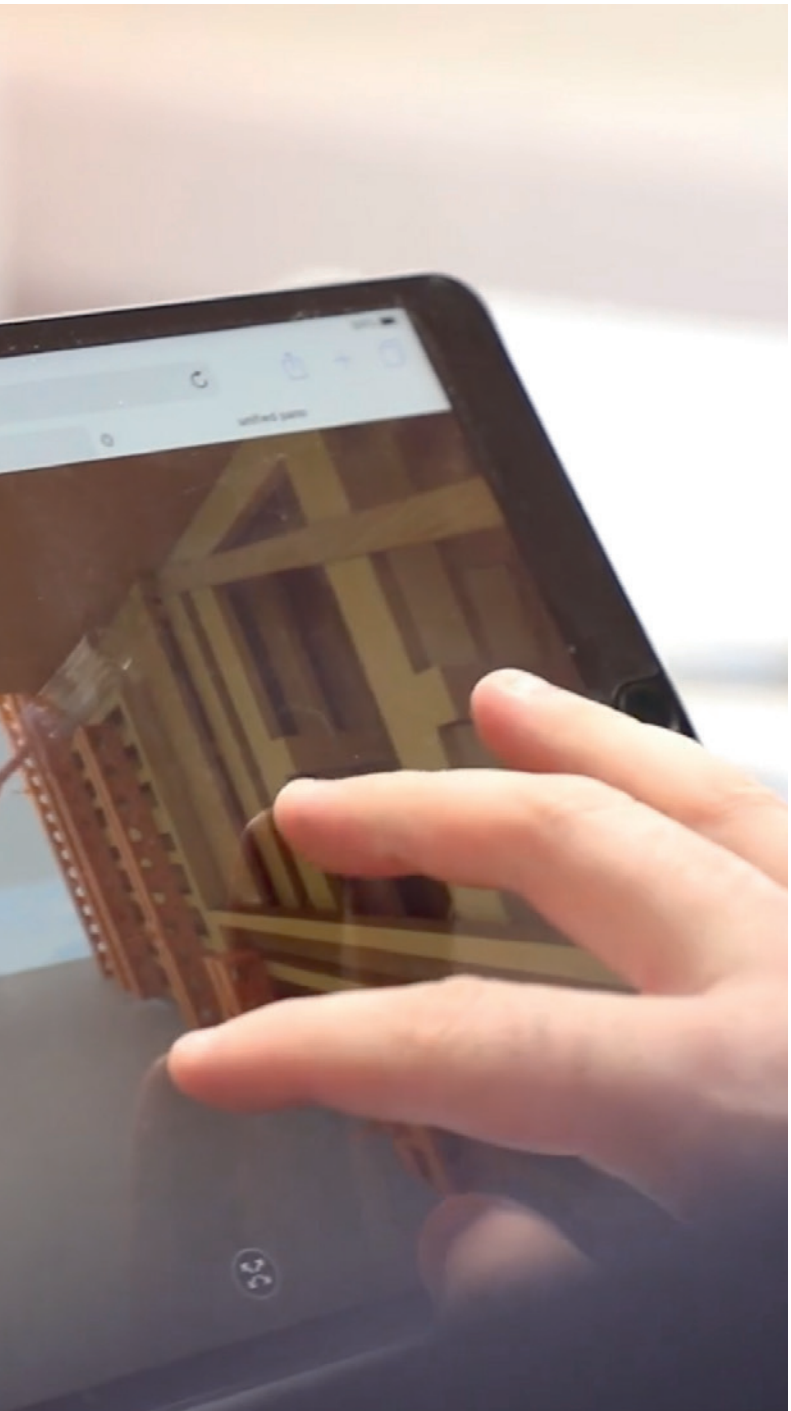
CITB WHITE PAPER

UNLOCKING CONSTRUCTION'S DIGITAL FUTURE:
A skills plan for industry



This research is part of CITB's **Changing Construction – Changing Skills** programme

October 2018

REVEALING REALITY

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FOREWORD

Digital technology and wider understanding of its benefits are the vital next steps for construction industry modernisation.

Digital technology will be a cornerstone of construction sector reform to productivity, efficiency and quality of delivery. Done right, it can also support the attraction, retention and inspiration of new generations of talent for our sector.

As this timely report from the Construction Industry Training Board (CITB) identifies, to truly benefit from the gains that embracing digital technologies will bring, our industry first needs to have a common understanding of what's available, how it works, and what are the minimum standards we can all rely on to drive the sector forward.

Without those common drivers – and a clear commitment to support them from our own organisations, government, clients and other stakeholders – we risk undermining progress through those happy to settle for the lowest common denominator.

In my work at Laing O' Rourke, and in my role on the government's Construction Leadership Council (CLC) Skills Workstream, I know how critical it now is for industry to collaborate in order to accelerate the pace of change in the construction sector.

Our industry comprises 10 per cent of the economy. It is the critical enabler that allows other industries to get on and play their part. We must ensure we all know what it takes to deliver practical change in this exciting area and how each of us plays a relevant role.

As this report highlights, we must ensure our understanding of digitalisation in construction is more than just Building Information Modelling (BIM), or new visualisation tools, or big data analysis – but a combination of all digital technologies that – applied appropriately – will assist all construction sector players, large and small.

Embracing the opportunity in that manner necessitates and drives a fundamental change to the sector's existing skills and culture.

Business and government leaders will require the know-how to create the market and commercial conditions to drive this transformational change. Employees will need continued support to improve digital literacy. Sharing and showcasing best practice will support this industry transformation and assist in increasing the pace of modernisation.

This report identifies how CITB will work with the CLC, the government, industry and training providers to demystify and promote digital skills. We will support industry in developing clear goals and actions including committing CITB funds to invest in widespread training. It's an exciting agenda but it will only be fully realised if we can work together – as modernisation will bring sustainability across our diverse sector.

I thank those who worked tirelessly on this report, and I look forward to working with you to see it brought to life.

John O'Connor
Group Commercial & Human Capital Director, Laing O' Rourke and 'Future Industry' Lead, Construction Leadership Council, Skills Workstream

"DIGITAL MEANS DIFFERENT THINGS TO DIFFERENT PEOPLE"

AIM OF THIS REPORT

CITB wants to help develop the digital skills and competencies industry requires. This report, based on research which covers companies that operate in England, Scotland and Wales, explores what those skills and competencies are and how industry can ensure they are developed.

KEY FINDINGS

The benefits of digital construction are well rehearsed and adoption provides huge opportunities. Digitalisation is at the heart of the Construction Sector Deal and policies designed to raise sector productivity. The imperatives for change are also rooted in longstanding industry issues. Tight profit margins, high profile project overruns and issues with quality continue to dog the industry. More recently, Brexit and the potential impacts on the availability of labour have sharpened the focus on doing things differently. However, the pace of digitalisation is gradual.

At the heart of digitalisation is a need for a digitally skilled workforce. Construction businesses not only need to be able to use technology, but to make the most of it. The right skills are a key catalyst for digital growth. This report examines what the current skills gap is and what is required to fill it.

There is a growing interest in the industry in the need to become digital but it doesn't always know how to go about it. The sector's vision of how to implement, recruit and fill the digital skill gap is unclear.

This research found that:

- **Digital construction is understood to mean different things by different people.** Many assume digital construction means Building Information Modelling (BIM) but it is wider than that. True understanding is concentrated on digital construction specialists. Those trying to implement digital methods felt frustrated when persuading others to take a 'leap of faith' because of the lack of understanding in how technology could be used to solve problems.
- **Much tech that is being used is not at the cutting edge of what is available.** Drones, Lidar, smartphones and tablets are increasingly widely used but really innovative tech – if used at all - is generally limited to small pilots or trials, as investment in larger scale innovations is considered too risky. Sharing best practice will help industry evolve understanding of the value of digital and the skills and training needed.
- **Data and its effective collection, communication and management are central to digital transformation.** Industry needs to demystify how data is used and the skills required across the entire workforce. Genuine understanding of what data management involves is limited.
- **Tech-specific skills aren't the problem – but broader skills and competencies at various levels need to be addressed.** Leaders need skills in implementing digital change and creating the right structures and culture. Managers and operatives need problem-solving skills and greater digital savviness. Not everyone needs to be at the same level. It's about enabling top-down and bottom-up change.

DEFINING DIGITAL CONSTRUCTION

"The problem is that the industry is disparate, and everyone is doing their own thing. It's all separate and hard to join up and say: 'Everyone is using this.'"

CEO, tier 1 contractor

Our research shows that digital construction is a catch-all term understood to mean different things by different people. This lack of consensus is part of the problem: industry needs to be clear on what digital construction means, how best to use it and what skills employees have - and will need.

For the purposes of this report:

Digital construction comprises of new technology hardware and software, data-led processes and equipping staff with the skills needed to maximise digital applications.

This research set out to explore the adoption, use and expected uptake of a broad range of digital technologies across construction, including:

- Augmented reality/virtual reality
- Drones/unmanned aerial vehicles (UAVs)
- 3D printing
- Artificial intelligence (AI)
- Wearable tech
- Lidar
- The Internet of Things
- Productivity/planning apps
- Data analytics

Further details on what these technologies are and how they can be used can be found in Appendix 1 of the full report.

BEST PRACTICE: HOW INDUSTRY IS USING TECH

"Land surveying is cut down from two days to 20 minutes now that unmanned aerial vehicles and drones are being used."

Director, tech specialist

The research found several examples of the ways digital technologies are being implemented onsite to deliver significant benefits. However, onsite examples are often pilots or individual projects. The organisations most successful at integrating technology were using digital tools to solve specific problems.

CASE STUDIES

HIGHWAYS ENGLAND

Highways England operates, maintains and improves England's motorway and major trunk road network. There are three underlying imperatives that guide all its activities: safety, customer service and delivery of projects and programmes.

Digital skills and data-based decision making are recognised by Highways England as critical to its future success. Opportunities include the better use of asset condition data to predict and optimise maintenance programmes, and the development of a network traffic simulation tool.

A14 INTEGRATED DELIVERY TEAM

"The greatest benefit is the amount of time [saved] out in the field. Setting out timber profiles and batter rails is very time consuming. Once the drivers get used to the system, they find it easier and they don't have to keep getting out checking line and level. It's got to be at least five times the speed and the new systems allows us to adopt changes quickly."

Manager, A14 Delivery Team

In its delivery of Highways England's £1.5 billion Cambridge to Huntingdon improvement scheme, the A14 Integrated Delivery Team (a joint venture between Costain, Skanska, Balfour Beatty and designers Atkins/CH2M), uses GPS equipment and 3D control systems to share data from digital 3D models with earthmoving equipment onsite. The machines can send survey data back to the office, allowing progress to be measured or visualised.

IMPLEMENTING DIGITAL: THE CHALLENGE INDUSTRY FACES

"Site diaries previously on paper and faxed are now on spreadsheets. Workers start to see that they can use a digital diary that populates a lot of things, making their lives easier. This is the first step."

Head of digital and innovation, tier 1 contractor

"To make technology uptake viable you need a client, contractor and design team who are willing to give it a go and trial it on different projects. Trusting someone to deliver on this tech is very difficult."

Director of innovation, client

Data and its effective collection, communication and management is central to digital transformation. This research found a lack of understanding of how digital technology and data can be used to solve construction problems. This is a big hurdle for industry. The business case for investing in digital technology and skills needs to be made.

The report found that:

- A site and project-specific culture does not support innovation being carried forward from one project to the next. Also, adversarial supply chain relationships slow adoption of new methods and skills.
- Clients and contractors face shorter-term pressures that restrict investment in tech.
- Infrastructure projects with long timescales, big budgets and powerful government clients were often cited as the only or best way to try out new tech.

Without the right conditions for innovation, demand for digital skills will be steady rather than explosive. Large clients and government in particular have a big role to play in encouraging innovation and digital mindsets much as they did for BIM, but at a wider scale. The Sector Deal and initiatives such as Project 13 (the industry-led initiative, launched in September 2017, to improve the way high performance infrastructure is delivered) are extremely important is creating the right conditions for innovation and skills.

"TRUSTING SOMEONE TO DELIVER ON THIS TECH IS VERY DIFFICULT"

UNLOCKING THE POWER OF DATA

"People identify tech that brings value but they don't understand the process of providing data to others, how to use it, what it means. The tech is pointless if we don't get this."

Head of innovation, tier 1 contractor

Many identified data as a key skills gap but the term was used to describe different things. Without a clear definition it is hard to identify the right skills and training.

The research identified some core skills needed to collect, store and use data well to strategically solve problems. But few knew how to do it. The research found that:

- Sharing data around the organisation isn't happening (e.g. across multiple sites). It's not always clear what data organisations had and what it could teach them – or what they could collect, how they could use it and what they could learn from it.
- Few were collecting data to help them identify problems or issues and ensure the right decisions were made.

Effective collection and use of data provides opportunities for improvement at both the micro and the macro level – it can help solve a problem onsite or contribute to improving outcomes across multiple sites. However, this requires appropriate mechanisms to be in place not only to collect data, but also to analyse it and then feed back the findings. Effective data management of this sort was rarely in place – and misuse or misunderstanding of the term 'data management' more widely serves as a barrier to its implementation.

HOW INDUSTRY CAN GAIN CLARITY ON SKILLS AND TRAINING

THE NEED FOR THE RIGHT SKILLS AND ATTITUDE

"We want a data centre like an F1 team who know everything about the car in every second. We want to replicate this for the construction site."

Head of innovation, client

Industry is in an inevitable period of exploration, where it is yet to agree which digital technologies offer the most value. But our research found that rather than having the skills for specific pieces of technology, underlying skills and knowledge (such as problem-solving, data skills and a broad digital literacy) are most important.

Digital transformation within construction companies requires both a flexible mind-set, and an understanding of digital tools and data.

Industry needs to raise digital skills across the board. However, not everyone needs to be at the same level. It's about enabling top-down and bottom-up change.

Some major contractors and consultancies have developed, or are developing, their own digital competency frameworks, but they are in a minority. Where frameworks have been undertaken it has usually been an iterative process over several years – and is not yet complete.

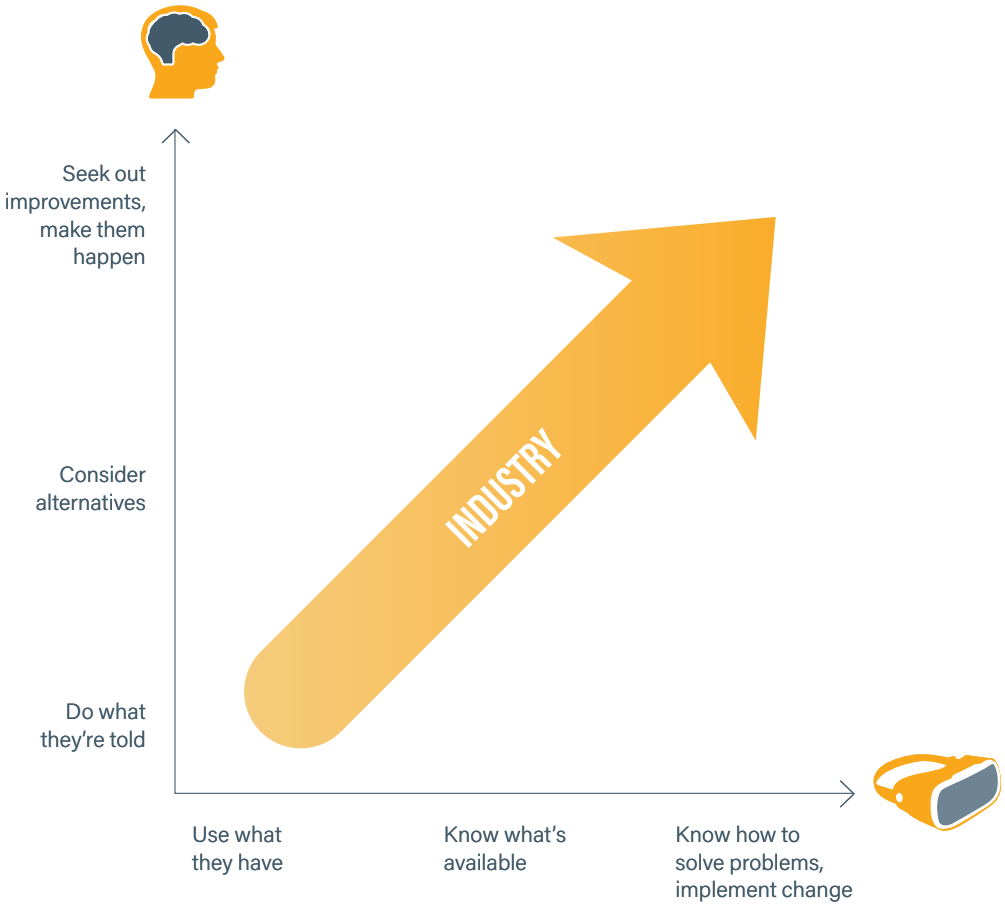
The two groups of competencies needed to push the industry forward

Flexible mindset

- Curiosity
- Problem-solving
- Creativity
- Emotional intelligence
- Communication

Understanding tools & data

- Knowledge of how specific tech works
- Range of tech available/ being developed
- How data can support tech development
- Collecting, storing, sharing, using data



"We need to realise that everyone needs a basic level of understanding of the technology. We shouldn't be creating islands of innovation but instead bring in the whole community – leaders, managers, juniors."

Head of talent, tier 1 contractor

CITB can help industry agree common definitions and objectives for digital skills. As the graph above shows, people need to be able to:

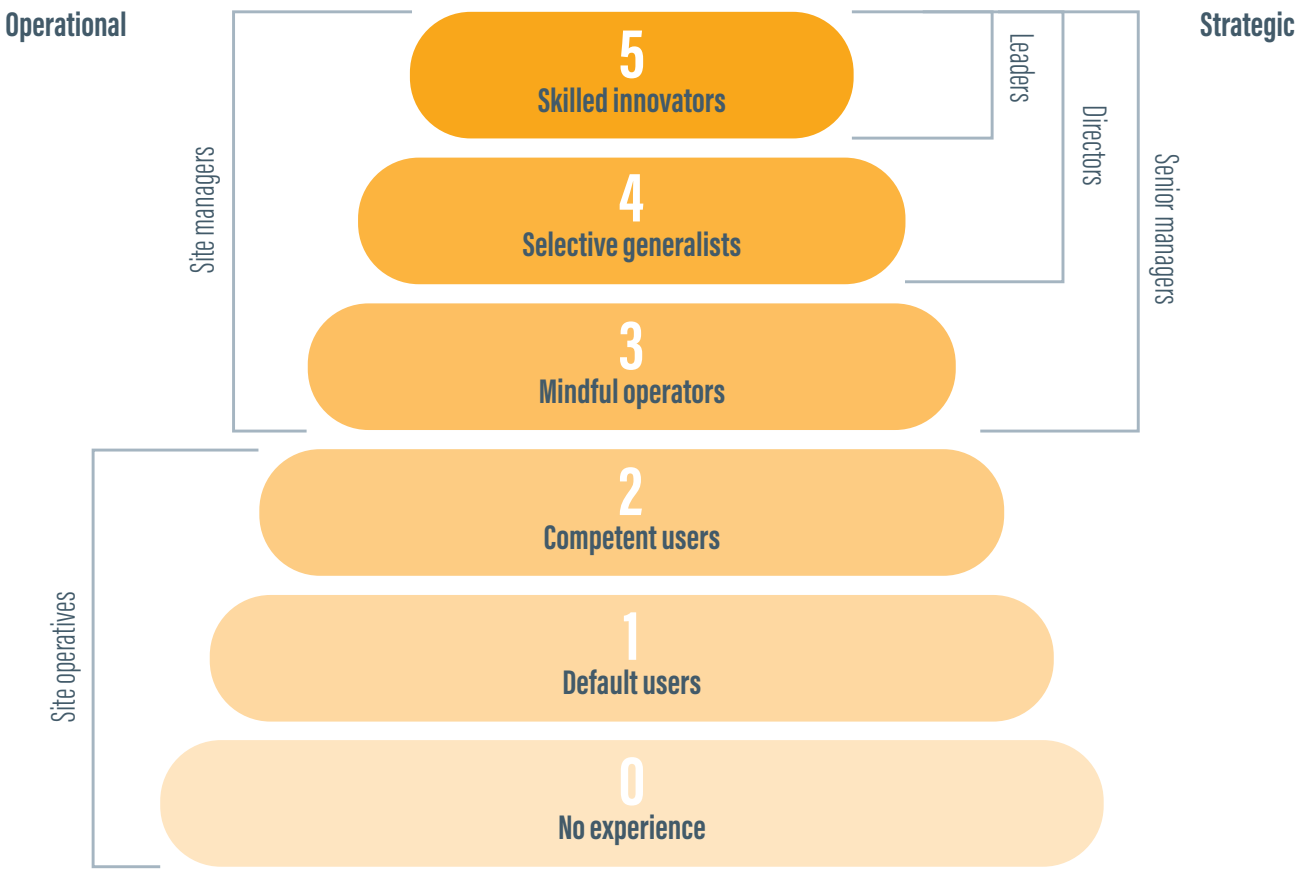
- Think creatively about problems and their solutions
- Understand how to use digital tools
- Assess which tools to use in which circumstances
- Manage the data that flows to and from the use of these tools.

Generally, the people starting to use and implement tech solutions were site managers and engineers. Managers were also more often the advocates of new technologies. In addition, many site supervisors found they could work more efficiently using 'lower level' technologies such as tablets. In most cases technologies did not yet affect the daily tasks of labourers.

For 'at scale' digitalisation, leadership needs to fully understand the potential of digital technology and how to make it flourish through changes to organisational structure, skills investment and culture. Managers and operatives will then be enabled to fully develop and apply digital competencies.

Based on these findings, desired competency levels for workers across the industry could look like this.

Scale of digital competency



COMPETENCY LEVEL	DEFINITION
Skilled innovators	• Considers/tries inventing own tech solutions • Identifies problems/goals that tech could help solve • Implements change and makes it happen.
Selective generalists	• Chooses the most appropriate technology for the task • Actively considers how problems could be solved using tech • Handles/delegates problems effectively
Mindful operators	• Actively considers how tech could be used better on existing or similar tasks • Handles problems or knows when to ask for help
Competent users	• Competent and confident using specific tech for particular tasks • Handles some problems if they arose
Default users	• Trained to use specific tech • Not highly skilled/competent or confident
No experience	• Never used tech

Spread of skills in different roles

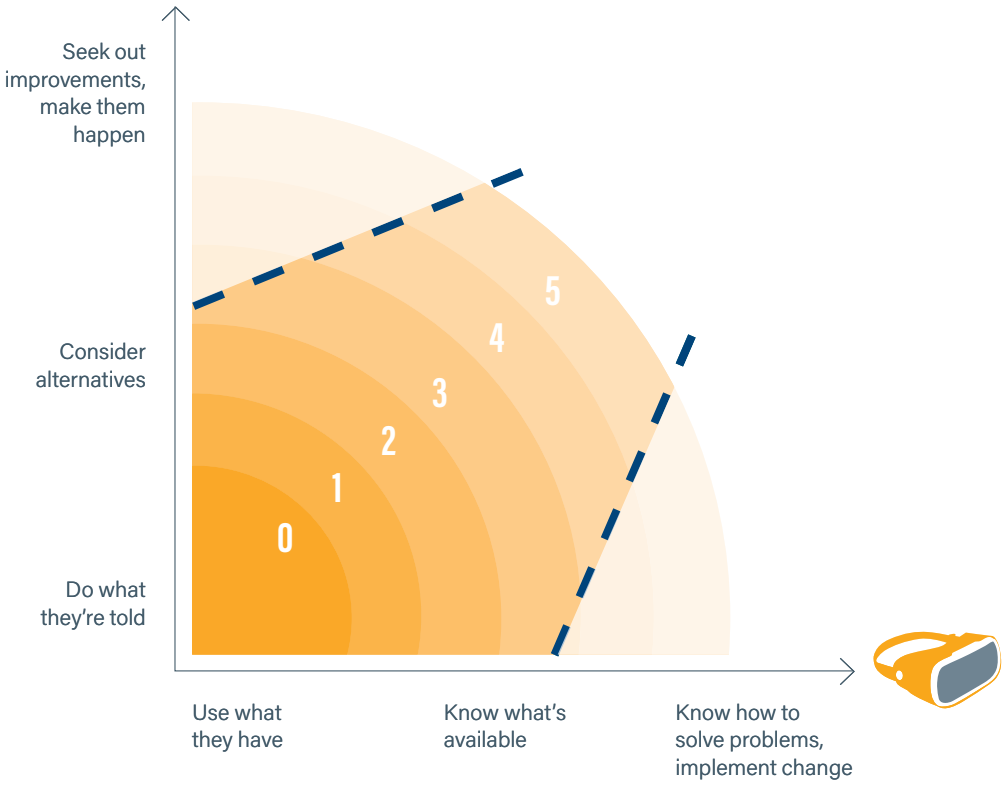
5 Skilled innovators
4 Selective generalists
3 Mindful operators
2 Competent users
1 Default users
0 No experience

Flexible mindset

- Curiosity
- Problem-solving
- Creativity
- Emotional intelligence
- Communication

Understanding tools & data

- Knowledge of how specific tech works
- Range of tech available/ being developed
- How data can support tech development
- Collecting, storing, sharing, using data



The competency graph and scale can be brought together into the diagram above. In this framework the dotted blue lines demonstrate how training should focus the skills and knowledge of workers at different levels.

The framework can help to identify where skills interventions need to be directed, depending on role and current 'digital literacy'. It could be used at an industry-wide level to map out the workforce's competency levels or it could be used by an organisation to assess its employees or supply chain workers – and then to consider where it wants them to be.

Beyond these high level objectives and needs, work with industry is required to define the specific skills needed by occupations across the sector and standardise them in qualifications, training and HR processes.

CASE STUDY

MACE 2022 BUSINESS STRATEGY

Mace has concluded that digital technology doesn't work unless soft skills are in place. Leadership skills, in particular, are needed to communicate tech benefits to its wider team: why they are using it and how to best integrate it. The push for soft skills is regarded as the 'glue' that holds the business together.

ATTRACTING THE NEW WAVE OF TALENT

"We have one person who did a civil engineering and computer science degree. What he can bring in terms of efficiencies is insane."

Head of innovation, tier 1 contractor

Construction employers are targeting a new wave of workers with various skillsets, including specialist 'digital' skills. Some are recruiting from non-construction training routes such as computer science. However, their role is not always well defined because of uncertainty on the best way to exploit digital disciplines and skills.

With some notable exceptions, directors and senior managers working in HR recruitment or talent and development teams were reluctant to take part in this research, saying either implicitly or explicitly that digital upskilling was not a priority for them.

Talent management functions need direction from the top to set priorities for recruiting new roles. Construction will be competing with many other industries for digital talent and needs to develop a compelling offer to attract them.

WHAT HAPPENS NEXT?

The scope for what digital could be used to achieve in construction is vast, however industry is far from realising the full scale of the opportunities.

Developing flexible attitudes, creative and problem-solving mindsets and a range of other softer skills alongside an understanding of tech and data could help the industry take great strides in its digital transformation – and potentially reduce some of the cultural and structural barriers to its uptake.

This report sets out some tools – digital competency scales and spectrums for industry - that outline how workers can be supported and trained to develop the required mindsets and understanding.

RESEARCH RECOMMENDATIONS

CITB has a vital role in taking digital tech and skills further – but will require the support of employers, industry bodies and the government to make the most of the opportunities.

Based on the findings from this research, it is recommended that CITB, industry and other stakeholders work together towards the following outcomes:

- Using the digital competency scales developed from this research, the construction industry agrees common goals and a plan of action to increase digital skills in line with ambitions for digital transformation throughout UK construction.
- Industry needs to work towards ensuring the current and future workforce has the right digital skills. This means:
  - Business leaders are equipped with the skills and knowledge to implement digital technologies, processes and competences in their business, including changes to HR activities.
  - Digital competence requirements across the built environment sector are standardised and embedded in qualifications, training and employer HR planning.
  - Training is available and undertaken to deliver standardised competencies across the sector, both as part of formal qualifications and continuous learning.
- The construction industry can compete with other industries to attract and retain specialist digital roles.

CITB'S RESPONSE

Stephen Radley
Policy Director, CITB

It's clear from the findings set out in this report that the industry has a huge opportunity. However, the skills challenge is sector-wide and stretches from the boardroom across the supply chain. So we need to act now with the support of industry and government.

We believe that this research can be a starting point for change that begins with a common definition of digital skills and agreement on where we need to get to. Below we set out what we as CITB are going to do to achieve the recommended outcomes and what we would like to see industry, CLC and government do to support.

Supporting industry to agree common goals for digital skills

A fragmented understanding of digital skills, and who needs what, is holding industry back. The digital competency scales presented in this report provide a framework to agree priorities. We will work with industry, including hosting roundtable discussions, to achieve consensus on digital skills goals and a plan of action to achieve them that garners cross-industry buy-in.

We recognise that this skills challenge is not isolated to construction. The government, through its UK Digital Strategy, has outlined relevant skills initiatives. We intend to work with government, including the Department for Digital, Culture, Media & Sport, to identify how **relevant policies, initiatives such as the Digital Skills Partnership and cross-sector knowledge can be leveraged to support construction** and vice versa.

The ambitions for skills are dependent on sufficient demand from industry for digitalisation. A commitment for skills needs to be supported by a drive from the **CLC to promote industry uptake of digital technologies** in line with CLC targets. This could include wider sharing of the benefits of digital adoption and best practice examples of use.

There is also a role for clients, in particular government as a major procurer, to **promote the right contractual conditions and project structures** that support successful innovation and investment in skills, for example Crossrail, Tideway and the Project 13 initiative.

Funding and influencing to drive widespread digital competencies

The research shows that to ensure the workforce has the right digital skills, interventions need to be targeted at different levels. This needs to start at the top; equipping leaders with the know-how to digitise their businesses and create the right conditions for a digitally competent workforce.

The wider workforce, both existing and future, needs to be equipped with role-specific and generic competencies.

CITB will use its funding and influencing activity to deliver interventions that will support these needs: from leadership programmes to standardised competencies and training for the supply chain. Funding will be directed to industry initiatives that deliver wide scale and ongoing impact.

We will also use our ability to influence industry stakeholders, government and the training sector to drive uptake and commitment to the activities. **Industry and government also have a role here to ensure that competencies are reflected in relevant apprenticeship standards** and T levels.

A unified industry approach to attracting the top digital talent

Finally, in line with the definition of competencies, industry needs to agree what specialist digital roles it needs and how they will be used.

Once it has done this, it will need to develop common messages and work on campaigns to 'sell' the industry to the required talent. This is likely to include emphasising the sector's ability to make a difference to society, or the opportunity to work in a job with tangible results and a potentially major impact. It will also need industry to consider whether it will require a culture shift to make construction a desirable industry to join and stay with.

CITB will work with the CLC Skills Workstream to ensure industry career campaigns build in messaging and activities to attract new digital skills. We will also scope out the potential to work with other sector bodies to generate awareness of opportunities.

There is no question that the industry needs to upskill and recruit new talent to make the most of the huge opportunities digital technologies hold for UK construction. It's not too late – but it won't happen on its own.

We are excited about the industry's digital future, and as the training and skills board we know that future depends on the people who work in the industry.

We are keen to begin working on the transformation required – led by an industry motivated to modernise.


Spill kit
SPILL KIT
MAX FRANK
FOSROC

RESEARCH METHODOLOGY

Interviews took place with 35 organisations in England, Scotland and Wales. The goal of these interviews and site visits was to explore both attitudes towards technology and its role in construction across the whole of the UK.

Knowledge review and refining objectives

- Desk research
- 14 subject matter experts (including construction industry and related worlds)
- Prioritisation workshop and refining the objectives

30 depth interviews

- Contractors, subcontractors, engineering consultants, project management/ quantity surveying consultants, clients looking to implement digital solutions
- Strategic view and operational view
- HR and talent teams
- Training providers

5 site visits

- Ethnographic fieldwork to observe technology in use
  - Tideway
  - Dudley College
  - Scotland Construction Innovation Centre
  - Basingstoke Sludge Treatment Centre
  - National College of High Speed Rail

REVEALING REALITY

About the Construction Industry Training Board (CITB)

CITB is the Industrial Training Board (ITB) for the construction industry in Great Britain (England, Scotland and Wales). CITB ensures employers can access the high quality training their workforce needs and supports industry to attract new recruits into successful careers in construction.

Using its evidence base on skills requirements, CITB works with employers to develop standards and qualifications for the skills industry needs now, and in the future. CITB is improving its employer funding to invest in the most needed skills and by making it easier for companies of all sizes to claim grants and support.

CITB WHITE PAPER

Research and full report by:
Revealing Reality
Revealing Reality is an independent insight and innovation agency.

Commissioned by:
Stephen Radley, CITB Policy Director
stephen.radley@citb.co.uk

For more information please contact:
Ben Lever, CITB Future Skills and Innovation Lead
ben.lever@citb.co.uk

For the full report visit:
www.citb.co.uk/research-insight/