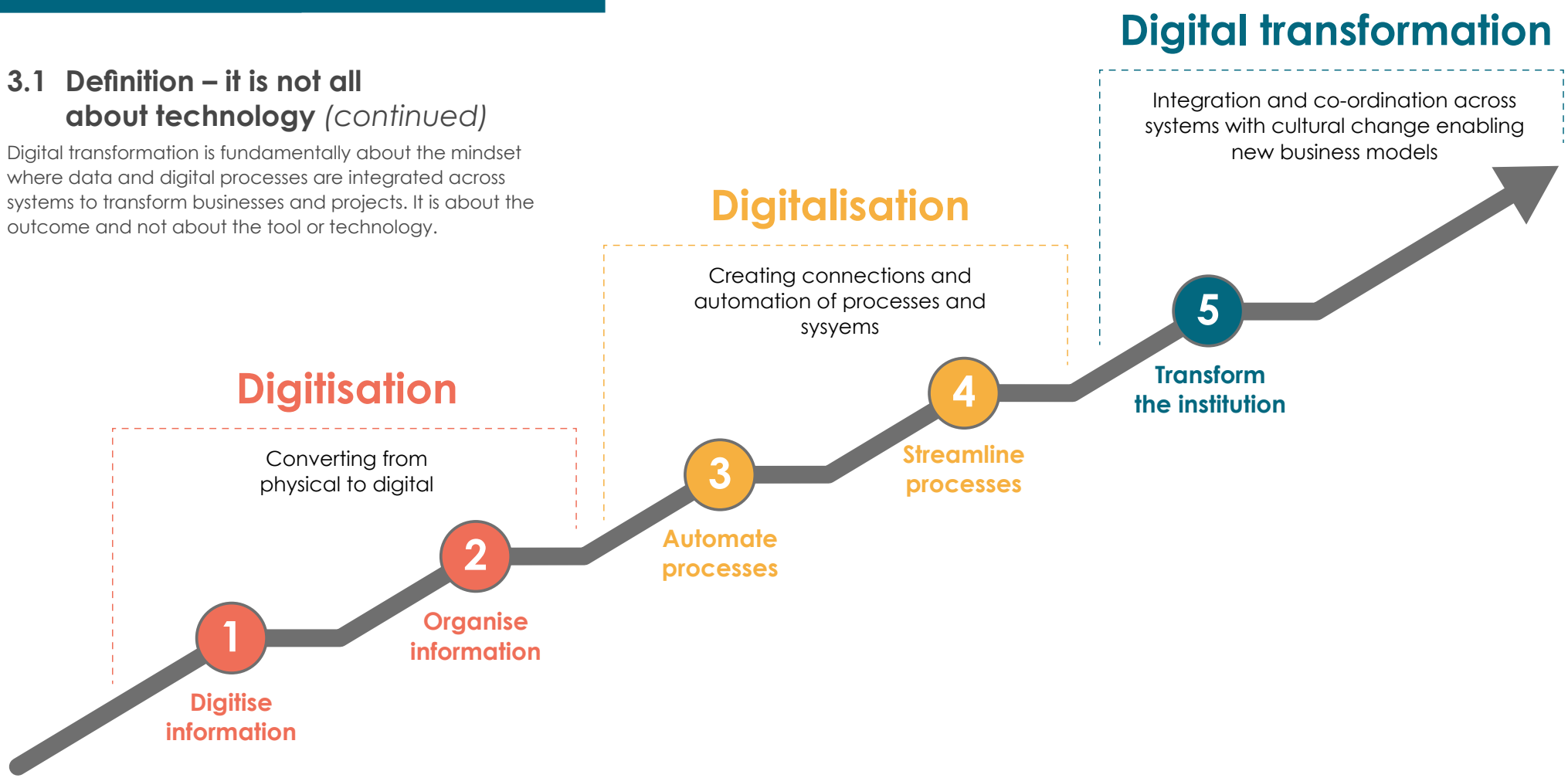


Figure 1: Conceptualising the progress from digitisation, to digitalisation and digital transformation.
(Adapted from source: Reinitz, 2020[9])

9 Reinitz (2020) Consider the Three Ds When Talking about Digital Transformation

3.1 Definition – it is not all about technology *(continued)*

Strong organisational leadership is important for creating a digitally-minded culture in an organisation. This then supports the implementation of systems and processes for digital integration, including workforce development and tools and technology, as illustrated in Figure 2. **From a competency perspective, the right people need to have the right skills to implement new digital solutions effectively**. There needs to be appropriate training and upskilling to ensure that this happens.

Note that workforce competence is one part of the process in digital transformation. Leadership and culture are critical in delivering change in industry. For other guidance about evaluating an organisation's digital readiness, see the information about PAS 1040 *'Digital readiness – Adopting digital technologies in manufacturing – Guide'* in the Appendix. Although this is written for manufacturing, the principles are applicable in the built environment.

Figure 2: A digitally-minded culture is critical for achieved desired outcomes when implementing digital approaches

3 Understanding the context

3.2 Examples of use of data and digital in the built environment

There is a wide range of digital tools, technologies and approaches that can be applied across the spectrum of the built environment.[10]

These range from hardware, such as drones and wearable tech, to software, such as productivity and planning apps or simulation tools. The infographic on the following page provides examples of some of the ways data and digital tools are used. Note that this does not imply that all these options should be used, but indicates the wide range of options available.

The focus of this report is on the broad competencies needed in organisations so that these tools are used effectively and achieve the desired outcomes. This is based on a 'problem first' approach to selecting digital tools, technologies, or systems, not a 'solution-first' approach, i.e. what is the 'pain point' that needs to be addressed, and how can digital approaches solve this. This is not about advocating specific solutions and the competencies needed to implement them.

10 For an example of detailed definitions and description of digital applications in construction, see Construction Industry Training Board (2018) Unlocking Construction's Digital Future: A skills plan for industry

Examples of use of data and digital in the built environment

Virtual modelling refers to the creation of a digital model of a project to visualise and analyse it virtually, for example Building Information Modelling (BIM). It can be adapted to incorporate time, cost, and other aspects.

Augmented reality overlays digital information, such as measurements or models, onto the real-world environment through devices such as tablets or AR headsets.

Virtual reality is an immersive, computer-generated simulation that allows users to experience and interact with a project design.

Drones can be used to capture aerial images, monitor projects or carry out site inspections using cameras, sensors and GPS location.

3D printing is a process where components or structures are created directly from digital models using layers of material (e.g. concrete or plastic) extruded from machinery.

On-site automation refers to the use of machines and digital technologies that can interact with the environment with minimal human intervention to carry out tasks like bricklaying, excavation, or material transport on site.

Wearable technology refers to electronic devices incorporated into items worn by workers, for example hardhats or vests, that can be used to collect health data, monitor safety, or track location.

LiDAR is a surveying method that uses lasers to create precise 3D maps and models of environments by measuring distances to surfaces.

Sensors and the 'Internet of Things' refers to the use of inter-connected devices located around the site, on buildings or machinery to collect and transmit real-time data.

Telematics is the use of GPS, sensors and data analytics to monitor equipment usage and location and improve efficiency.

Data analytics is the process of analysing, cleaning, and interpreting data to identify patterns, trends, and insights. This is often presented on visual dashboards and used to inform decision-making.

Collaboration tools such project management software and document management systems are used to facilitate communication, coordination, and data sharing among project stakeholders.

Productivity/ planning apps are used on-site or in the office to collect data, manage tasks, track progress, allocate resources, and improve communication. Site workflows can be fully digitalised through apps.

Business management tools can be used to support core operational functions like cost management, invoicing, HR, payroll, client relationships and compliance reporting.

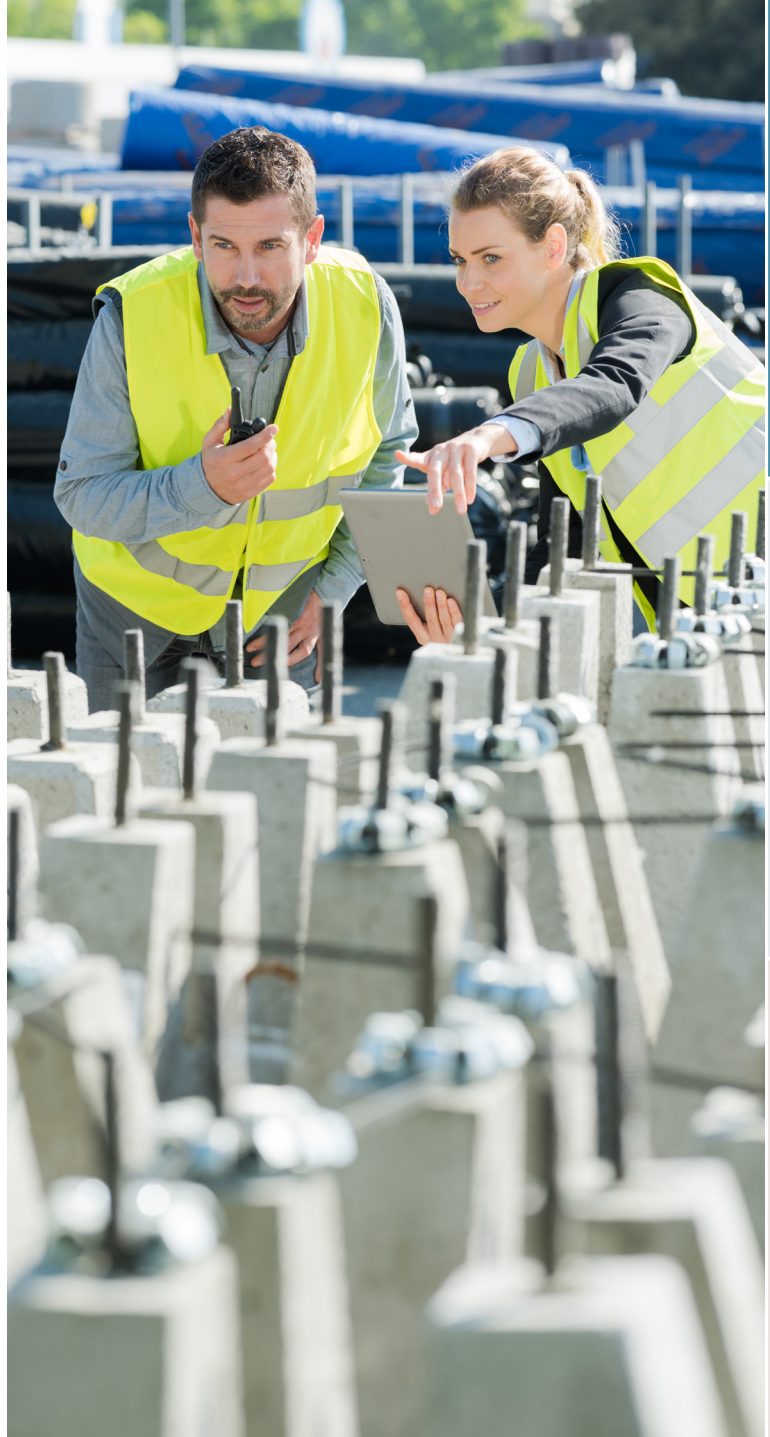
3.3 Artificial Intelligence (AI) in Construction

The use of Artificial Intelligence (AI) is expanding rapidly across all sectors, and construction is no exception. Whilst AI in various forms has been in use for many years already, there is now more widespread awareness of its potential to transform the built environment.[11] Given the increasing recognition of impacts of using AI, e.g. social and ethical considerations, organisations should support their employees by upskilling them in how to use AI responsibly and effectively.

Digital competence should include the ability to evaluate AI critically, mitigate risks, and ensure appropriate oversight when using AI, ensuring transparency and accountability in how these technologies are deployed.

With all the opportunities AI presents, it is important to ensure a clear understanding of its risks and limitations and wider considerations around use of AI in construction:

- **'Black-box' models**: Depending on how the AI is structured, there may be a lack of transparency in how the AI interprets information and makes decisions. Algorithms may be trained on historical data that may be incomplete, inaccurate, or biased. Some AI tools are also limited by the software's attempts to please the user such that it will generate outcomes that are false or not viable. This can result in flawed outputs, such as unreliable cost estimates or unfair risk assessments.
- **Ethical considerations**[12], for example around privacy and surveillance: AI can be used to monitor workers' behaviour, location, and productivity, raising questions about consent and potential misuse of personal data.
- **Social impact**, for example on labour requirements: As automation increases, certain job roles may be displaced, necessitating upskilling and retraining to ensure workers are not disadvantaged.



11 For an example of a more detailed analysis of AI in construction, see the report by EY and FIDIC (2024) 'How artificial intelligence can unlock a new future for infrastructure'

12 Pillai, V. S. and Matus, K. J. M. (2020) 'Towards a responsible integration of artificial intelligence technology in the construction sector'. Science and Public Policy, 47(5), 2020, 689–704. doi: 10.1093/scipol/scaa073

4 Defining categories of digital competencies

To better understand digital competencies, we need a clear classification of the different categories that define competency. This helps organisations to understand the range of competencies that may be needed across their workforce, ensuring that the right people have the right competencies for their role or function.

This chapter provides an overview of the categories of core digital competencies. This draws inspiration from the CITB's *'Digital Competence Framework for Construction'*[13], which defines knowledge, skills and behaviour statements for digital competency. The framework is separated into two broad groups:

- **Core transferable competencies:** These are the foundational competencies that are applicable across the built environment. The level of expertise required will vary depending on the type of organisation and type of projects undertaken.
- **Core specialist competencies:** These explore the general competencies that are applicable for various specialist applications or use-cases. For each category, examples are given of what it looks like to apply data and digital solutions at different levels of maturity, ranging from simple use case to advanced use case.[14]

Note that not every organisation or individual would need to be fully competent in all the categories. An organisation's size and function determine which competencies are most relevant. Different roles require different levels of competency, so each person should have the right level for their job.

13 Construction Industry Training Board (2024) Digital Competence Framework for Construction

14 Note that there are niche capabilities in some SMEs, with high level of sophistication in how tools and technologies are applied, therefore this is split by level of maturity, not organisation size.

4 Defining categories of digital competencies

The image below illustrates the **main categories in bold**, with sub-categories for each listed alongside. An overview for each of the main categories is provided in the tables on the next two pages.

The Appendix has detailed capability statements for each sub-category at different levels of maturity – emerging, established and advanced.

4 Defining categories of digital competencies

CORE TRANSFERABLE COMPETENCIES		
Category	**Why this is important**	**What it covers**
1 Digital Literacy and Fundamentals	Digital literacy is the foundation for delivering improved performance through digital approaches. Effective use of common digital tools and processes builds confidence in how these can be used to improve outcomes.	• Basic computer skills (e.g., email, spreadsheets, word processing) • Use of smartphone and apps • Navigating internet • Troubleshooting challenges
2 Digital Communication and Collaboration	Digital collaboration supports effective communication across project stakeholders and within an organisation. This enables faster decision-making and resolution of issues whilst supporting record-keeping of key project decisions.	• Interacting in a professional context with digital tools • Virtual meetings and remote collaboration • Cloud-based document sharing and version control • Project management software
3 Legal and Ethical Considerations	Understanding data privacy, cyber-security risks and legal requirements ensures digital practices are secure and compliant, protecting both business and client interests. From a legal perspective, digital tools can be used to ensure compliance with quality and safety standards and can improve accountability.	• Cybersecurity and data protection • Compliance with copyright requirements • Understanding and protecting Intellectual Property • Compliance with relevant regulations, e.g. Building Safety Act 2022
4 Exploring digital opportunities	The fundamental challenge in achieving the expected benefits of digital transformation is understanding the challenge or problem to be solved and then investigating how data and digital solutions can be used to address this. It is crucial that this is addressed from an integrated systems perspective and not isolated adoption of particular tools.	• Understanding available digital solutions that can be deployed • Identifying specific challenges or needs with appropriate digital solutions • Identifying and developing people's competencies to use tools, technologies etc. • Developing coherent and integrated digital systems
5 Data Analytics and decision support	With increasing amounts of data available (both on construction projects and in business management), organisations need to be able to collect and translate raw data quickly and effectively into insights that support better communication and faster decision-making.	• Understanding types and attributes of data • Data collection and management • Presentation of data in meaningful ways • Data analytics and intelligence to support informed decision making • Implementing appropriate feedback loops to use insights generated

4 Defining categories of digital competencies

CORE SPECIALIST COMPETENCIES		
Category	**Why this is important**	**What it covers**
6 Design and planning	Data and digital solutions are used to enhance project planning and design, for example in early stage optioneering, exploring multiple design options in a rapid time frame that meet a range of criteria as well as being able to incorporate learning from past projects into designs and schedules.	• Use of digital tools in design and optioneering • Scheduling and managing project programmes • Site surveys and early-stage data gathering • Stakeholder engagement
7 Modelling and Simulation	Well-executed virtual 3D modelling has a wide range of benefits, for example, collaboration and stakeholder engagement as well as improving design accuracy and reducing errors or rework (e.g. through early clash detection). When the sequencing of construction is incorporated in 4D modelling, this supports buildability of designs and resource management during construction.	• Fundamental principles of BIM (e.g. common data environments, interoperability) • Use of software to generate 2D and 3D models • Clash detection and model coordination • Digital twins
8 On site technologies, automation and robotics	There is a vast range of ways in which digital solutions support onsite delivery of construction projects, increasing productivity, enhancing safety and monitoring project performance.	• Range of site monitoring applications and real-time data collection and analysis, e.g. telematics for equipment tracking and fleet management, drones for progress tracking, etc. • Safety tools e.g. computer vision, AR and VR • Use of robotics and automation in construction processes • Use of apps for logging inspections, notes, or communication
9 Asset management	Monitoring in-use performance helps ensure assets (buildings or infrastructure) operate as intended. This can support activities such as planned and predictive maintenance, understanding operating costs, and user satisfaction.	• Sensors and Internet of Things (IoT) monitoring and controlling assets performance e.g. tracking energy use, temperature, or occupancy • Comparing actual performance data against design expectations or benchmarks • Identifying maintenance needs through predictive analytics • Supporting post-occupancy evaluation with user feedback
10 Business management	Digital business management tools streamline operations, improve insights into business performance, and help organisations run efficiently. These tools not only increase operational efficiency, but also improve collaboration between site and office teams, enhance data accuracy, and support compliance and risk management. In larger organisation, digital systems help to ensure consistency in processes and reporting across departments.	• Digital marketing and sales • Customer relationship management • HR and employee management systems, including recruitment and training • Account management, including invoicing and payroll • Contracts management and legal processes • Analysing business performance through dashboards and reporting tools • Financial and non-financial compliance and reporting, e.g. sustainability, ESG etc.

5 Understanding the benefits and opportunities of investing in digital competence

Digital transformation should be embraced in the built environment because of the range of opportunities for improving outcomes. A key barrier to the successful adoption of digital innovation is a lack of awareness about the benefits of digital technologies (to organisations and individuals), how these can be used to address challenges in the built environment sector, combined with the complexity in the digital landscape[15].

The table on the right provides an illustrative example of the benefits of investing in increasing digital maturity, moving up from the initial stages of digitisation to digitalisation and then digital transformation. This demonstrates how even small changes, e.g. replacing paper forms, can lead to measurable benefits in productivity, accuracy, and communication across a project and business.

To support upskilling, organisations need to see the value of investing in digital competence and have a clear understanding of the benefits and opportunities.

There are a range of benefits to different stakeholders at different project stages, and these will depend on what is being evaluated and by whom. Benefits of digital transformation are evident in multiple dimensions:

- **Sector-Level**
  – e.g. improvements in site safety performance
- **Organisation-Level**
  – e.g. streamlining business financial systems
- **Individual-Level**
  – e.g. reducing administrative burden in executing work

Table 1: Illustrating the progression in digital maturity and benefits achieved

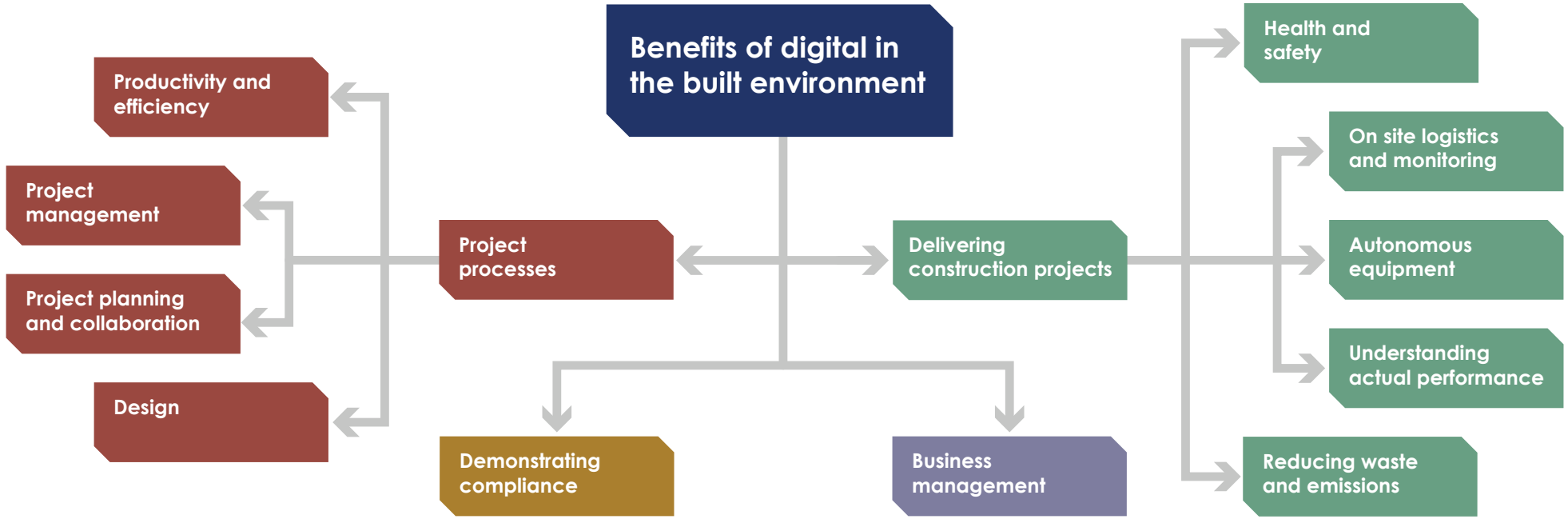
Example case study using tracking material use on site as an illustration of the steps in digital maturity.	
Stage of digital maturity	**Description of how digital tools are used and benefits achieved**
Digitisation	Information from project material deliveries entered into digital formats, such as spreadsheets. This enables project tracking against targets e.g. waste rates, comparison of material used versus project estimates. Supply chain invoices also digitised, which allows for cross reference to materials information for verification.
Digitalisation	Systems created to reconcile data across platforms – e.g. material delivery, waste records, invoices, etc. Notifications are created to detect discrepancies and identify when aspects do not meet project specification. Data collected feeds into progress monitoring and project reporting (e.g. carbon), saving time in administrative tasks, e.g. collecting and cleaning data for reports. Improved information flow across stakeholders.
Digital transformation	Integration of systems across stakeholders to monitor and predict material and waste across projects and portfolios. Access across teams to the same data improves collaboration. Data incorporated into lifecycle review of projects, improving cost and material estimates on future projects and feeding into bid preparation in procurement and streamlining future designs. Data used to support project and business targets, e.g. carbon or ESG reporting.

15 This barrier is referenced in a range of academic and industry literature, for example Zulu et al. (2023) 'The Mediators of the Relationship between Digitalisation and Construction Productivity: A Systematic Literature' Review', Buildings, 13, 839. https://doi.org/10.3390/buildings13040839; Windapo AO. (2021) 'The construction industry transformation and the digital divide: Bridging the gap.' S Afr J Sci. 117(7/8), Art. #10990. https://doi.org/10.17159/sajs.2021/10990 ; Shojaei (2022) 'What can make or break your digital investments?' SCSS webinar.

5 Understanding the benefits and opportunities of investing in digital competence

In industry, there are a wide range of examples of how digital tools and technologies are being used to improve project and business outcomes. Figure 3 below provides an overview of the areas where these benefits are often proclaimed. Appendix 7.4 gives further details on examples of the benefits that can be achieved across a variety of stakeholders, project stages and levels through implementing various digital tools, technologies or systems.

Figure 3: Common areas where use of data and digital solutions improve outcomes



6 Implementation and recommendations

6.1 What should industry do

This report provides an outline of core data and digital competencies across all organisations in the built environment. Industry should support appropriate training and upskilling to ensure that the right people have the necessary competencies to implement digital solutions effectively.

Each organisation can use this report as a framework to identify areas for upskilling that are aligned with the organisation's strategic objectives, ensuring that digital upskilling supports business and industry outcomes such as improved productivity, safety, and sustainability.

To embed digital competency into your organisations, use the report to identify and leverage the strengths of the workforce across these competencies and identify gaps or areas for improvement:

- Create a vision for digital competency in own organisation – understand the interplay between people, processes and technology
- Evaluate the current position, noting strengths and gaps – a 'maturity' ranking could be determined against each of the competency categories detailed in the report.
- Take action to address gaps - partner with government and training providers to ensure appropriate training interventions are created

For further guidance on how this could be implemented, see the spotlight on PAS 1040 'Digital readiness – Adopting digital technologies in manufacturing – Guide' in the Appendix.

There are various ways to use the competence classification:

- Create Training Needs Analysis
- Include in career development evaluation and performance management
- Integrate into job descriptions and recruitment
- Use the statements as knowledge, skill and behaviour statements in writing competency frameworks.

Note that the focus is on core transferable competencies which are role and sector agnostic. When applying these in specific organisations, additional sector-specific competencies may be required. If looking to apply these at the individual level, role-specific competencies will need to be developed.

For SMEs, who may lack the resources of larger firms, resources such as the Supply Chain Sustainability School can help with evaluating and building digital competence.[16] There are also examples of initiatives targeted at supporting SMEs in the digital landscape – see 'Solving Tech for Small Builders' case study on the next page.

16 For a targeted digital maturity assessment that can be used for organisations or individuals, refer to the Supply Chain Sustainability School assessment: https://www.supplychainschool.co.uk/topics/digital/

CASE STUDY

‘Solving Tech for Small Builders’

Small construction businesses often find themselves overwhelmed by technology. With limited time and resources, many businesses either delay adopting new systems or invest in the wrong ones – creating more stress than value.

The ‘Solving Tech for Small Builders’ program, delivered by Construction Coach and funded by CITB Impact Fund, is a 3-month training program designed to boost small builders’ confidence in using technology in their business. Launched in April 2025, the program provides a mix of online and in-person sessions which guide builders in defining goals, considering options, and implementing the right solutions.

The challenge:

- Low confidence: Lack of confidence in ability to choose right tech and embed it in their business.
- Overwhelm: Too many software choices, unclear return on investment, fear of “wasting money.”
- Time pressure: small builders need practical, quick-to-apply advice, not generic theory.

The solution:

- Overcoming common challenges: Clear, jargon-free training materials from an industry expert
- Practical solutions: Providing hands-on experience with digital tools and showcasing solutions suited to small building firms.
- Community of Practice: Being part of a cohort provides peer support, motivation and accountability, with real-life experiences from fellow business owners sharing what they were using and the impact it was having.

Results from the Pilot run (April to June 2025)

- 80% of participants reported higher confidence in choosing and implementing tech.
- Improved efficiency, reduced admin time, and better customer communication were the top reported benefits.
- One business saved £15,000 by streamlining the tech they are using and no longer need.
- One business is saving £30,000 by utilising what they already have and introducing new automations to cut down admin time

This pilot run has demonstrated the value in investing in digital competence, highlighting the value that is added by creating the opportunity to holistically evaluate how best to use digital solutions to improve business outcomes.

Participant Feedback:

> It’s made me look at all of our tech, and evaluate it. Spending time focusing on the business has had a massive impact on learning and being resilient for the future. Engaging with people on the programme brings a world of different views and experiences that are inspiring and heart warming it
>
> *Nik, Builder from Croydon*

> Being in a safe space to learn, with your peers, people that get you, is invaluable. I also loved how the course was delivered, to have it explained by somebody that’s super knowledgeable but actually speaks a normal language is key
>
> *Pam, Builder from Stirling*

Industry Collaboration

- Content Creator / Delivery Partner: Limes Consulting
- Online Course Creator: RLB Digital
- CITB Levy payer heading up the bid: North London Loft Rooms
- CITB bid supported by: Laing O'Rourke, Federation of Master Builders
- Delivered by: Construction Coach

6 Implementation and recommendations

Alignment with CLC's Information Management Initiative (IMI)

Whilst this report has been written independently of the CLC's Information Management Initiative (IMI), the competencies advocated support the implementation of the IMI.

The IMI is a programme led by CLC and supported by nima (formerly UK BIM Alliance) with the aim of "progressively transforming information management practices across the built and natural environment sector"[17]. The IMI is predominantly about the over-arching principles and practices for managing data and information.

The competencies defined in this report support the implementation of the principles described in the sector-wide directive as well as those which will be defined in organisational level mandates.

The overarching aim of the IMI is:

> To enable the digital integration of data and information across the whole life cycle of the built and managed environment, enhancing collaboration, efficiency, safety and sustainability to meet the evolving needs of society, business and the environment chain[18]

17 CLC and nima (2024) 'Construction Leadership Council and nima launch Information Management Initiative' ; nima (2024) 'Introducing the Information Management Initiative'

18 CLC and nima (2024) The Information Management (IM) Initiative for the Built and Managed Environment

6 Implementation and recommendations

6.2 The role of Government and clients

For government:

- To support industry and education by developing policy that advocates digital literacy at all levels. Ensure the emphasis is on outcomes and not specific tools, technologies or systems
- Work with education providers and industry bodies to embed digital competency into training programmes and improve their accessibility.
- Lead by example through public procurement, incentivising digital competency on publicly funded projects. This is in line with Construction Playbook[19] policies, for example Policy 4 "Harmonise, digitise and rationalise demand", which advocates for the digitalisation of processes associated with design, delivery and operation to drive performance improvement.

Clients have an important role in supporting digital competency in the built environment. This includes upskilling and competence development of their own staff as well as raising awareness of the benefits that can be achieved through holistic, integrated use of digital solutions that deliver strategic outcomes on their projects. As has been emphasized in this report, digital transformation is not about using more digital solutions, for example multiple individual technologies, but about better use of digital approaches.

6.3 Education and training providers

Education and training providers can use this report in conjunction with other published sources of competency information (e.g. CITB, National Occupational Standards etc.) to build competence frameworks and embed these into curricula, qualifications and courses.

The competencies can be classified against the technical and vocational qualification levels to provide an understanding of what is needed at each level. This supports training providers in understanding what needs to be addressed in training materials and evaluations.

19 HM Government (2022) 'The Construction Playbook: Government Guidance on sourcing and contracting public works projects and programmes'

CASE STUDY

Digital Twins Skills Academy ‘partner’ with local authority, the London Borough of Brent

The Digital Twin Skills Academy CIC (DTSA) is a black-owned social enterprise committed to diversity, equity and inclusion in the construction industry. Following the UK’s Building Safety Act 2022, they promote an unapologetic adoption of the digital twin concept to deliver the golden thread competently and comprehensively - actively working with other initiatives designed to create access to meaningful career opportunities for young people.

Through their professional development services in digital construction, DTSA develop competency in the creation, design and lifecycle management of digital twins as well as upskill industry professionals in the legal requirement for ‘Golden Thread’. They advocate for the use of digital twins to manage construction costs actively in real time and support the delivery of ambitions such as social value and net zero, highlighting the paradigm shift in this data-driven approach to ‘whole-life’ asset management.

DTSA partnered with London Borough of Brent in a pilot project that sought to identify upskilling opportunities for senior management level at the council as well as in the contracted supply chain. The focus was on the achievement of their ‘Gateway 3’ deliverables (Completion Certification as per the Building Safety Act) on a cladding project, ensuring this was achieved to the highest quality. The project focused on the inspection, removal and replacement of defective cladding on an in-scope, occupied, 15-storey building called Peppermint Heights. Part of the outcomes included a clear description of the digital journey for LB Brent, overlaid on project stages. This ‘digital first’ approach was recognised as being a new way of working for a public sector organisation.

What competencies are needed – what are the gaps?

- Digital-first advocacy about the use of data and digital twins in evidencing compliance with the requirements of the Building Safety Act. The key competency needed is ‘understanding the capability of digital tools’ as well as leadership as an organisation in supporting implementation through upskilling people to embrace digital processes.
- Soft skill advocacy: inter-generational collaboration and critical thinking

What impact can you make?

- Enabling achievement of Gateway 3 contract deliverables by implementing ‘digital’ prerequisites during construction phase and seamless handover
- Use of social value place-based KPIs (through a social value digital twin concept)
- Social value creation through upskilling and permanent job placements

DTSA are committed to value creation and supporting the underserved and wider underprivileged communities, whatever their age and wherever they may exist, across the world.

McConnell SINCE 1929 — Digital Twin Skills Academy

https://www.digitaltwinskills.academy

7 Appendix

7.1 Capability Statements for the Core Transferable competencies

These statements can be used as knowledge, skill and behaviour statements in writing competency frameworks. Note – that statements are written as concise, active-verb capability statements. They can be read as "My organisation can:"

CORE TRANSFERABLE COMPETENCIES				
Category	**What does this mean in a construction/ built environment context?**	**EMERGING MATURITY**	**ESTABLISHED MATURITY**	**ADVANCED MATURITY**
1 Digital Literacy and Fundamentals				
1.1 Using basic digital technologies	Using digital tools and technologies that may be required in the workplace or on a construction site. This includes basic computer skills, such as email, spreadsheets and word processing as well as smartphone applications. Understands the benefits of effective use of digital tools and technologies.	• Use standard applications to generate basic digital documents and record routine activities. Digitised processes may not be fully integrated or streamlined.	• Use a variety of digital tools to plan and execute work. • Actively seek ways to use digital technologies to improve existing ways of working.	• Confidently apply a wide range of digital tools to execute professional tasks and record/track information, supporting implementation across the supply chain. • Support novel or innovative applications, including fundamentally rethinking processes and business models through digital solutions.
1.2 Browsing, searching and filtering digital information	Finding relevant information online, for example product specifications, manufacturer's information and suppliers' details, as well as accessing information in digital repositories, such as company filing systems or shared project drives.	• Use basic digital tools and cloud storage to search, browse, and access information and key documents. • Understand how to structure search queries to find relevant digital information.	• Search for information in a variety of digital environments, including websites, standards, organisational databases and project folders or repositories.	• Use advanced systems with search, filtering, and version control to access the most relevant information within the organisation and externally.
1.3 Evaluating digital information, including AI	Critically evaluating the credibility and reliability of digital information, including AI generated outputs e.g. ensuring trustworthiness of information, and potential for bias or misrepresentation. For example, product information may be biased if produced by manufacturer without any independent verification of results.	• Identify trustworthy information by checking sources for basic credibility, relying on practical experience to assess if digital information seems credible. Rely mainly on known suppliers and familiar sources.	• Assess the trustworthiness of digital information by checking sources for bias and accuracy, comparing sources and seeking independent validation where possible.	• Apply structured processes to assess digital content for reliability, bias, and source credibility. Use verified data and third-party validation to inform decisions.

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CORE TRANSFERABLE COMPETENCIES				
Category	**What does this mean in a construction/ built environment context?**	**EMERGING MATURITY**	**ESTABLISHED MATURITY**	**ADVANCED MATURITY**
1 Digital Literacy and Fundamentals *(continued)*				
1.4 Managing and storing digital information	Ability to organise, store and retrieve digital information in a structured digital environment. This includes the principle of the 'Golden Thread of Information', ensuring a digital track record of relevant information about a construction project that it is accessible for future evaluation.	• Establish simple systems for organising and storing digital information in a structured way which supports information retrieval. • Provide access to digital information as needed by others to verify compliance with regulations. • Be able to integrate into other companies management systems as required on projects.	• Organise and filter digital information through shared platforms and centralised repositories. • Tag and structure files to support fast, consistent access to project data.	• Create and manage systems to organise, store and retrieve digital information in structured, digital environments, ensuring accessibility in complex multi-disciplinary projects. • Advocate and use Common Data Environments across stakeholders on projects. • Design and implement processes to ensure compliance with standards and regulations, for example ISO 9001 and the Building Safety Act.
1.5 Managing digital presence	Creating and managing online profiles in professional contexts and understand the implications and benefits, for example in networking, winning work or collaborating with others.	• Create and manage basic online profiles on directories or social media to improve visibility and attract local work opportunities. This includes access to key information that may be valuable to others, e.g. company policies and certifications.	• Manage professional digital presence across platforms and industry portals to support networking and partnerships.	• Strategically manage online reputation through coordinated profiles, content, and engagement to support brand visibility, business development, and collaboration. • Showcase best practice or innovation through digital channels.
1.6 Managing digital competence	Recognising the importance of digital competencies; to understand where their digital competence needs to improved or updated and seek out opportunities to upskill.	• Identify gaps in digital competencies and seek basic resource, training or peer support to improve confidence and capability.	• Monitor digital competency levels across teams and actively endeavour to keep up to date with digital evolution. • Provide targeted upskilling through workshops, online courses, or mentoring.	• Embed digital competency frameworks and continuous learning pathways to stay abreast of evolving technologies and industry standards. • Develop appropriate training resources and support upskilling both internally and in the supply chain. • Use a competence management system to demonstrate that individuals have acquired the specified competence requirements for tasks (e.g. per UKAS policy TPS 69).

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CORE TRANSFERABLE COMPETENCIES				
Category	**What does this mean in a construction/ built environment context?**	**EMERGING MATURITY**	**ESTABLISHED MATURITY**	**ADVANCED MATURITY**
2 Digital Communication and Collaboration				
2.1 Communicating and collaborating through digital technologies	Communicating both formally and informally with team members, supply chain, project team etc. via digital technologies. Able to engage in virtual meetings and remote collaboration.	• Use emails, messaging apps, and video calls to communicate with teams and clients. • Engage in remote collaboration, for example calls and document review and editing.	• Use a variety of digital technologies and structured digital tools to communicate and collaborate, including shared drives, project platforms, and virtual meetings. • Guide stakeholders in selecting and using relevant methods.	• Coordinate formal and informal communication across departments and organisations using integrated digital platforms, supporting real-time collaboration and remote project delivery. • Engage with full suite of available technologies for a given context, adapting approach to meet specific project or team needs.
2.2 Sharing through digital technologies	Sharing information digitally and being aware of the implications – e.g. not sharing commercially sensitive information outside of the company, uploading information into AI chatbots etc. Understanding and using cloud-based document sharing and version control.	• Share documents using email or basic cloud tools. Aware of the need for security or access controls to prevent unauthorised access to sensitive information. Observes good practices within own company and adheres to other organisations policies in this area.	• Use cloud platforms with permission settings and version control to share files securely • Share content with others through appropriate digital technologies understanding the context of other organisation's needs. Interact confidently with new digital tools and formats used by others in a collaborative context.	• Manage digital sharing through secure systems with strict access controls, audit trails, and data governance policies. Comply with ISO and other recognised standards in information management and safeguarding with proactive training and auditing of employees and supply chain.
2.3 Developing digital content	Creating and editing digital content in different formats, to express the proposed content through digital means. To modify, refine and integrate new information and content into an existing body of knowledge.	• Interact with information received digitally in a variety of means such as tenders, drawings and invoicing. • Use digital tools to organise, analyse and store own products, services and business information for effective retrieval and ongoing business development.	• Use a wide variety of programmes and formats to create, store and share content through digital means such as drawings, policies and proposals. Competently create digital products to drive own business development.	• Follow a 'digital first' approach, using various tools and programmes to record all business knowledge, content and activities and integrate these in internal and external processes. Manipulate digital content to create new products and services.
2.4 Digital etiquette	Know how to use digital tools and technologies appropriately and professionally, being sensitive to different levels of awareness and expertise across cultures and generations.	• Communicate clearly and respectfully through digital means. Understand the different uses and expectations of other organisations within the supply chain.	• Follow professional behavioural norms whilst using digital technologies and interacting within digital environments. Adapt communication strategies to be inclusive across roles and levels of comfort and experience, demonstrating awareness of cultural and generational diversity in digital environments.	• Promote professional behaviours through robust policies and training. Be flexible and sensitive in the approach to all partners understanding the variety of digital capabilities and expectations that exist within the organisation and across the full supply chain.

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CORE TRANSFERABLE COMPETENCIES				
Category	**What does this mean in a construction/ built environment context?**	**EMERGING MATURITY**	**ESTABLISHED MATURITY**	**ADVANCED MATURITY**
3 Legal and Ethical Considerations				
3.1 Cybersecurity – protecting data and devices	Understand the risks from cybersecurity attacks, such as unauthorised access to sensitive information (cost data, design, workforce or client data etc.), access to site-cameras, autonomous equipment etc. and use appropriate strategies to protect both personal and company data and devices from cybersecurity risks. With the increasing digitalisation of the industry, cyber resilience is an essential aspect of project and business management.	• Understand different types of data, e.g. personal data and commercially sensitive data. • Understand common cybersecurity risks • Prevent unauthorised access through effective use of security software and password good practice. • Store and share data responsibly, using basic security tools and considering privacy risks when handling personal or company information.	• Apply robust policies and procedures to manage data privacy and safeguard company systems and assets. • Ensure a trained and competent workforce to adhere to company policies. Examples include regular software reviews and user permissions. • Raise awareness of issues relating to security breachers and improper sharing.	• Implement organisational-level safeguarding policies and procedures to enforce robust data protection across all operations. • Proactively scan for novel and emerging threats and continuously adapting approach to protect data and devices. • Protect the organisation from the financial and reputational risks of data mismanagement through proactive policies and compliance training for all employees.
3.2 Copyright and licences and Intellectual Property (IP)	Understanding how to use digital information and tools in compliance with copyright and licences. To understand what IP is and how to protect IP when applying digital tools and technologies.	• Understand what information might be protected by copyright and licensing and use digital content and materials in accordance with copyright rules. • Understand what IP means and seek to act accordingly. • Protect valuable differentiators and potential IP in organisation.	• Ensure appropriate referencing and attribution practices. • Comply fully with copyright and licensing within the organisation and proactively ensure employee compliance. • Understand the need for IP and take measures to safeguard company's own potential IP.	• Comply fully with copyright and licensing within the organisation and support compliance within own supply chain. • Apply formal IP management processes to protect proprietary knowledge, data or designs and safeguard organisational value.
3.3 Ethical use of data and digital tools	With increased use of digital solutions, there is a responsibility to ensure that these are used ethically to respect privacy, ensure transparency and avoid misuse. Examples include surveillance and use of employee data, e.g. from location tracking or smart wearables; or unfair impact to particular individuals or groups through digital workforce optimisations. Organisations should be able to assess the ethical implications of data and digital tools and put appropriate governance and safeguards in place.	• Recognise ethical risks when using digital tools, such as employee tracking, AI-generated assessments or automated decision-making. • Use data and technology in ways that are transparent and respectful of individual rights. • Apply basic policies to safeguard privacy and ensure fairness in data use.	• Evaluate digital tools for potential bias, privacy issues, and ethical risks before implementation. • Develop guidance for ethical deployment of technologies such as AI, drones, and site monitoring systems.	• Establish cross-disciplinary teams to review and mitigate ethical risks in digital workflows, AI tools, and analytics systems. • Implement advanced privacy audits for technologies that collect or process worker or project data.

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CORE TRANSFERABLE COMPETENCIES				
Category	**What does this mean in a construction/ built environment context?**	**EMERGING MATURITY**	**ESTABLISHED MATURITY**	**ADVANCED MATURITY**
4 Legal and Ethical Considerations				
4.1 Understanding capability of digital tools	Researching and assessing the landscape of digital tools and understanding what different technologies can do, how they support project delivery, and where they add value. This includes advances in existing tools (e.g. scheduling, modelling, cost) as well as emerging technologies (e.g. AI, robotics).	• Understand basic types of digital tools to address business and project requirements such as planning, communications and accounting. • Stay informed about mainstream digital solutions through industry news or peer networks.	• Evaluate a range of digital tools for different functions. Explore how different solutions can work together for maximum impact, not simply adding extra 'digitised' processes. • Monitor developments in digital construction technologies and assess their relevance to business priorities.	• Understand the use-cases of digital solutions across all functional areas and proactively consider novel uses. • Actively explore emerging technologies and capabilities for use across all business operations, adopting new technologies and retiring obsolete solutions.
4.2 Identifying needs and appropriate digital solutions	Assessing needs or problem to be solved and evaluating digital tools and possible technological responses to address these needs. This includes reviewing existing tools and the level of use or uptake across the organisation, understanding their limitations, and exploring alternatives that offer better outcomes.	• Explore simple, cost-effective tools that meet specific needs, making sure that there are the resources to implement these effectively (employees, finances etc.) • Select tools that clearly solve practical problems and save time, effort or cost. • Compare basic digital options for ease-of-use, compatibility, and return on investment.	• Assess operational needs and workflow inefficiencies and evaluate digital solutions to address constraints or improve working processes. • Evaluate a wide range of digital capabilities and tools and have the confidence to test and adopt new technologies. •	• Review the digital landscape across the organisation to understand coverage, gaps, and overlaps. • Create digital strategy that supports business objectives with regular review to evaluate performance of adopted solutions. • Select scalable, integrated solutions that address defined business needs and achieve holistic benefits across the organisation, project and/or supply chain. • Foster creative exploration and trialling of digital capabilities to solve problems.
4.3 Interoperability and integration of systems ↓	This refers to the ability to coordinate and integrate digital tools/systems used across various processes or disciplines to ensure seamless flow of information across platforms. This promotes better collaboration, reduces duplication and improves accuracy. The goal is not just competent use of multiple tools, but a digital ecosystem that integrates digital approaches to deliver strategic outcomes	• Understand the value of integrating basic systems. • Select digital tools that are compatible with others commonly used in the industry (e.g. formats like IFC or PDF). • Share project data using standard file formats.	• Use tools that support interoperability across teams and disciplines. • Align workflows to ensure smooth transfer of data between project phases and processes, e.g. design, construction, health and safety, quality assurance. • Work with supply chain to ensure systems integrate for consistent data exchange, e.g. Common Data Environments for collecting and managing project data	• Implement organisation-wide platforms that integrate core business, project, and asset data systems. • Procure digital solutions that prioritise interoperability and integration with other digital solutions that are already being used. • Drive the use of integrated digital environments on projects that can be used as a 'single source of truth'

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CORE TRANSFERABLE COMPETENCIES				
Category	**What does this mean in a construction/ built environment context?**	**EMERGING MATURITY**	**ESTABLISHED MATURITY**	**ADVANCED MATURITY**
5 Data Analytics and decision support				
5.1 Data fundamentals	It is critical to understand the various types of data generated (e.g. structured and unstructured), data quality principles and the value that can be derived from effective use of data. This includes operational data (equipment use, fuel, labour); financial data (cost estimation, cash flows); safety & compliance data and environmental data.	• Recognise different types of data used in construction. • Follow basic data standards to ensure good quality data, and implement practices to ensure data captured is valid, accurate and representative. • Store and organise data in consistent formats for analysis and sharing.	• Monitor data quality across systems or teams. • Establish standard processes for collecting and cleaning data from multiple sources and presenting data in consistent formats.	• Build organisation-wide understanding of data structures, quality frameworks, and governance. • Implement tools and processes for large-scale data integration, cleansing, and validation.
5.2 Data architecture	Data architecture defines how data is collected, organised, stored and shared, creating effective data management systems which support consistency and interoperability of data. Data collection can be manual (such as checklists or forms) or automatically collected (e.g. through sensors).	• Capture and record routine data using basic digital tools, for example in spreadsheets or mobile applications. • Share data in consistent formats to support wider compliance reporting, e.g. for environmental targets or sustainability reporting.	• Establish procedures for consistent collection of key data for evaluating performance. • Synthesize various forms of structured and unstructured data. • Capture and integrate data from multiple sources using project management platforms.	• Implement integrated systems and procedures for collecting data from a wide range of sources and types. • Use integrated data management systems to link real-time data with planning and reporting tools. • Develop scalable, centralised data environments to support analytics and industry-level benchmarking of performance.
5.3 Data visualisation	Present data in clear, understandable visual format that assists in understanding patterns and trends, to support decision-making, coordination, and communication. Tools range from simple graphs in Excel to sophisticated visualisations in platforms like Power BI or BIM viewers.	• Use simple charts or graphs to present basic data like project progress or costs to team members and clients. • Access and interpret visual data from third-party platforms e.g. supply chain or product manufacturers.	• Create and share customised visual dashboards using tools like Power BI or project software to support clear reporting and understanding of project/business performance. • Embed visualisations into project workflows or business reporting.	• Use advanced, interactive data visualisations integrated with real-time systems to support strategic oversight, performance tracking, and stakeholder engagement.
5.4 Analytics and intelligence and feedback loops	Ability to analyse data (structured and unstructured) to identify trends and generate insights to support decision-making, for example on project or business performance. This ranges from retrospective analysis that focuses primarily on compliance reporting to proactive predictive evaluation. Feedback loops are the processes used to feed the learning back into real-time activities to allow for continuous learning and performance improvement.	• Use simple data tools like spreadsheets to analyse performance data (e.g. cost, time, safety) and identify trends. • Build basic templates or checklists that support tasks and decisions. • Apply lessons learned from previous projects to improve future delivery and planning.	• Analyse data across multiple projects to identify patterns and recurring issues. • Use software tools to generate insights into key outcomes such as progress, quality, or productivity. • Develop custom tools, such as dashboards or reporting software to support project or business tracking and insights.	• Leverage advanced data analytics, bespoke software, and automation to identify trends, enhance reporting, and support strategic decision-making. • Use advanced methods to generate performance benchmarks and track project or business progress in real-time.

7 Appendix

7.2 Capability Statements for the Core Transferable competencies

This section addresses the competencies that are additional to those covered in the core transferable skills.

CORE SPECIALIST COMPETENCIES				
Category	**What does this mean in a construction/ built environment context?**	**EMERGING MATURITY**	**ESTABLISHED MATURITY**	**ADVANCED MATURITY**
6 Design and planning	Digital tools support design, optioneering, and programme planning. This encompasses the primary activities in the early stages of project development, including stakeholder engagement, spatial planning, structural analysis, cost estimation and schedule development.	• Use digital tools for spatial layout and project design, understanding assumptions made when using software and interpreting the output. • Use simple software or spreadsheets to prepare and present cost estimates and project timelines.	• Use integrated design software to develop and test designs, for example spatial arrangements, structural analysis, environmental assessments, or compliance checks. • Use estimating software and databases to produce more detailed and consistent budgets. • Integrate designs with cost planning and scheduling tools. • Understand what good outputs look like from software and how to prompt appropriately.	• Employ advanced digital tools or specialist software for multidisciplinary design coordination and optimisation. • Understand validity and appropriateness of historical data to use for benchmarking and analysis of project costs and programmes. • Use data to support procurement and logistics planning, understanding the limitations and boundaries of assumptions made.
7 Modelling and Simulation ↓	Modelling and simulation involve using BIM principles such as common data environments and interoperability to create coordinated virtual models. These tools support clash detection, improve design accuracy, and enable the development of digital twins for enhanced planning, construction, and operational insights.	• Use digital design tools to produce basic virtual models. Ensure models can be incorporated into main contractor or client's virtual models. • Interpret and comment on digital drawings from clients or design teams.	• Work with 3D design tools and contribute to coordinated digital models. • Use Common Data Environments for design collaboration. • Participate in digital design reviews, clash detection, and value engineering processes.	• Lead fully integrated, multidisciplinary BIM workflows from concept to construction. • Manage design coordination using advanced collaboration platforms and model federation tools. • Use digital twins to understand project requirements and performance and inform decision-making

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CORE SPECIALIST COMPETENCIES				
Category	**What does this mean in a construction/ built environment context?**	**EMERGING MATURITY**	**ESTABLISHED MATURITY**	**ADVANCED MATURITY**
8 On site technologies, automation and robotics	Digital solutions enhance construction delivery through real-time monitoring tools like telematics and cameras, improve safety using computer vision and immersive tech, and improve productivity with automated processes and apps that streamline communication, inspections, and site reporting.	• Use mobile apps to log site inspections, take photos, and share updates. • Adopt simple digital forms and checklists for health & safety and quality assurance. • Track materials and equipment via basic telematics or QR/barcode systems.	• Deploy site apps for real-time communication, task management, and snagging. • Use drones and sensors to monitor progress, site conditions, and asset use. • Apply telematics to monitor equipment usage and maintenance needs. • Introduce tools like AR for installation guidance or VR for safety training.	• Develop fully digital workflows on site – from inspections to reporting. • Integrate site data to provide real-time insights on progress, safety, and logistics with dashboards to support informed decision-making and performance monitoring. • Advocate for use of advanced solutions for enhancing health & safety. • Trial and implement robotic or semi-autonomous construction solutions.
9 Asset management	Monitoring performance of assets helps to compare real-world data against design benchmarks, enabling predictive maintenance, and supporting a better understanding of asset performance to feedback into future design.	• Use basic digital solutions to track maintenance and asset condition information • Select appropriate sensor types and understanding their placement for optimal data collection • Interpret results and compare actual versus expected	• Provide digital handover packages with information about asset to enable effective long-term operation and maintenance. • Capture and analyse operational data (e.g. energy use, downtime, repair logs) to inform planning. • Compare building performance against industry standards and benchmarks.	• Integrate sensor data into digital twins for real-time asset monitoring. • Use predictive analytics to identify maintenance needs and optimise lifecycle performance. • Link asset data with cost and carbon tracking to inform sustainability goals.
10 Business management	Digital business management tools streamline operations, improving insights into business performance and helping organisations run efficiently. These tools not only increase operational efficiency, but also improve collaboration between site and office teams, enhance data accuracy, and support compliance and risk management.	• Use simple accounting and invoicing software for financial management. • Manage HR records and timesheets using basic digital tools or spreadsheets. • Track client interactions with simple CRM tools	• Use integrated platforms for finance, payroll, HR, and project resourcing. • Track client pipelines, bid opportunities, and follow-ups using CRM systems. • Generate business reports using dashboards and analytics tools. • Apply digital tools to manage training records, employee development, and compliance.	• Operate Enterprise Resource Planning (ERP) systems to integrate finance, HR, supply chain, and project delivery. • Use advanced CRM tools for managing customer relationships, tracking tenders, and analysing win rates. • Employ data analytics and AI to forecast business performance, costs, and workforce needs. • Automate repetitive business tasks and reporting, improving efficiency and oversight across departments.

7 Appendix

To provide further details and examples of real-life applications, each category addressed in the 'Core specialist competencies' has been investigated further with examples of specialist applications in these categories.

For each category, examples are given of what it looks like to apply data and digital solutions at different levels of maturity, ranging from simple use case to advanced use case.

CORE SPECIALIST COMPETENCIES		
Category	**Basic level of maturity (Simple use case)**	**High level of maturity (Advanced use case)**
6 Design and Planning		
6.1 Use of design tools	Use of basic design software to generate layouts and designs that comply with regulations and client requirements.	Use of advanced parametric or generative design software to optimise design at the earliest stages, maximising scope of benefits such as decarbonisation and use of advanced construction approaches (e.g. Design for Manufacture and Assembly)
6.2 Programme/scheduling	Using digital tools to develop and manage project schedules, identifying critical path and sequence work. As maturity develops, programmes can be linked to virtual models (BIM) to visualise planned project progress.	Use of AI models trained on appropriate historic data as well as industry trends and project performance benchmarks to create and evaluate project delivery schedules. This can be sued to identify emerging risks and contingency allowances.
6.3 Project analysis	Use of widely available tools for evaluating project performance, for example life cycle analysis tools for carbon reporting, modelling tools for energy performance/daylight/acoustics etc.	Using data analytics platforms to assess performance trends across multiple projects, including cost, time, productivity, and risk data, to drive continuous improvement.
7 Modelling and Simulation		
7.1 Use of 3D models to visualize design intent	Simple virtual model created to visualise layout and form; may not be coordinated with other disciplines or trades to identify clashes or interdependencies. Can perform basic interrogation of project, e.g. extracting quantities, clash detection, and design validation.	Designs are fully coordinated across disciplines, integrating structural, MEP, and architectural elements. All teams work within a Common Data Environment to ensure consistency and interoperability. Models are continuously updated throughout the project to reflect real-world conditions accurately. Models include additional dimensions, such as time and cost.
7.2 Use of VR/AR in addition to 3D model	Using AR on site for installation guidance – e.g. through mobile phone application or headsets.	Interactive and immersive VR experiences support design reviews, client walkthroughs, on-site installation guidance or health & safety training. This is usually set up in a dedicated room to allow for the immersive VR experience.
7.3 Digital twins	Using a digital twin to monitor energy use or occupancy in real-time through connected sensors.	Creating a dynamic, real-time digital replica of an asset that integrates IoT data, predictive analytics, and maintenance scheduling to support operations and decision-making.

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CORE SPECIALIST COMPETENCIES		
Category	**Basic level of maturity (Simple use case)**	**High level of maturity (Advanced use case)**
8 On site technologies, automation and robotics		
8.1 Using digital tools for site management	Using mobile apps to record site activities such as inspections, snagging, or track material and waste movements.	Site workflows are fully digitalised with inspection checklists, snagging reports and progress photos automatically synced with project management and BIM systems. Real-time tracking of progress and issues.
8.2 Site monitoring	Using cameras and sensors to capture and record site data, e.g. noise, dust, weather, site access records and progress. No centralised systems for integrating and processing these disparate data sources.	A range of systems such as drones, IoT sensors, and AI-powered analytics are connected to monitor progress, productivity, environmental conditions, and safety compliance in real time. Automated early-warning systems alert to issues to be addressed. Detailed scans and surveys are used to generate as-built information.
8.3 Health and safety management	Using digital checklists and mobile apps to complete safety inspections or report hazards on site.	Using AI-powered computer vision to detect unsafe behaviours e.g. missing PPE or unauthorised access to controlled areas.
8.4 Digital surveying	Using total stations or laser distance measurers to collect basic site dimensions.	Applying laser scanning (LiDAR) to create point clouds and digital twins for design validation or verification of as-built conditions. The data are processed and integrated with BIM or GIS platforms.
8.5 Autonomous/semi-autonomous equipment ↓	Operating machinery with GPS-guided controls (e.g. for basic excavation or grading). Health, safety, and programming requirements are adapted to account for autonomous vehicles.	Use of semi-autonomous robots to perform repetitive or hazardous tasks with minimal supervision, for example brick-laying or reinforcement placement and fixing.

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CORE SPECIALIST COMPETENCIES		
Category	**Basic level of maturity (Simple use case)**	**High level of maturity (Advanced use case)**
9 Asset management		
9.1 Golden thread of information	Digital storage of operations and maintenance information, as-built information, building layout, and key fire safety matters, all of which can be accessed by whoever requires the information for the purposes of ensuring building safety.	Ability to automatically update the Golden Thread information in accordance with maintenance records from contractors and others. Over time, this could extend to a risk analysis software that provides automatic notifications to the Accountable Person of changes to risk levels impacted by the maintenance carried out throughout the building's life cycle, by applying certain metrics and relevant PAS risk assessment practices.
9.2 Digital handovers	Using digital platforms to store as-built drawings and operation and maintenance (O&M) manuals	Linking asset data (e.g. serial numbers, maintenance schedules) to BIM models, with digital models continued to be used and updated during operation to reflect 'as-maintained' conditions.
9.3 Building management systems	Incorporating sensors into buildings to capture real-time data and to monitor actual performance like temperature, indoor air quality, or energy use as well as occupancy.	Integrating data collected from a building's performance monitoring systems into dashboards or digital twins and combining with other data such as weather or occupancy for real-time optimisation of energy use, predictive maintenance, and fault detection across multiple building systems. This can also "monitor electricity prices and generation mix, allowing it to adjust the building's electricity use based on cost or carbon intensity at any given time."[20]
9.4 Infrastructure management systems ↓	Using GIS tools and spreadsheets to record asset location and condition for infrastructure like roads or pipelines.	Implementing an integrated asset management platform with IoT sensors, predictive analytics, remote monitoring and lifecycle planning of infrastructure assets. For example, AI processing of video footage to assess road signage compliance and prioritise repairs and upgrades.[21]

20 EY and FIDIC (2024) 'How artificial intelligence can unlock a new future for infrastructure' https://www.ey.com/en_gl/insights/infrastructure/how-artificial-intelligence-can-unlock-a-new-future-for-infrastructure
21 Video presentation by MPAMOT at FIDIC Global Leadership Conference, April 2025. Not publicly available.

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CORE SPECIALIST COMPETENCIES		
Category	**Basic level of maturity (Simple use case)**	**High level of maturity (Advanced use case)**
10 Business management		
10.1 Financial and cost	Using dedicated accounting software to manage budgets, track expenses, and generate financial reports regularly.	Implementing integrated cost management platforms with real-time forecasting and integration with project schedules.
10.2 HR and workforce	Using HR software for managing employee records and processing payroll.	Using digital platforms for workforce planning, training management, skills tracking, and mobile-enabled onboarding and time-tracking on site.
10.3 Client relationships and bids	Using Customer Relationship Management (CRM) tools to track client communications, bid submissions, and follow-ups systematically.	Using CRM systems linked to project performance data and historical win/loss analytics to support targeted bidding and client engagement strategies.
10.4 Procurement and supply chain	Managing purchase orders and supplier communication via cloud-based procurement software for better tracking.	Using digital platforms for digital tendering, contract management, supplier performance tracking, and integration with BIM for materials planning. Integrating purchase orders, delivery notes and invoices with finance modules for seamless, paperless transactions.
10.5 Compliance and risk	Using compliance management software to monitor deadlines and document submissions.	Using software to manage regulatory requirements (e.g. Building Safety Act), automate reporting, and collecting data from supply chain e.g. for ESG and other non-financial reporting requirements
10.6 Contract management and legal processes	Examples include automated internal processes notifying businesses of key dates/processes such as payment dates or when projects are about to fall into delay.	AI or software used to draft and/or evaluate contracts, appointments, warranties etc., identifying specific risk factors or issues to address for each project. Automated population of relevant notices, costs build up information etc as required for contract management which is based on data available within a centralised construction management software.

7.3 Spotlight on PAS 1040

Guidance for evaluating an organisation's digital readiness

PAS 1040:2019 'Digital readiness – Adopting digital technologies in manufacturing – Guide' presents a standardised methodology to assess a business' readiness to adopt digital technologies and a track progress on their digital journey. The PAS explains how to measure digital readiness, which is the maturity of a business in optimising its use of digital technologies, on a scale of 1 to 9. Although this PAS is focused on the manufacturing sector, the principles can be applied in the built environment sector too.

Digital readiness is defined as the "maturity of a business or part of a business in optimizing its use of digital technologies to achieve its organizational, operational, social and financial objectives".

The digital readiness is evaluated across the business as a whole, including factors such as leadership, culture, processes and workforce capabilities. This shows how digital competence of the workforce sits within the broader landscape of organisational factors needed to maximise the benefit achieved from digital technologies.

Key points:

- Standardised framework for businesses to self-assess digital readiness
- Helps businesses identify key strengths and gaps to address
- Provides guidance on evidence and diagnostic tools that can be used to evaluate digital readiness
- Does **not** recommend specific tools or address how to implement digital tools or technologies
- Does **not** define how to evaluate the business case or opportunities for using digital technologies.

Ten characteristics are defined, with descriptions of 'weaker' and 'stronger' digital readiness provided:

1. Leadership vision for digital
2. Culture of innovation with digital
3. Technology integration with digital
4. Processes to optimise use of digital
5. Systems to support digital integration
6. Collaboration with external partners on digital alignment
7. Skills to exploit digital
8. Workforce performance management with digital
9. Operational performance with digital
10. External partner performance with digital

As can be seen, the skills of the workforce sit alongside other institutional factors that promote digital maturity. The PAS highlights that "developing skills and experience in digital systems, technologies and processes across the business increases digital readiness." The following examples are provided for how to support skills development:

- Investing in training in digital skills
- Promoting knowledge sharing
- Recruiting and training to address skills gap

7.4 Examples of the benefits of digital tools and technologies

This section gives some examples of the benefits that can be achieved across a variety of stakeholders, project stages and levels through implementing various digital tools, technologies or systems. This is not an exhaustive or comprehensive list but gives an idea of what is possible.

The digital tools and technologies can be used in different phases of the project, with some more applicable in early-stage planning and design, while others are only relevant during on-site construction. Figure 4 illustrates examples of how digital tools can be used in different phases of the project lifecycle.

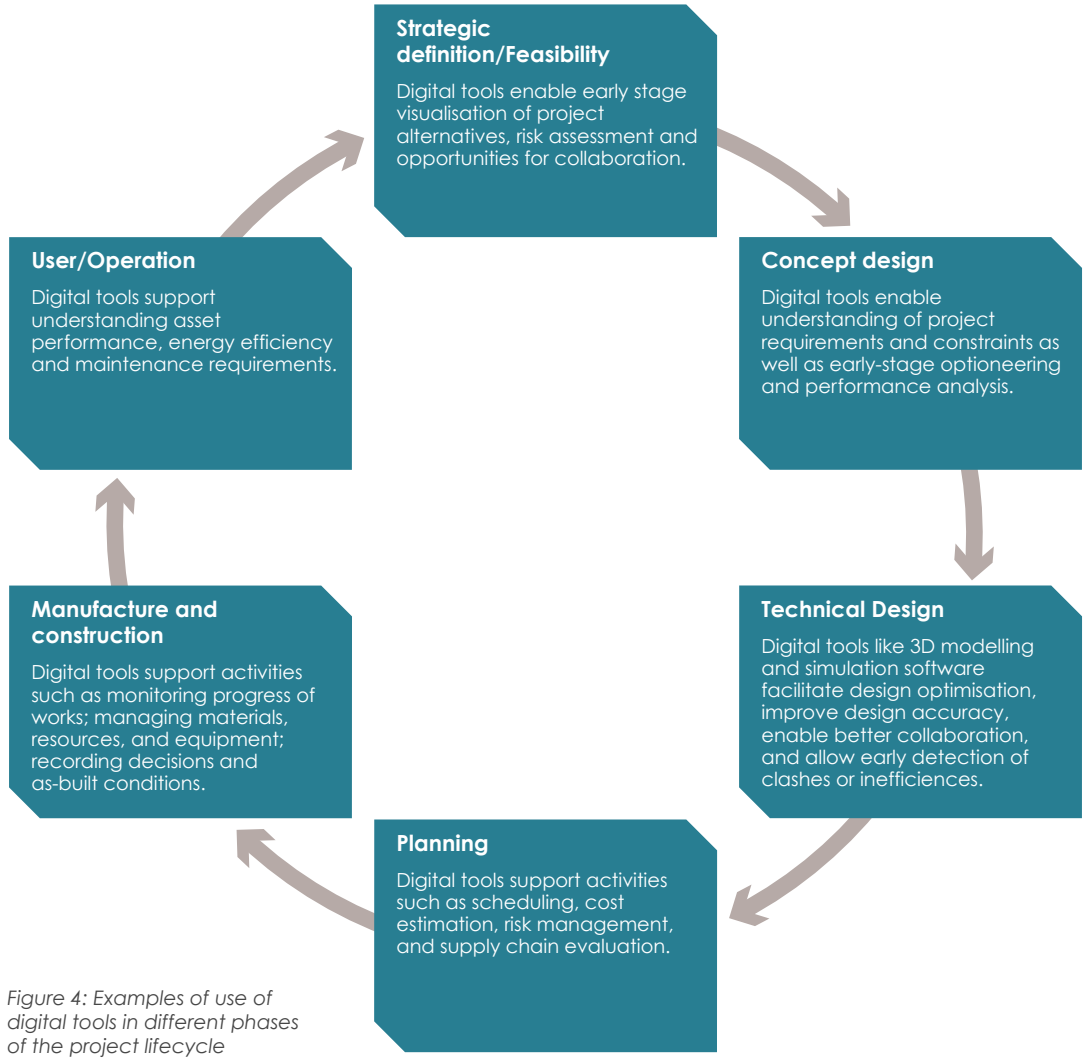

Figure 4: Examples of use of digital tools in different phases of the project lifecycle

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Examples of the benefits of digital tools and technologies *continued*

To maintain neutrality, references to specific software solutions or technologies have been avoided as much as possible. Any inference to specific solutions does not constitute endorsement by the authors or by the CLC. There are many examples in industry and online of case studies demonstrating the different types of applications. [22]

THEME	Benefit of digital	Example of application
Productivity and efficiency	Digital solutions can be used to redesign site processes and procedures, streamlining activities and reducing time spent on tasks such as site inductions and manual data entry.	Use of digital systems that verify qualifications, process site inductions and register personnel check-in and -out of site.
	Using interactive virtual models instead of 2D drawings improves the speed and accuracy of work delivery.	Steel fixers use tablets with 3D models of reinforcement layouts to construct rebar cages, reducing time taken to understand complex layouts.
	Capturing and analysing data about site processes provides insights into opportunities for saving time and cost.	Telematics can be used to capture real-time data on how machines and equipment are working, providing insights into more effective use of machines such as reducing fuel consumption, reducing idling and hiring the right type of machine.
	Virtual reality can simulate site setup, deliveries, crane positioning, and material storage, helping to optimise workflows and reduce clashes. Other benefits of simulations and virtual reality are explored in 'Health and safety' and 'planning and collaboration'	In earthworks projects, machine guidance technology can be used to overlay geometry from a virtual model and guide the operator in digging to a profile.
	Digitalisation of work flows and site data enables real-time progress tracking, providing insights into challenges, delays, and prioritisation of work.	Digital dashboards visualise project milestones, highlight delays, and show task completion rates in real time. Mobile apps for site reporting, where supervisors log daily progress and site conditions from tablets or smartphones, reducing time spent on paperwork and enabling faster decisions. Digital snagging allows non-conformances or issues to be reported rapidly, allowing site teams to prioritise and resolve outstanding issues.

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22 Examples include Supply Chain Sustainability School (SCSS) Digital workstream resources and Constructing Excellence 'Awards Winner Database' Select the checkbox filter for 'Digital'

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THEME	Benefit of digital	Example of application
Productivity and efficiency	Automating repetitive tasks reduces the time spent by staff on computer-based activities and reduces the likelihood of errors or omissions.	Software can be used to replicate computer-based tasks that would normally be done by a person by mimicking the steps taken e.g. invoice processing or data entry into standardised reports. Proprietary construction management software applications provide solutions that use "machine learning algorithms to simplify and automate workflows and repetitive tasks"[23] and facilitate overall project management.
	AI can be used to help people navigate complex requirements and understand key actions and impacts	Large Language Models can be used in contract management and construction law to help users comprehend and navigate extensive contractual documents, often written in complex legal language.
Project management	The use of AI can improve accuracy and reliability in project scheduling and cost management, reducing uncertainties and risks of delays and cost overruns. [24]	AI-based scheduling software can be used to analyse construction costs and project timeline and identify variables that may adversely impact a project. This promotes realistic project timelines that are less subject to human bias (such as optimism bias) and inherent/ siloed knowledge.
	Predictive modelling can evaluate risks in project execution, identifying possible delays and issues for example in supply chain logistics, weather conditions, contract type and experience of the team.	AI solutions can be used to analyse data from site inspections and identify factors that can help to predict risks to the project a construction progresses.
	Cost and programme can be linked to virtual 3D model to test build processes and identify any possible issues in sequencing of work, reducing risk of unforeseen costs and interactions.	
	Ability to foresee potential challenges during the construction or installation process and resolve issues.	Using augmented reality to overlay digital representations of the project over the physical project helps to identify discrepancies and provide clarity over what is required in delivering the project. This can happen on a live construction site, allowing operatives to see virtual project elements and ensure that they map correctly onto the physical asset.

23 EY and FIDIC (2024) 'How artificial intelligence can unlock a new future for infrastructure'

24 Regona, M.; Yigitcanlar, T.; Xia, B.; Li, R.Y.M. (2022) 'Opportunities and Adoption Challenges of AI in the Construction Industry: A PRISMA Review.' Journal of Open Innovation: Technology, Market, and Complexity 8 (45). https://doi.org/10.3390/joitmc8010045

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THEME	Benefit of digital	Example of application
Project planning and collaboration	Accurate information about site conditions, for example from spatial images, identifies important features and aspects to be aware of and allows for realistic project planning, design and delivery. This can assist with early-stage project planning and optioneering and is particularly beneficial for remote or difficult to access locations.	Satellite or drone images can be analysed by AI algorithms to create a 3D geospatial analysis, identifying key features and creating a digital map of the site conditions for project planning. Digital repositories about key infrastructure allow for the location of assets and services to be quickly and easily determined and works planned accordingly. For example, the National Underground Asset Register (NUAR)[25] enables access to standardised data about buried assets such as pipes and cables across England, Wales and Northern Ireland.
	A virtual model that is the 'single source of truth' during the planning, design and construction phase brings together drawings and documents across disciplines, providing a single point of interaction with data, for example material specifications, design dimensions, and inspection records. This promotes collaboration, enhances communication, and reduces risk.	Digital models facilitate design coordination and clash detection, integrating models of each discipline such as structural, mechanical, electrical and architectural and detecting clashes or installation challenges before construction begins. Details of material types and quantities can be extracted from the model, supporting accurate cost estimations, tracking changes, and reducing waste. The digital model can be used to collate all relevant information about the design and construction of an asset, including material data, user manuals, and warranty information. This supports the asset owner or facility manager in improving maintenance and long-term performance.
↓	3D visualisations of projects can be easily understood by all stakeholders and promote clear communication and collaboration. They are accessible to everyone, from operatives who can easily investigate the build, to clients, who can see how their requirements will be delivered. Incorporating virtual reality allows for a fully immersive experience in a virtual model that simulates the real-world.	Clients and project teams can "walk through" virtual buildings to review layouts and finishes, clarify end-user requirements and verify design requirements. Immersive experiences help non-technical stakeholders (e.g. clients, end-users) visualise the final outcome and enhances understanding and feedback at early stages from clients or end-users.

25 https://www.gov.uk/guidance/national-underground-asset-register-nuar

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THEME	Benefit of digital	Example of application
Project planning and collaboration	3D modelling promotes early supply chain engagement, enabling information to be shared in more consistent format and more accurately. This supports the ability to generate accurate time and cost estimations, and clearer understanding of requirements for tendering by any sub-contractor, product manufacturers or specialists required.	Digital models give suppliers and subcontractors access to detailed, accurate information for procurement, improving understanding and enabling meaningful input before construction begins. This can include material specifications, interactions and workflow constraints. Manufacturers can suggest standard components or alternatives by analysing the digital model, helping to streamline procurement. This is particularly relevant for off-site manufacturers, who can suggest modifications to improve the standardisation of the design.
	Virtual models that incorporate time – i.e. scheduling and sequencing of works – allow for clear visualisation across the project of how the work progresses.	A digital model can be linked to the schedule to simulate the construction process over time. Models with the necessary parameters defined and with access to databases of construction process information can be used to create schedules and simulations automatically.
Design	Generative design is an AI driven approach that uses algorithms to explore a range of design possibilities given specific parameters and objectives. It saves time and cost by automating iterative design processes and can be used from the earliest project stages.	There are a range of generative design tools that can be used by various disciplines. The AI generates multiple design solutions that meet the requirements, refining and optimising to find the most effective solution based on factors such as cost, material efficiency, or carbon emissions. This is invaluable for optioneering and comparing the impact of design choices, for example material types or column layouts on buildings.
	Digital processes allow for efficient design that streamlines the construction process, e.g. by proposing suitable geometries and layouts. This is particularly relevant when looking to use pre-manufactured or offsite solutions.	Design for Manufacture and Assembly (DfMA) is an approach that considers the opportunities and constraints in manufacturing components for construction projects and generates a design that can be readily manufactured and assembled.
	Improving buildability and minimising errors. Application of digital technology significantly enhances the ability to understand how design impacts project delivery and any potential challenges or issues to be addressed. This includes better understanding of sequencing of work and location and timing of materials and equipment.	Clash detection is a key benefit of using 3D modelling software, which can automatically coordinate designs and identify conflicts between architectural, structural, and MEP (mechanical, electrical, plumbing) systems before construction begins. This facilitates better project scheduling and reduces cost of redesign and rectifying errors during the construction.

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THEME	Benefit of digital	Example of application
Demonstrating compliance	Digital technologies make it easier to capture, track, verify, and present evidence of compliance in a reliable and auditable way. This can be compliance with regulations, standards, or contractual requirements – particularly relevant for Building Safety Act.	This is particularly relevant for complying with the Building Safety Act 2022, which stipulates that high-risk buildings must create a 'golden thread of information' about the building[26]. Digital technology can support collecting, storing and managing access to the necessary information with access by asset owners, inspectors, and regulators. Construction product manufacturers can provide key data about their products in digitised format. This can be used in digital models and to verify compliance with specifications.
	Proving provenance of materials through supply chain to support sustainability targets and requirements for transparency and traceability.	Digital product passports and QR codes can be embedded on products or components to provide access to information such as origin, certifications or installation instructions. Blockchain systems are being explored to create permanent, tamper-proof records of a material's journey from extraction to installation. For example, a blockchain system can be used to demonstrate that all timber on a project is FSC-certified and sourced from sustainable forests. Digital platforms are available to map supply chains and review potential risks or ethical concerns when evaluating materials and suppliers, e.g. for compliance with Modern Slavery Act.
	Collection of data and records required for Health and Safety reporting.	Digital technologies allow for collection and verification of data required for compliance with health and safety regulations, for example, records of labour on-site, incident reports, permits to work, inductions and training completed, and certifications.

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26 Comprehensive guidance has been published by the Construction Leadership Council (2024) 'Delivering the Golden Thread' https://www.constructionleadershipcouncil.co.uk/news/golden-thread-guidance/

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THEME	Benefit of digital	Example of application
Health & safety	Mixed reality technologies (e.g. virtual reality and augmented reality) can simulate project processes, allowing for training and practising complex procedures in controlled environment, reducing time spent during the actual construction and potentially reducing errors.	A virtual replica of the physical construction site can be used to practise complex installation procedures, identify hazards, and plan emergency procedures in a safe, simulated environment.
	Smart wearable technologies monitor movement, position and posture of workers, providing feedback about potentially strenuous or unsafe work.	Various proprietary solutions are available to monitor worker safety through smart wearables. Features include aspects such as fall detection, SOS alerts, and body positioning detection to reduce the risk of musculoskeletal injuries.
	AI collision avoidance systems on construction plant can be used to detect humans and can be combined with autonomous braking systems.	Warning systems on heavy machinery that detect the presence of workers and automatically stop the equipment, reducing the risk of man-machine collisions.
	Automated generation of risk assessments and method statements based on information captured from site, for examples, photos, tasks and weather.	Combination of computer vision, machine learning and pattern recognition that can identify safety related concerns, generate risk assessments and/or support delivery of toolbox talks.
	Real-time safety monitoring on site through video imagery, for example, detecting people and identifying whether correct PPE is being used or unauthorised access to restricted areas. Early-warning of unsafe working conditions.	AI-integrated cameras automatically identify whether workers are wearing required PPE, for example hard-hats, high-visibility vests or goggles, and issue alerts when safety gear is missing. Smart cameras placed at entrances or restricted zones detect when unauthorised individuals enter hazardous or secure areas.

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THEME	Benefit of digital	Example of application
On-site logistics and construction monitoring	Software can be used to track materials on site, including delivery, inventory, locations and movement of materials and forecasting requirements.	QR codes, RFID tags or other GPS based systems can be integrated to automate the process and provide real-time information. This can be used to create a map of the site that shows the location of materials and machinery, reducing time spent locating items and predictability of having the right materials when needed.
	Real-time monitoring of construction activities and progress through automated collection and processing of site data, for example, from cameras and sensors located around the site. These can be used to monitor workforce activities, and track (and evidence) progress.	During construction, Internet of Things (IoT) technology, images and scanning devices such as LiDAR can be used to collect and process data on sites. The data can be analysed, categorising the progress of tasks and activities in real-time and linking to the project programme. This facilitates comparison of actual work completed to planned progress and can alert to delays. Drones can be used to capture aerial images and then AI algorithms can analyse the images to evaluate construction progress and flag potential risks or challenges. This is particularly beneficial for remote or large linear infrastructure projects.
Autonomous equipment and automation of construction processes	Autonomously operated construction machinery can improve productivity, efficiency and safety, as well as deliver more precise and accurate work. This is particularly relevant in large repetitive or high risk environments, such linear infrastructure projects or demolition sites.	There have been rapid developments in the use of autonomous earth-moving equipment such as bulldozers and excavators for earthworks and excavation, combining a range of technologies such as sensors, cameras, GPS and virtual models to enable automation. Examples include use of GPS guided automation systems that follow pre-set 3D designs with minimal operator input. On large infrastructure projects, autonomous haulage vehicles transport materials without human drivers, operating efficiently with central coordination and geofencing.
↓	On site automation can reduce labour-intensive work by using systems that automate repetitive tasks, reducing time and effort spent on repetitive strenuous tasks.	Robots have been developed that are able to lay bricks, following specific layouts such as for a house. Other areas being explored for automation include tying of reinforcement.

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THEME	Benefit of digital	Example of application
Autonomous equipment and automation of construction processes	Additive manufacturing, such as 3D printing of components or whole buildings, enables precise use of materials and complex geometries. Benefits include speed and precision of construction, use of off-site construction and reduced waste.	Concrete slabs often require excess material to suit simpler, easier geometries. Various research projects have explored the design and construction of vaulted concrete slabs, optimising material efficiency by placing concrete only where it is needed. This reduces carbon and material waste.
	In off-site construction facilities, digital solutions can be used to automate the construction processes, especially for standardised products.	Automation of processes ranges from replication of existing processes, for example placement of panels or reinforcement, through to novel transformation of fabrication processes through integration of design automation and manufacturing.
Understanding actual performance	Embedded sensors can enhance efficiency and optimise resource use by providing real-time data on a wide range of metrics about how the asset is behaving or being used, allowing for better decision-making and maintenance. This replaces the need for manual measurement and surveying and provides long-term visibility on an asset's performance. This is particularly beneficial in remote or logistically challenging locations, such as highway bridges.	This highlights the use of sensors in a wide range of applications, including infrastructure assets such as bridges to monitor loading conditions and structural response and fibre optics in piles to monitor performance.
	Streamline processes for reporting and evaluating snags or issues post completion of a project	Integrated digital platforms can be used to log issues and record data such as images or performance data and communicate these to the asset manager and contractor.
	Establish robust quality assurance and verification of as-built and as-maintained information about materials, components, products, etc.	Digital record-keeping can be used to verify that the right products with the correct specifications have been installed as required. This can also be used in verifying compliance of buildings with regulations, e.g. for fire safety.

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THEME	Benefit of digital	Example of application
Reducing waste and carbon emissions	Processes that automatically capture and report on materials and waste enable streamlined end-to-end environmental reporting, reducing the time and effort required in manually entering information and improving accuracy and reliability.	Apps for mobile phones and devices digitally capture key information on material delivery and waste removal, with built-in features that check compliance against project specifications and targets and compile the data into reports.
	Analysis of data can help identify opportunities for waste reduction and appropriate waste management strategies.	Using AI to analyse data across the construction project lifecycle can provide insight into how various factors affect waste generation. For example, this includes selection of construction approach, reuse and recovery opportunities, contractual requirements and procurement incentives.
↓	Digital technologies enable material reuse and circularity in the construction industry[27]. Digital records of materials and components allow for future verification, quality assurance and reuse of materials.	For example, 3D scanning of a building prior to demolition can help identify materials and elements that can be reused. Material passports can be created and tagged in the digital model, recording key information for future reference.

27 Construction Management (2024) 'Digitalisation and circularity: the future of sustainable construction' https://constructionmanagement.co.uk/digitalisation-and-circularity-construction-sustainable-future/

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THEME	Benefit of digital	Example of application
Streamlining business management	Centralised and integrated management of business finances enhances real-time visibility of cash flow, project profitability, and financial forecasting.	On construction projects, digital platforms can be used to automate tracking of project budgets, invoices, and subcontractor payments.
	HR systems help with managing HR requirements, maintaining auditable records and ensuring compliance with employment regulations.	Organisational HR systems can be used to management recruitment, onboarding, training, timesheets, and employee leave. Systems that support tracking of employee training and development can enhance staff retention. On site, various systems can be used to manage worker onboarding, training records (e.g. CSCS cards), timesheets, and site access control.
	Customer Relationship Management (CRM) tools enable more targeted marketing and stronger client relationships.	Improves tracking of leads, client interactions, and project pipelines. Various tools can be used to manage bids, track tender pipelines and evaluate conversion rate
	Digital systems for document management streamline processes and create traceable audit trails recording changes and approvals.	Common Data Environments can be used to create automated workflows for approvals of drawings, RFIs, or documents. Cloud storage systems with version control allow for collaborative working with secure remote access to updated documents
	Collaboration and communication platforms connect teams across departments, sites and offices, facilitating coordination, updates and resolution of issues.	

ACKNOWLEDGEMENTS

(Alphabetically by surname)

Dr Bola Abisogun OBE – Digital Twin Skills Academy
Nandeesh Babanagar – University of Cambridge
Faye Burnett – SLG10 Super Sector Programme Director
Dame Dawn Childs DBE FREng – Pure Data Centres
Paul Drayton – Laing O'Rourke
David Emery – Supply Chain Sustainability School
Andy George – HBF
Michael Jaggs – BRE Academy
Anne Kemp – CLC Data and Digital group
Daniel King – Causeway Technologies
Paul Madeira – Causeway Technologies
Jessica Marston – Construction Industry Training Board
Ollie McGovern – Causeway Technologies
Dan Rossiter – BSI and CLC Data and Digital group
Martin Vallance – Egis
Karen Wood – Department for Business and Trade
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