Innovate UK

Transforming Construction Challenge brochure

Progress and achievements
February 2022

Transforming Construction Challenge

Centres of excellence

Projects

Academic led research projects in conjunction with EPSRC

Wider context and Challenge influence

Appendices

Foreword

Collaboration across government, industry and academia.

Innovate UK is the UK's innovation agency. We aim to inspire, involve and invest in innovation. The Industrial Strategy Challenge Fund (ISCF) was developed to address the big societal challenges facing business today. By setting a bold vision for the UK economy we sought to inspire system change. Across the challenges we involved all the stakeholders needed for real change. We then invested record amounts, matched by industry.

The ISCF Transforming Construction Challenge was a collaboration across government, industry and academia to accelerate the modernisation of construction. Buildings and infrastructure underpin the productivity of almost half our economy. Yet the construction sector still use methods that haven't changed much since Biblical times. The sector was resource intensive and had a productivity gap with the rest of the economy.

The Transforming Construction Challenge is a powerful example of what Innovate UK does best: involving different disciplines in a significant opportunity. Manufacturing, digital and renewable energy experts have been brought together with construction sector pioneers. New processes have been developed and demonstrated. A new ecosystem for delivering our built environment has been shaped. In just four years the Transforming Construction Challenge has established genuine system change and meaningful impact.

I would like to thank all of those who delivered this challenge. In particular the visionary leaders in government and industry who have committed to change. This document provides more detail on what was achieved.

Indro Murkejee
CEO Innovate UK

Foreword

Leading the transformation of construction at scale.

Just over three years ago we began the government's programme for Transforming Construction, with the aim to shift the system away from lowest cost towards whole-life value of our built assets. The targets were daunting: reduce whole-life costs by a third; halve carbon emissions; reduce the trade gap; and double the speed of delivery. All this against a backdrop of contractor margins averaging 2% and decades of flat-lining productivity.

What has happened since, however, has shown that not only are the targets achievable, but that a number of profitable business opportunities could be created as well. By this time next year, the sector will have invested £250 million in funding to match the government's £170 million contribution, and the solutions that the Transforming Construction Challenge has backed are already a part of over £13 billion in public and private sector procurement.

The next objective is to scale these solutions further and that's where everyone from clients, contractors, consultants or suppliers can all play an important role. Disruptive technology and innovation have already proven themselves in the automotive industry in recent years, and there's no reason why construction could not follow the same path with the right engagement and behavioural change.

The projects in this brochure have succeeded in showcasing what's possible not only in terms of meeting the ambitious targets set by government, but also in what the future could hold, with a commitment to new concepts of manufacturing approaches, digital and data-driven processes, robotics, clean energy, and embedding whole-life value in every part of the industry's output.

With The Construction Playbook and Transforming Infrastructure Performance: Roadmap to 2030 announcements demonstrating confidence and commitment from government in the industry's potential and direction, the barriers to innovation are being overcome.[1] Modern construction methods are already being put into practice and the principles of many of the innovations developed under the Transforming Construction Challenge are being applied across the sector for new building projects. From schools to hospitals, infrastructure and domestic homes, it is with great pride that we see the principles, learnings and technologies nurtured through the Challenge beginning to have a wider impact – with public demand to match ambition.

The result is that we are now starting to see a golden age for construction, with many of the projects backed by the Transforming Construction Challenge leading the way in driving lasting change.

Sam Stacey
Challenge Director

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Centres of excellence

Construction Innovation Hub

As part of the Transforming Construction Challenge, the Construction Innovation Hub has pioneered a number of initiatives that are driving innovation throughout construction, addressing the sector's production and performance challenges: the Value Toolkit, Platform Programme, Information Management, and International Programme.

Value Toolkit

A government-backed initiative designed to change the way the construction industry thinks about and measures value.

Led by the need to respond to evolving policy priorities that have a greater focus on more holistic value metrics, Construction Innovation Hub collaborated with over 200 experts from across government and industry to develop the Value Toolkit – a new process and digital tools designed to change the way the construction industry thinks about and measures value. Aligned with the government's Construction Playbook and HM Treasury's Green Book, the Value Toolkit empowers decision-makers to make more informed and policy-aligned decisions.[2]

The Platform Programme

Defining the rules on how to take a platform approach to deliver social infrastructure.

A collaboration of industry leaders, peers and government is developing, prototyping, testing and demonstrating the fundamentals of a platform approach to design for manufacture and assembly. This is an approach that not only encourages innovation within construction, but also helps to future-proof industry.

Following analysis of a government five-year new build pipeline worth circa £50 billion, the Platform Programme estimated that 70% of the spaces required are suitable for delivery, in whole or in part, through an innovative platform solution – just one of the ways in which a platform approach could help create greater efficiencies, cost savings and boost long-term value for both public and private sectors.

Construction Innovation Hub (continued)

Information Management

Focusing on harnessing the potential of digital evolution to create a world-leading industry that delivers better long-term outcomes for all.

The world and our infrastructure is evolving, and digitalisation plays a key part in this. For the construction industry to thrive for future generations it must embrace digital ways of working now that help to secure its pipeline.

In collaboration with industry, government and academia, the Information Management project researches, tests and demonstrates how establishing the golden thread of information management within digitalisation will help boost efficiencies, productivity and ensure sustainability of the sector.

International Programme

Establishing and creating opportunities for an open, digitalised and innovative global construction market.

The International Programme is working to support the adoption of global standards for digital ways of working within construction that help to create a democratic and open global marketplace, creating opportunities and facilitating trade across international borders.

Introducing global standards within construction also helps to progress the policies of governments around the world. Through establishing a Global BIM Network, the International Programme is supporting governments around the world to mandate building information modelling to increase productivity, improve infrastructure performance, and deliver long-term social, economic and environmental outcomes.[3]

Active Building Centre

The Active Building Centre (ABC) programme aims to transform the UK construction and energy sectors by demonstrating and advancing best-practice net zero carbon technology for Active Buildings.

Active Building Centre Ltd (RTO)

Delivering buildings with greater certainty of cost and time, and providing better value and performance over their whole life.

As an independent national centre of excellence, the Active Building Centre (ABC) (a Research and Technology Organisation) convenes industry, academia and government to enable the deployment of Active Buildings at scale. ABC aims to improve efficient energy use and decarbonisation across the built environment, providing open access to data and statistics for analysis and optimisation of system performance, and delivering the skills and training required to change the construction sector's beliefs, thoughts and actions.

Connah's Quay

Sustainable housing in Flintshire, Wales, setting the standard for future developments.

Flintshire County Council set out to build low or net zero carbon social housing at scale. It had the incentive from the Welsh government to pioneer social homes that are net zero carbon, driven in part by the Well-being of Future Generations Act, which is a pioneering piece of legislation in Wales.[4] At the heart of delivering the wellbeing duty is the requirement for sustainable development. This means that Flintshire County Council, as a public body in Wales, must act in a manner that seeks to ensure the needs of the present are met without compromising the ability of future generations to meet their own needs.

Delivering 20 new homes at Ffordd Llanarth as net zero carbon for operational energy, as well as making a significant contribution to reducing the embodied carbon, will provide Flintshire County Council with the opportunity to build an exemplar sustainable development and set the standard for future developments going forward.

ABC has identified that early engagement and intervention in the RIBA design process offers the greatest opportunity to maximise impact in delivering net zero carbon buildings. This has proved invaluable in this project, with ABC becoming integrated into the design team at the concept stage. As well as undertaking an initial design review, which resulted in changes to the site layout and the roof designs, dynamic simulation modelling of energy demand and generation before the planning application submission has been critical to informing design decisions. This has resulted in a fundamental shift in the development process and has maximised the chances of this project delivering net zero carbon homes, benefiting everyone, especially the residents who will live there now and in the future, and the council who will build, manage and maintain these homes for the life of the buildings.

Active Building Centre (continued)

Active Building Centre Research Programme (ABC-RP), Swansea University

A large-scale programme that brings together the expertise of 10 leading UK universities to solve new and existing energy challenges.

ABC-RP mobilises a consortium of technical and academic experts from 10 academic institutions, led by Swansea University, who are developing the underpinning capabilities and technical know-how that will support the scale up and mass deployment of Active Buildings, while also establishing credibility within the policy, business and local government community. One example of ABC-RP's progress is Behind the Meter Billing at Trent Basin.

Behind the Meter Billing

Informing residents about their energy consumption to drive behaviour change.

Behind the Meter Billing is a dynamic living lab, collecting data about active buildings at a community level to show how they can have far reaching benefits for households and for the grid. It builds on the Energy Research Accelerator and Project SCENe (Sustainable Community Energy Networks), an existing active building housing development in Trent Basin.

A team from the University of Nottingham and SmartKlub set themselves up as an Energy Service Company, essentially taking over regulation of the energy supply from Ofgem. The project sought to streamline energy bills for residents. They made energy usage more visible to see if it could create positive energy behaviour and help people better manage how and when they use their energy supply and what they pay for it. This rich, real-time data also gives Ofgem insights into billing mechanisms and how community systems can help smooth out demand peaks for the grid, helping make energy more affordable for all.

Transforming Construction Network Plus (N+)

A community of researchers brought together to inform future construction policy and practice.

The N+ mobilised a new movement in the construction community, bringing together experts from a range of disciplines to tackle the most pressing problems across the digital, energy, construction and manufacturing space. The network united academic researchers with industry and policy representatives through networking and skills-building events. Over the life of the Transforming Construction programme, the N+ provided funding for research projects through two funding calls, producing outcomes such as the Challenging Space Frontiers in Hospitals project.[5]

Challenging Space Frontiers in Hospitals

Learning from space industry procurement to improve the whole-life value of hospital operating theatres.

What do operating theatres and spacecrafts have in common? They are both restricted spaces where complex tasks need to be carried out, and they both need to be kept infection-free. And so the way to procure these two highly-specialist environments has to support careful design, planning and delivery.

A research collaboration between UCL, Loughborough University and Cranfield University investigated the parallels between space-shuttle engineering and modern methods of construction (MMC) with an aspiration to develop an advanced platform for the design, manufacture and assembly of surgical spaces. Their purchasing model – Challenging Space Frontiers in Hospitals – showed improvements could be made in construction time, build quality and safety, as well as in the reduction of defects.[6] And, importantly, the programme recommendations showed they could improve clinical outcomes, patient safety and experience. So much so that the Estates Delivery lead at NHS England and NHS Improvement has called for a bigger focus on MMC and a platform approach to design for manufacture and assembly in the procurement of hospital buildings.

Projects

Adaptive Learning for Zero Defects

Tailored learning to help workers understand tasks and deliver them right, first time.

TR Control Solutions has created BIMformed™ Adaptive Learning Engine – software that helps ensure construction tasks and installations are carried out correctly first time, and every time. It uses artificial intelligence (AI) and machine learning (ML) to check in with an operative and assess their understanding of a task in hand. Depending on their level of understanding, it can then adjust the instructions to their individual needs so they can confidently learn on the job and carry out the task correctly. This supportive software will minimise errors and defects and lead to more productive projects and the delivery of buildings that perform as they were designed. Because it can adapt to an individual worker's needs, Adaptive Learning can ensure the learning and assessment of their understanding is tailor-made to the person receiving it. BIMformed™ also helps ensure knowledge is retained so that subsequent training acts more as a refresher rather than new or repeated learning.

PROJECT IMPACTS

Outputs: Digital application/ software.

Digital application: AI- and ML-based software that helps ensure construction tasks and installations are carried out correctly.

Benefits: Reduction in whole-life costs; reduction in productivity gap; improved assurance of buildings.

Reduction in whole-life costs and delivery time: Research by the Get It Right Initiative estimates that errors cost the industry between £10bn and £25bn (or 10% to 25% of project cost). Completing tasks right first time will ensure systems work correctly so buildings are handed over to their end users with the confidence that they will perform as they were designed. And the reduction in rework means there are fewer wasted materials.

PROJECT DETAILS

Sector:
Housing
Education
Commercial
Other Social Infrastructure

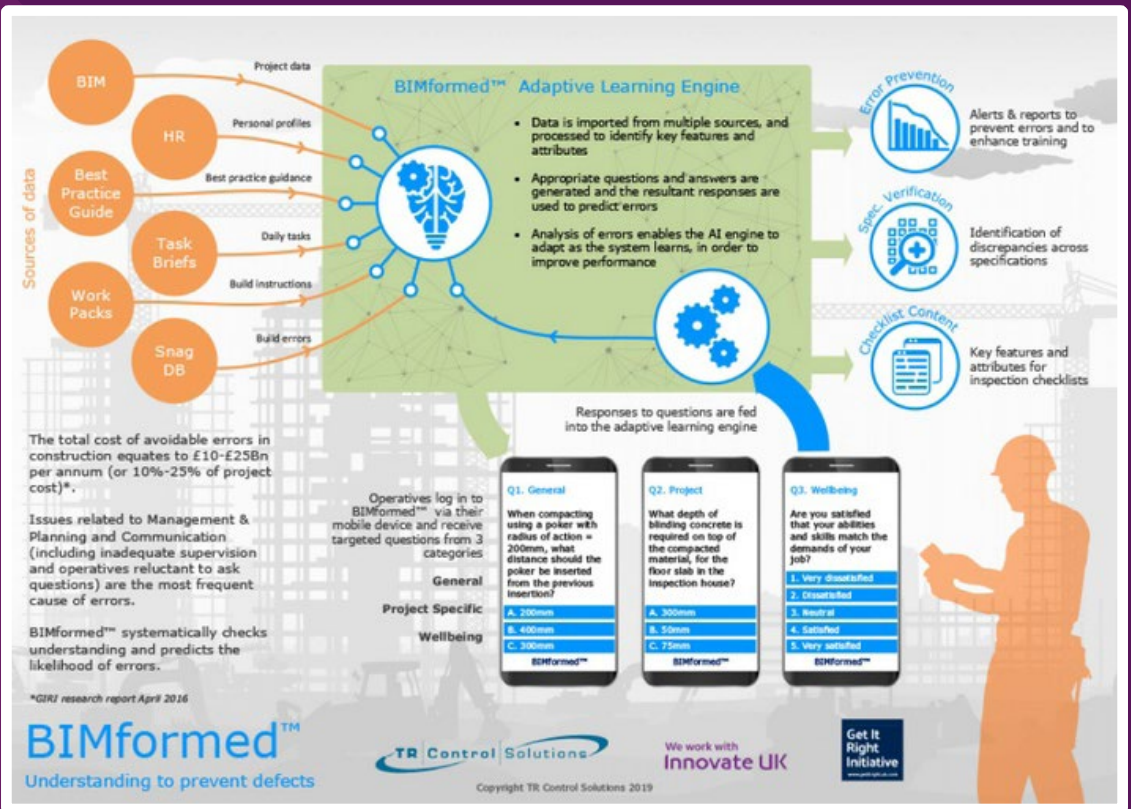
Focus:
Digital

Innovation Lead:
Mat Colmer

Project participants:
TR Control Solutions Ltd (lead)
Anglia Ruskin University

Project number:
104792

UKRI funding:
£192,647



Advanced Industrialised Methods for the Construction of Homes (AIMCH)

Building more homes, with the same skilled workforce, at similar cost.

Led by Stewart Milne, and together with SME Forster Roofing, Barratt Homes and L&Q, the collaborative set out to gather data on modern methods of construction (MMC) at scale on real housing sites. The AIMCH initiative wanted to provide comparative cost data on new manufacturing approaches versus traditional methods. Meeting government housing targets is currently limited by the availability of skilled workers, and so requires innovation in build methods. Through offsite/on-the-ground build methods and greater collaborative working through the supply chain, the partnership was able to capture data on real sites that show over 70,000 more homes could be built each year with the same workforce across the UK. The new methods were considerably safer for employees and showed significant improvements in productivity, efficiency, speed and cost.

By embracing improved digital systems, efficient scheduling and standardised supply chain processes throughout the build, more houses can go up in half the time, using the same skilled workforce. These improvements will make home construction more productive at scale, safer for workers, and ultimately better quality and more affordable for the end user.

PROJECT IMPACTS

Outputs: Built asset, information (knowledge, processes and standards), digital application/software.

Digital application: AIMCH is producing a single seamless digital system (an Enterprise Resource Planning or ERP system) that will allow businesses to process offsite manufacturing from concept design to completion. This will demonstrate an increase in efficiency, quality and a reduction in lead time, downtime and processing time.

Built asset: The project involved the design of two separate robotic workstations for sheathing and insulation applications and advanced roof tiling solutions.

Benefits: Reduction in whole-life costs; reduction in delivery time; reduction in productivity gap; uptake of concepts at scale; higher levels of lifetime built asset performance; improved health and safety; improved regional balance.

Reduction in productivity gap: Following this method, 120,000 additional homes could be built each year for the same or less cost than traditional craft methods, with a 30% faster build time.

PROJECT DETAILS

Sector:
Housing

Focus:
Digital
Manufacturing/MMC
Performance

Innovation Lead:
Mike Pitts

Project participants:
Stewart Milne Group Ltd (lead)
Barratt Developments PLC
London & Quadrant Housing Trust Ltd
Forster Roofing Services Ltd
The Manufacturing Technology Centre
Construction Scotland Innovation Centre

Project number:
104805

UKRI funding:
£3,938,448

AEC Delta Mobility

Seamless data sharing across the Architecture, Engineering and Construction (AEC) industry.

Buro Happold, 3D Repo, University College London and a consortium of industry collaborators have solved one of the biggest barriers to the adoption of building information modelling (BIM) – the ability to share data safely and securely. AEC Delta Mobility is an open-source solution that is flexible for teams to use and will improve knowledge sharing and programme management across the sector. Users can live-stream individual changes instead of having to share large design files over and over again. This more streamlined data exchange at the early design phase dramatically improves workflow. As a result, less time is wasted, the cost of person-hours is reduced and project productivity increases. AEC Delta Mobility has the potential to change collaborative working and data-sharing in the construction industry forever.

PROJECT IMPACTS

Outputs:
Digital application/software.

Digital applications:
AEC Delta Mobility is an open-source solution that is flexible for teams to use and will improve knowledge sharing and programme management across the sector. It creates a digital signature and auditable trail of authorship so design teams can easily provide evidence of quality assurance to objects that have been added, removed or modified in BIM.

Benefits:
Reduction in delivery time; reduction in productivity gap; uptake of concepts at scale; improved assurance of buildings.

Reduction in whole-life costs and productivity gap:
Buro Happold estimates that AEC Delta Mobility could make productivity gains of up to 15% over the next five years. This represents 2.5 million person-hours saved and a possible business saving of £450,000, across an average team of 20 designers.

PROJECT DETAILS

Sector:
Housing
Education
Commercial,
Other Social Infrastructure
Transport
Infrastructure

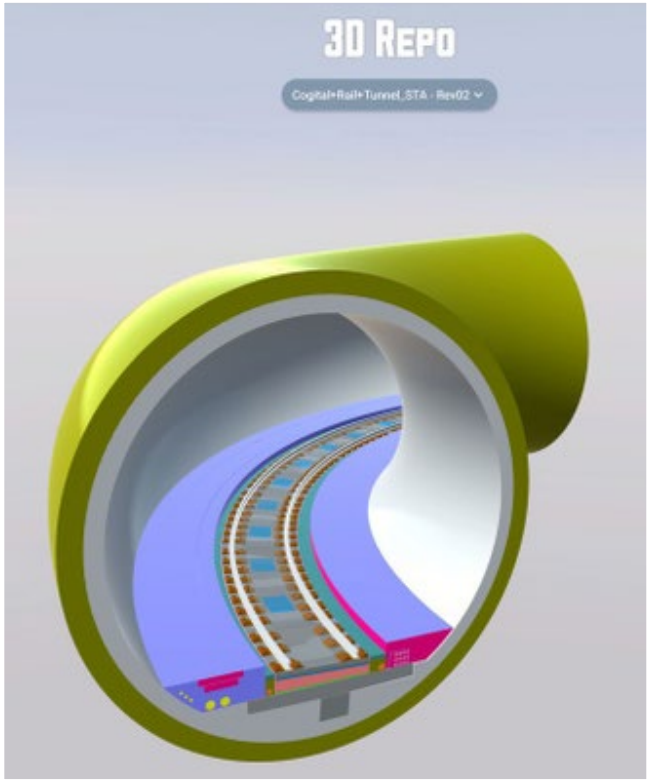
Focus:
Digital

Innovation Lead:
Christine Coonick

Project participants:
Buro Happold Engineers Ltd (lead)
3D Repo Ltd
Rhomberg Sersa UK Ltd
University College London

Project number:
104799

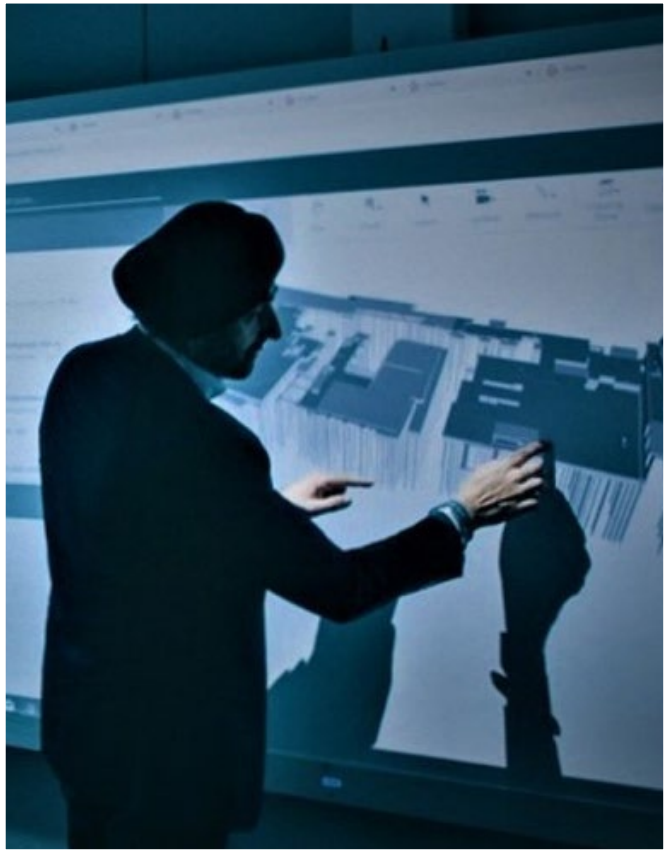
UKRI funding:
£722,103



AEC Production Control Room

A NASA-inspired mission control to deliver up-to-minute data on construction projects.

Smart construction planning just got smarter with this NASA-inspired control centre for large-scale projects. Frustrated by the lack of real-time, accessible information from sites, a diverse collaborative from across the industry has developed a sophisticated production control room that can improve decision making around delivery. The data-powered platform acts as a single source of truth across a complex chain of contractors. Teams can digitally rehearse tasks, spot inefficiencies before they cause delay, and flag safety hazards. It means decisions can be made with certainty, so projects are more likely to be delivered on time, on budget and built as they were designed.



PROJECT IMPACTS

Outputs: Built asset, information (knowledge, processes and standards), digital application/software.

Digital application: Production control room turns highly accurate, real-time data into digital models at the touch of a screen, so the team has the same detailed access to site information at the same time. Project coordinators can then use it to run digital rehearsals before anyone even sets foot on site.

Benefits: Reduction in whole-life costs; reduction in delivery time; reduction in greenhouse gas emissions; reduction in productivity gap; improved assurance of buildings; improved health and safety.

Reduction in productivity gap: Site team arrives on site knowing exactly where they need to be and what they need to do. This virtual run-through also helps project teams improve on inefficiencies they spot, saving time, costs and minimising disputes.

Reduction in greenhouse gas emissions: eviFile's workflow management process has already been proven to be more sustainable, replacing 500,000 sheets of paper by digitalising reporting.

Reducing delivery time: Production Control Room provides construction teams with 50% more information, reducing daily briefings by 2.5 hours per week and resulting in a 40% reduction of time spent for planners alone. Reporting can now be produced at the click of a button, saving as much as 10 days on large construction projects.

PROJECT DETAILS

Sector:
Education
Commercial
Other Social Infrastructure
Transport
Infrastructure

Focus:
Digital
Performance

Innovation Lead:
Chris Coonick

Project participants:
Mace Ltd (lead)
3D Repo Ltd
eviFile Ltd
Mission Room Ltd
University College London
Imperial College London

Project number:
106169

UKRI funding:
£1,568,968

AI-enabled Automated Cost and Carbon Estimating (AACE)

A tool to provide quicker feedback loops on cost and carbon estimates during design.

Being able to assess the cost and carbon impact of a building during the design stage currently relies on manual estimates that can change before a design is finalised. Skanska and Mott MacDonald have led the development of a software solution that uses artificial intelligence (AI) to automatically estimate carbon and cost in real-time during design, mapping it into building information modelling (BIM). By helping visualise, measure and compare carbon and cost as the design is worked on, it will reduce the time and cost at the design stage and lead to more environmentally-friendly buildings.

To be able to deliver a better solution to estimating cost and carbon at the design stage, the partnership developed a standard data structure and mapping methodology. AACE enables an automated quantity take-off from Uniclass to Standard Methods of Measurement in cost planning. The data structure is then mapped to BIM, leading to shorter pre-construction phases, reduced project management costs, greater visibility of carbon emissions and overall improved cost and carbon control.

PROJECT IMPACTS

Outputs: Information (knowledge, processes and standards); digital application/software.

Digital application: A software solution that uses AI to automatically estimate carbon and cost in real-time during design, mapping it into BIM.

Benefits: Reduction in whole-life costs; reduction in delivery time; reduction in greenhouse gas emissions.

Reduction in delivery time and whole-life costs: The project estimates that these improved data flows and working practices will significantly reduce project pre-construction and construction costs by 13% across the delivery life cycle. Skanska expects the toolkit to deliver cost savings of approximately £2.4m per year for the organisation, which, if extrapolated across the UK construction sector, represents a £2.5bn annual saving.

Reduction in greenhouse gas emissions: The aim in deploying the tool is to reduce embodied carbon by 30% and operational carbon by 10%.

PROJECT DETAILS

Sector: Housing, Education, Commercial, Other Social Infrastructure, Transport, Infrastructure

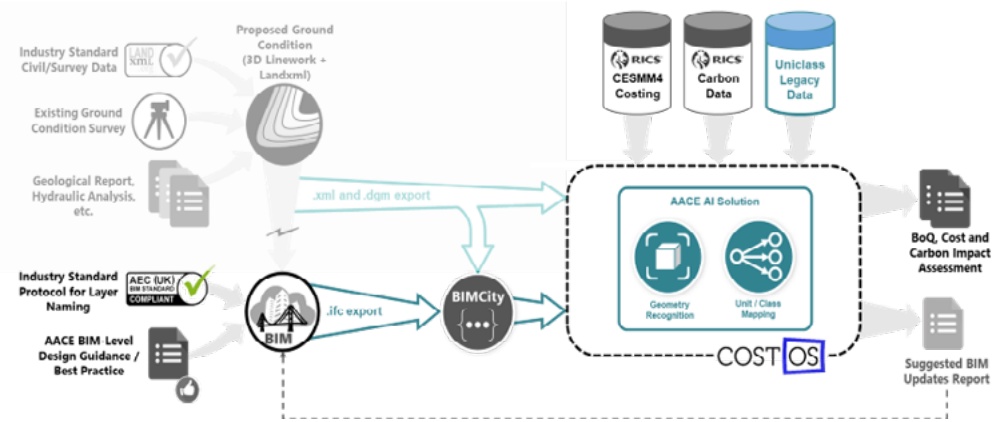
Focus: Digital

Innovation Lead: Sherrie Rad

Project participants:
Skanska Technology Ltd (lead)
Mott MacDonald Ltd
The Manufacturing Technology Centre
Nomitech Ltd
Royal Institution of Chartered Surveyors
HS2 Ltd

Project number:
106170

UKRI funding:
£398,095



AI-Optimised Pathways for Schedule Execution

Machine learning from past programmes to improve schedule planning.

Even experienced planners working on large-scale construction projects can inadvertently add their own bias or subjective intuition when they design project schedules. nPlan has used artificial intelligence (AI) and machine learning to process over 200,000 historic projects and capture data around the difference between planned schedules and the reality of delivery. These learnings were fed into the AI-Optimised Pathways for Schedule Execution – a platform that can improve accuracy in scheduling and give planners and clients greater certainty and confidence around project delivery. The platform was then tested out on a live project with Network Rail to demonstrate how past evidence can improve future delivery, and save time and money in the process.

PROJECT IMPACTS

Outputs: Digital application/software.

Digital application: A platform that can improve accuracy in scheduling and give planners and clients greater certainty and confidence around project delivery.

Benefits: Reduction in whole-life costs; reduction in delivery time; reduction in productivity gap, uptake of concepts at scale.

Reduction in delivery time: nPlan estimates the platform saves 5% of the time normally taken from project inception to project sanction. More accurate project scheduling will provide improved certainty of budgets and timing, reducing contingency by 20%.

Reduction in whole-life costs: Improved certainty will minimise delays and reduce the chance of overrunning programmes, rework or unexpected resource. This has the potential to improve profit margins by an estimated 15 to 25%. Network Rail tested the platform on two of its largest rail projects – the Great Western Main Line and Salisbury to Exeter Signalling project. It found that by leveraging past data, it could save up to £30m of a £3bn expenditure on the Great Western Main Line project.

PROJECT DETAILS

Sector:
Education
Commercial
Other Social Infrastructure
Transport
Infrastructure

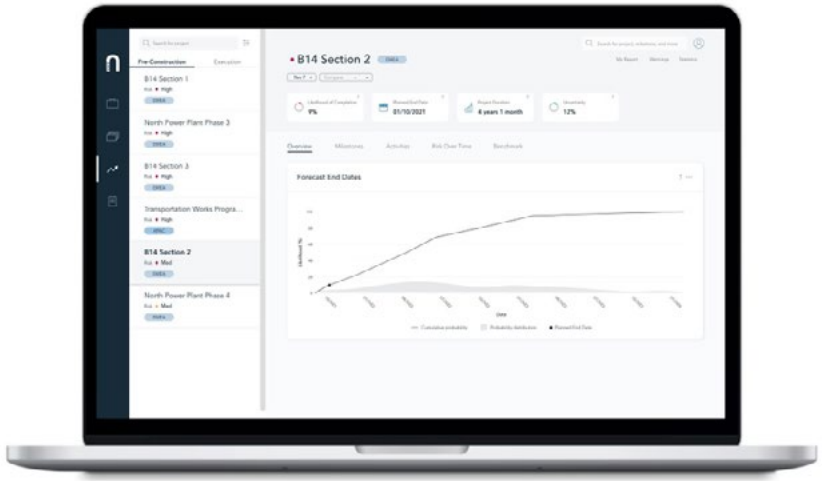
Focus:
Digital

Innovation Lead:
Sherrie Rad

Project partners:
nPlan Ltd (lead)
Kier Construction Ltd
WS Atkins Ltd
University of Cambridge

Project numbers:
104795 and 105877

UKRI funding: £963,046



Aquila

A digital platform to view and optimise the use of site equipment.

Plant and heavy-duty equipment such as excavators and dump trucks can wait on site redundant until used or, worse, doubled up. So BIM Academy led a team to develop a digital platform that could better plan the use of plant. The result is Aquila, which combines 3D models of the site, scheduling plans and real-time data from the project. This information is processed using artificial intelligence to synchronise activity and create a sequence for what equipment is needed when. The result is more streamlined projects and smarter use of plant on site, so the right equipment is in the right place at the right time.

Aquila improves plant and equipment utilisation in real-time. It gives everyone the ability to view plant and equipment in a project by linking live data in a 3D model (part of BIM) with time- or schedule-related information. This kind of platform is known as 4D BIM and can help plan and synchronise activities on both the works programme and on site, creating a sequence for what equipment is needed and by when. This streamlining creates safer, cleaner and more productive sites.

PROJECT IMPACTS

Outputs:
Digital application/software.

Digital application:
Aquila gives everyone in a project the ability to view the use and movement of plant and equipment. The app gives project managers instant access to real-time data, and the ability to capture location and speed data of plant on site.

Benefits:
Reduction in whole-life costs; reduction in delivery time; reduction in greenhouse gas emissions; reduction in productivity gap; improved health and safety; equality, diversity and inclusivity

Reduction in productivity gap:
Aquila makes sites more productive for workers, so people can concentrate on the right tasks with the right kit, and also safer because it avoids large machinery standing redundant on site.

PROJECT DETAILS

Sector:
Housing, Education, Commercial,
Other Social Infrastructure
Transport
Infrastructure

Focus:
Digital
Performance

Innovation Lead:
Sherrie Rad

Project partners:
BIM Academy (Enterprises) Ltd (lead)
Walters Plant Hire Ltd
BuildStream Ltd
Northumbria University

Project number:
105882

UKRI funding:
£492,919

Augmented Reality for Operative Productivity & Continuous Quality Analysis (AROPCQA)

Automated digital processes in factory production to improve quality control.

A pan-industry team of industrial technology companies, software developers and research centres have applied cutting-edge digital solutions to tackle issues around quality control. AROPCQA is a smart headset that blends together a suite of digital innovations – from augmented reality (AR) and virtual reality (VR) to artificial intelligence (AI), 3D modelling and live video feeds. By sending rich data and images from the site to manufacturing teams overnight, these digital tools allow construction operatives to work with confidence and accuracy, while completing the necessary quality assurance alongside their installation work. The use of vision and digital technologies such as AR, VR and mixed reality (MR), laser scanning, computer vision, ubiquitous wireless communications and 3D digital design creates a common platform and workflow that increases consistency throughout the supply chain. The team has demonstrated the effectiveness of AROPCQA on a live project at Hinkley Point C nuclear plant.

PROJECT IMPACTS

Outputs:
Digital application/software, hardware.

Digital assets:
AROPCQA is a smart headset that blends together
a suite of digital innovations – from AR and VR to AI, 3D modelling and live video feeds.

Benefits:
Reduction in delivery time
Reduction in greenhouse gas emissions
Reduction in productivity gap
Improved assurance of buildings
Improved health and safety
Improved regional balance

Reduction in productivity gap:
AROPCQA are testing productivity gains within various demonstrator projects, hoping to achieve a 20%+ greater workforce productivity for each of the related activities.

PROJECT DETAILS

Sector:
Education, Commercial, Other Social Infrastructure, Transport, Infrastructure

Focus:
Digital

Innovation Lead:
Liam Winder

Project participants:
Laing O'Rourke PLC (lead)
Offset Services Ltd
Esay Solutions Ltd
Trimble Solutions (UK) Ltd
The University of Sheffield

Project number:
105096

UKRI funding:
£617,691

AutoBIM

Software plug-in tools that automate building information modelling (BIM) workflows to improve consistency and increase adoption.

Inputting information into BIM can be a laborious process and a blocker to its wider use, particularly as data comes from many different sources in different formats. AutoBIM is a plug-in software solution that supports easier use and adoption of BIM for construction professionals. It does this by automating task delivery plans and providing an embodied carbon calculation tool. It also uses a health check tool to validate the quality of design data and spot gaps, and has a risk-alert tagging tool to share lessons learned. The software will support organisational BIM adoption, industry compliance and collaboration.

Use of BIM will be intuitive and new workflows will provide seamless population of information systems that manage projects. Consistently collected data will unlock automated information plans and automated calculation of embodied carbon. Design health checks and tagging of risks will be easier because known issues from previous project data can be compared with the 3D design model. Lessons learned from previous projects will automatically be highlighted, improving project delivery, which will be faster with reduced errors.

PROJECT IMPACTS

Outputs: Information (knowledge, processes and standards); digital application/software.

Digital application: AutoBIM is a plug-in software solution that supports easier use and adoption of BIM for construction professionals.

Benefits: Reduction in whole-life costs; reduction in delivery time; reduction in greenhouse gas emissions; improved health and safety.

Reduction in delivery time and whole-life costs: Fully collaborative and data-rich BIM can lower project costs by 33%.[7] Auto-BIM's coordinated, consistent standard of information will eliminate issues that lead to rework, which accounts for about 5% of cost over-run.[8]

Reduction in greenhouse gas emissions: The AutoBIM Carbon Calculator has been trialled across four of Balfour Beatty's projects. During trials on live projects, the use of this tool has evidenced a potential saving of up to 14% embodied carbon through more informed design choices.

PROJECT DETAILS

Sector:
Housing
Education
Commercial
Other Social Infrastructure
Transport
Infrastructure

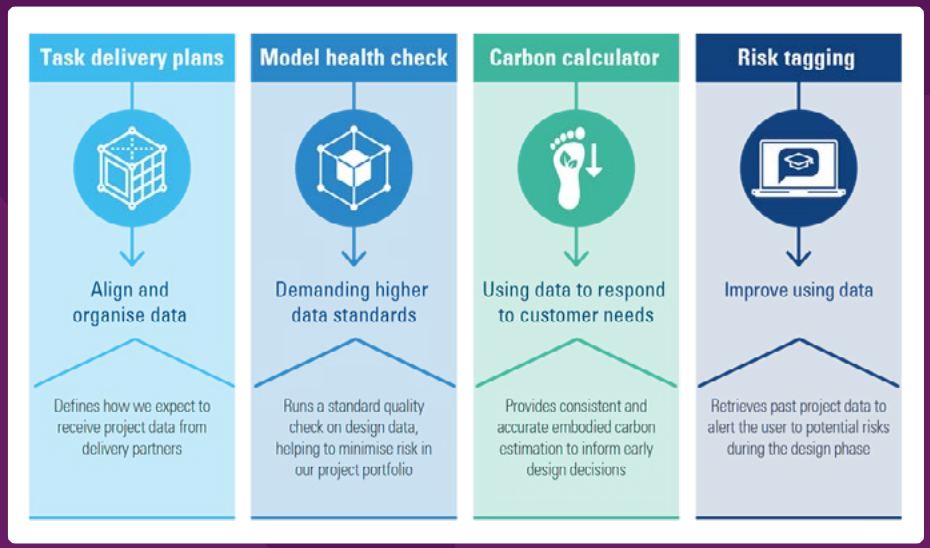
Focus:
Digital

Innovation Lead:
Sherrie Rad

Project partners:
Balfour Beatty PLC (lead)
White Frog Publishing Ltd
Leeds Beckett University
University of Hertfordshire

Project number:
104796

UKRI funding:
£608,823



Cloud Box

Sensors in lorries that make sure concrete is delivered on time and with minimal waste.

Wasted concrete is one of the most pressing challenges for the construction sector because of its contribution to carbon emissions. Cloud Cycle has blended sensor technology with machine learning to create the Cloud Box – a cost-effective solution to automate the flow of concrete across sites. Installed within trucks, the Cloud Box can measure the quality and conditions of the wet concrete and how long there is left to use it. By optimising the processes around concrete deliveries, Cloud Box means there are fewer failed quality tests and less concrete ends up going to landfill. Anything left over is resold on a digital marketplace to other local suppliers. Cloud Cycle has proven the concept works on HS2, secured follow-on funding, and is now integrated with other digital systems.

PROJECT IMPACTS

Outputs:
Digital application/software, hardware.

Digital application:
Cloud Cycle has developed a software solution that combines digital sensor technology in wet-concrete trucks with analytics to calculate the real-time quality and volume of the wet concrete and, importantly, the time remaining before the wet-concrete load sets.

Benefits:
Reduction in delivery time; reduction in greenhouse gas emissions; reduction in productivity gap.

Increased industry investment:
Sustainable Ventures supported Cloud Cycle with investment and connections to HS2 to carry out their trials. HS2 provided £250,000 match-funding for a total project cost of around £835,000.

Reduction in greenhouse gas emissions:
Based on HS2 trials, Cloud Cycle has been able to forecast waste reduction of 760,0000 tonnes, which would reduce carbon emissions by a forecasted 228,000 tonnes and a forecasted reduction in water usage by 47m litres.

PROJECT DETAILS

Sector:
Housing
Education
Commercial
Other Social Infrastructure
Transport
Infrastructure

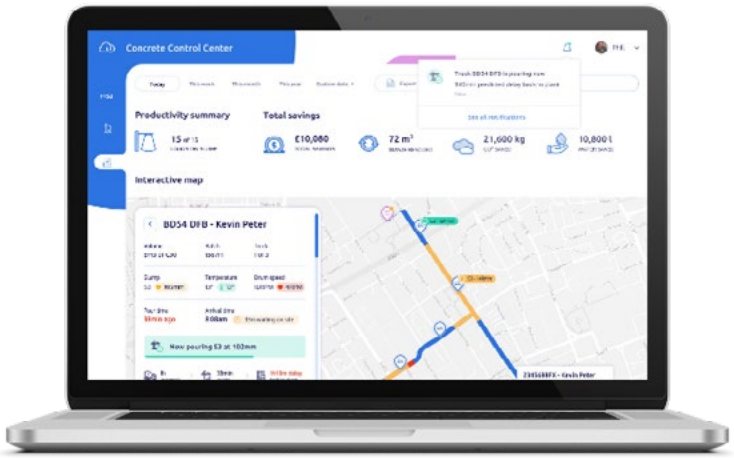
Focus:
Digital

Innovation Lead:
Liam Winder

Project participants:
Cloud Cycle Ltd (lead)
Sustainable Venture Development Partners Ltd

Project number:
105867

UKRI funding:
£175,746



Change Impact Intelligence Tool (Ci-iT)

An artificial intelligence (AI)-enabled platform to help project teams respond to change and adopt innovation more easily.

Change is not always easy to plan for or navigate around, especially on large complex programmes. But the Ci-iT developed by Skanska has the potential to help project teams quickly understand the impact of design changes and any possible knock-on effects to cost, time, resource, waste and rework. A cloud-based, AI-enabled platform, Ci-iT can integrate multiple datasets and apply different change scenarios to it to provide real-time impact intelligence. This makes changing a management workflow quicker, easier and more productive, not less. Using machine learning (ML), impact models and new visualisation technology, Ci-iT will support near real-time change impact intelligence. Optimal decisions can be made more easily and quickly to improve a project's outcomes or minimise emerging issues. It will also help the industry incorporate innovations more readily into programmes as the positive impact of this kind of change will be more easily seen and understood.

PROJECT IMPACTS

Outputs:
Digital application/software.

Digital application:
A knowledge management platform such as Ci-iT works by integrating and analysing structured and unstructured data from multiple tools across a construction programme's management workflow. This means bringing together complex datasets around project scheduling and building information modelling in one place and applying ML to incorporate near real-time changes in information, such as project duration, cost, resourcing and materials waste.

Benefits:
Reduction in whole-life costs; reduction in delivery time; reduction in productivity gap; higher levels of lifetime built asset performance; improved health and safety.

Reduction in productivity gap:
The Tool helps clients and contractors in complex programmes understand the impact of design changes during a project and the knock-on effects, in terms of cost, time, waste and rework. This improves real-time decision making and increases productivity, resource efficiency and the performance of the final building or infrastructure.

PROJECT DETAILS

Sector:
Housing
Education
Commercial
Other Social Infrastructure
Transport
Infrastructure

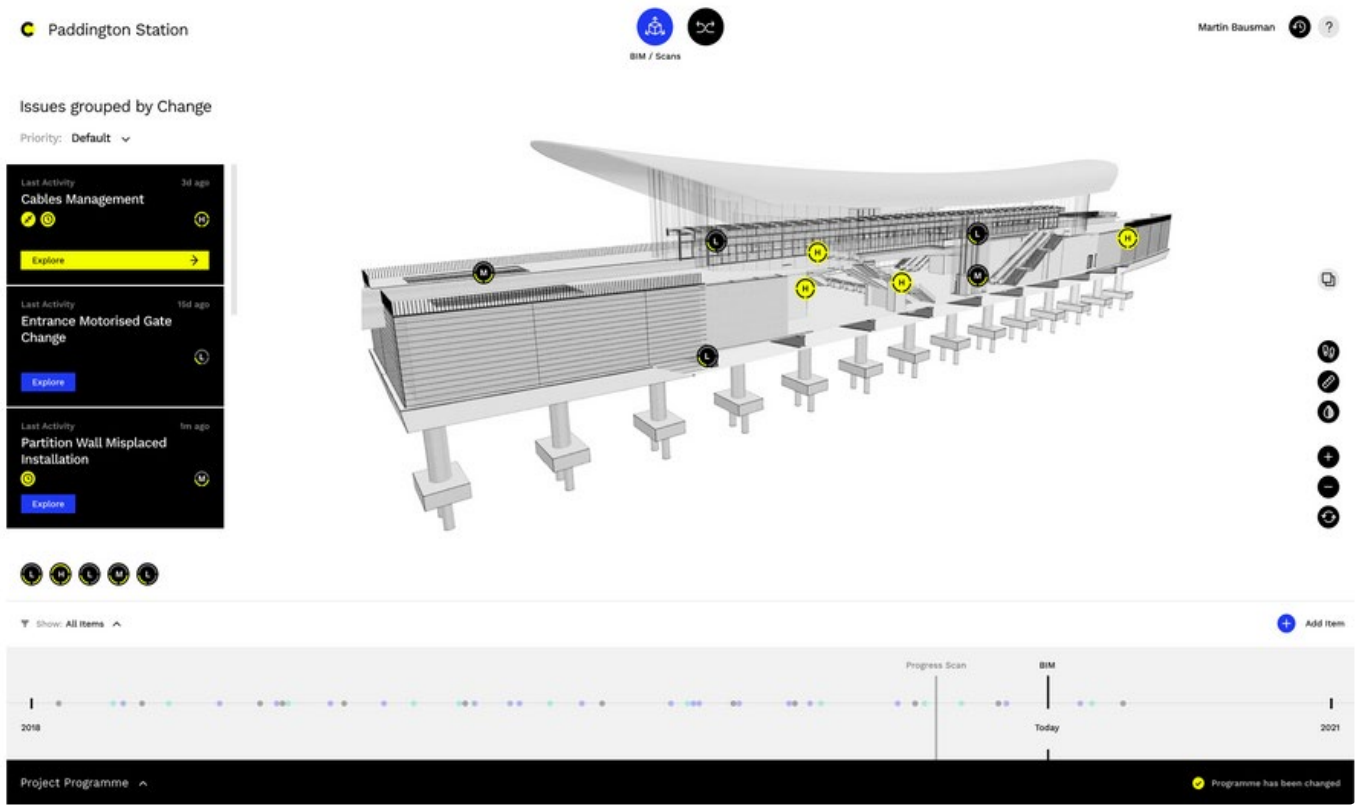
Focus:
Digital
Performance

Innovation Lead:
Sherrie Rad

Project participants:
Skanska Technology Ltd (lead)
Mobibiz Ltd
Unit 9 Ltd
The Manufacturing Technology Centre

Project number:
105868

UKRI funding:
£726,438



COLAB DfMA Toolkit

A digital toolkit to support product thinking and platform design in new housebuilds.

Frustrated that residential builds were taking too long, costing too much and not meeting the needs of tenants, a consortium of architects, designers and social housing providers has created a new roadmap for housebuilding. It draws on platform design to help the supply chain think of houses as manufactured products assembled from factory-made components so they can implement design for manufacture and assembly (DfMA) properly. The COLAB Toolkit pulls data from across supply chains together into a single digital dashboard so end-user organisations can better plan and manage projects, view and compare Business Intelligence data, and capture and share knowledge. The result is that housing projects are completed faster, at a higher quality and at lower costs – and the homes are better suited to the needs of people that live in them.

PROJECT IMPACTS

Outputs:
Digital application/software.

Digital application:
The COLAB Toolkit provides a single dashboard for all projects within organisations, pulling in information from their supply chain and combining it with their own internal processes. This allows projects to be compared, best practice to be captured and shared, and productivity and manufactured content to be steadily increased.

Benefits:
Reduction in whole-life costs; reduction in delivery time; increase in trade; reduction in productivity gap; improved assurance of buildings.

Reduction in delivery time and whole-life costs:
It is estimated that the programme could speed up design and construction programmes by 30%, providing total cost savings of around 25% to housebuilders.

PROJECT DETAILS

Sector:
Housing

Focus:
Digital

Innovation Lead:
Sherrie Rad

Project participants:
Quadrant Construction Services Ltd (lead)
Virtual Viewing Ltd
Hawkins Brown Design Ltd
HTA Design LLP

Project number:
105878

UKRI funding:
£143,015

Configurable BIM tool to drive efficient fabrication

Combining push-button manufacturing and building information modelling (BIM) software to create bespoke joinery.

Push-button fabrication is well used in advanced sectors of manufacturing, but is largely absent from the construction industry, especially on smaller scale projects. Bath-based SME Future Joinery Systems (FJS) has developed software that applies design rules and algorithms to automate complex geometry and create high-quality joinery products, literally at the press of a button. Drawing on standardised digital manufacturing processes, these digital tools ensure the integrity of the initial design is translated precisely from screen to machine. It gives everyone in the process a single source of truth to work from and allows clients and designers to draw on multiple configurations to deliver thousands of outputs. The whole process is more efficient, more precise and more cost effective, while the finished product is custom made for each unique scenario.

FJS wants to create smoother and more precise handovers between designers, architects and manufacturers and put the end user at the heart of the design and build. The organisation wants to retain the integrity of the final joinery work so it is made exactly as it was designed, but also leave room for customisation. This push-button manufacturing approach allows designers, suppliers, contractors and homeowners to digitally select the exact elements of items in the home and make them fully personalised. The standardised data exchange, digital rules and algorithms then improve the speed and precision of the final product.

PROJECT IMPACTS

Outputs: Digital application/software.

Digital application: The digital platform links together design intent, configurability and customisation with directly manufacturable output. The software provides the data building blocks, from screen to machine, that provide one source of truth with multiple configurations and thousands of outputs.

Benefits: Reduction in delivery time; reduction in productivity gap; improved health and safety; improved regional balance.

Reduction in delivery time: By using parametric model definitions and automating complex geometry within joinery, the BIM configurable software can create bespoke products using repeatable and standardised digital fabrication processes. It's much more efficient to use the same parametric design for multiple applications of different sizes. The team has seen it reduce time on a project by as much as 10 times.

PROJECT DETAILS

Sector:
Housing
Commercial

Focus:
Digital
Manufacturing/MMC

Innovation Lead:
Hannah Gibson

Project participants:
Future Joinery Systems Ltd (lead)
Mark Wray Architects Ltd
Rocketmakers Ltd
Fourth Dimension Routing Ltd

Project number:
105869

UKRI funding:
£128,812

CORE

Artificial intelligence and sensor-based tech that replaces concrete curing guesswork with precise real-time data.

Concrete setting has often been one of the causes of site delays and inaccuracies, leading to waste of materials and resources. Converge and BAM Nuttall have taken the guessing game out of concrete curing by drawing on cutting-edge technology that provides more accurate strength data and improves concrete cycles. CORE's artificial intelligence (AI) engine and Internet of Things (IoT) sensors gives site teams live, real-time data that improves the concrete mix (reducing waste) and predicts the precise moment the concrete has reached its minimum strength (removing delays). Construction teams can now plan with confidence and know when to act, leading to more productive, quality and sustainable builds in the sector.

Rather than throwing away precious time, money and resources, concrete precision data will allow construction teams to plan better, act more precisely and have the right people in the right place, at the right moment. Notifications, alerts and live feeds will mean contractors can access real-time, in-situ concrete strength data so tensioning can begin as soon as minimum strengths have been met, with not a moment lost. Knowing when project milestones are reached like this will save valuable time, money and resources – and reduce the impact of concrete waste on the environment.

PROJECT IMPACTS

Outputs: Digital application/software, hardware.

Digital application: CORE's AI engine and IoT sensors give site teams live real-time data that improves the concrete mix (reducing waste) and predicts the precise moment the concrete has reached its minimum strength (removing delays). By getting real-time alerts straight to their phone the moment slabs are ready to strike, instead of waiting for cube results, project managers can better plan resource and materials, keeping costs on track.

CORE reduces concrete use in two ways. Firstly, the historic performance data makes it easy to optimise the mix design, and so the improved mix decreases the number of batch returns. Secondly, the precision data reduces risk of over-pour.

Benefits: Reduction in whole-life costs; reduction in delivery time; increase in trade; reduction in greenhouse gas emissions; reduction in productivity gap; improved health and safety.

Reduction in delivery time: CORE typically saves four to six hours per concrete pour, which would equate to 60 to 100,000 hours on a typical construction project.

Reduction in productivity gap: Scaled up, Converge estimates that this increased productivity could save as much as £136m annually by 2025.

PROJECT DETAILS

Sector:
Education, Commercial
Other Social Infrastructure
Infrastructure

Focus:
Digital

Innovation Lead:
Sherrie Rad

Project partners:
Octagon I/O Ltd (Converge) (lead)
Bam Nuttall Ltd

Project number:
104800

UKRI funding:
£700,000

Cost and Carbon Calculator

Helping engineers make data-driven decisions about carbon impact alongside cost efficiency at the design stage.

Cost has typically been the accepted benchmark used by engineers to make design decisions, seeing carbon-reducing ideas left out of new buildings if they are considered too expensive. But imagine if they no longer had to choose between one or the other? Price & Myers, a civil and structural engineering consultancy, has created the Cost and Carbon Calculator to make it easy for engineers to reduce embodied carbon in new buildings and keep costs low. The calculator automatically assesses the embodied carbon in each of the materials being considered. It then weighs up the respective carbon- and cost-saving that each material represents and helps engineers select the best and most sustainable combination of materials, frameworks and foundations to use. The choice is no longer cost over carbon-savings. It's about which represents the greatest value to the project, the end user and the planet.

A robust data-driven tool such as the Cost and Carbon Calculator can assess a new building's carbon impact as well as its cost in a matter of minutes, leading to better, more sustainable decision making at design stage. Engineers will have greater confidence that they are being as effective in their use of carbon-reducing solutions, as they are being efficient in management of financial resources.

PROJECT IMPACTS

Outputs: Digital application/software.

Digital application: The data-driven calculator tool automatically assesses the embodied carbon in each of the materials being considered.

Benefits: Reduction in whole-life costs; reduction in greenhouse gas emissions.

Reduction in greenhouse gas emissions: Project research found this benchmarking software tool could result in 50 to 100kg/m^2 savings in embodied CO^2. Using an average construction cost of £2,500m^2, this could equate to 160,000m^2 per year and as much as a 12,000-tonne savings in CO^2 across construction projects in one year.

Reduction in delivery time and whole-life costs: Price & Myers estimates that the tool could be used on approximately 75 projects per year for an average practice such as itself. These projects would typically involve two to three weeks' engineering time at the scheme stage, where the benefits of the tool can be felt most. Early estimates suggest 75% of this time can be saved through use of the software. That's the equivalent of £500,000 worth of increased efficiency savings for the business per year, and a return on investment of 900% after five years.

PROJECT DETAILS

Sector:
Housing, Education, Commercial, Other Social Infrastructure Transport, Infrastructure

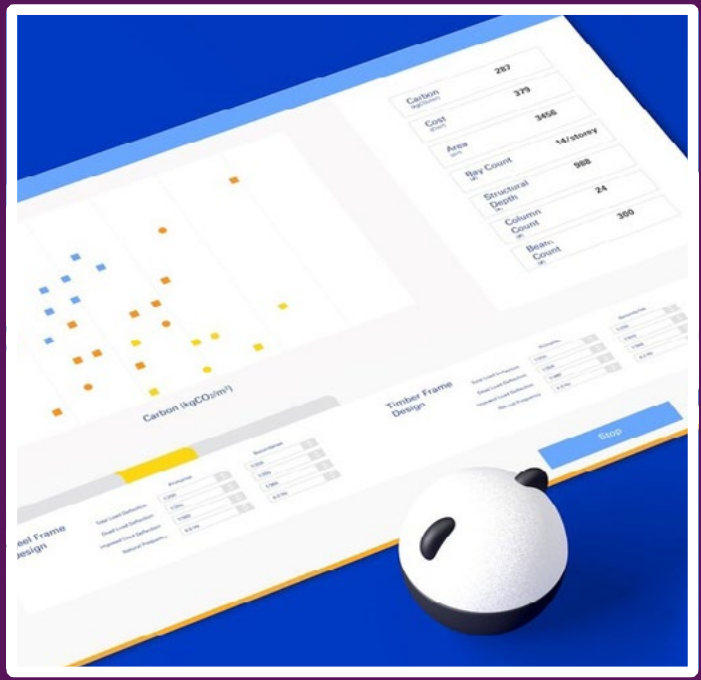
Focus:
Digital, Performance, Financial and assurance

Innovation Lead:
Sherrie Rad

Project partners:
Price & Myers (lead), University of Cambridge

Project number:
104803

UKRI funding:
£208,932



Digital Compliance Platform for the Built Environment

Understanding regulations, requirements and standards automatically.

The entire life cycle of the built environment is governed by a variety of regulations, requirements and standards. The checking of compliance against these is a complex task, which is currently performed manually and can be highly resource intensive.

The Digital Compliance Platform project is developing an open platform where accessible standards for digitising regulatory/requirement clauses and standardised APIs link with existing and new compliance tools to retrieve, manage and execute checking processes consistently and automatically. The result will integrate the current scattered development of ad-hoc approaches to compliance into a cohesive ecosystem, in turn enabling the widespread adoption of digitised compliance processes across the construction industry. The result? Safer, better performing, higher quality buildings and a golden thread of compliance information. The project team are spearheading this by developing a selection of new compliance tools, tailored to their specific use cases, that will draw on the open platform standards.

This digital platform project has grown from the D-COM network, a group of visionaries that have led the way in terms of championing the vision of automated compliance processes in the built environment. It complements the work of the Construction Innovation Hub on digital ecosystems – integrating the web of tools and data sources that firms must use as part of the compliance process more accessible.

PROJECT IMPACTS

Outputs:
Information (knowledgeprocesses and standards), digital application/software.

Digital application:
An open platform-based approach to the digitisation of compliance.

Benefits:
Reduction in whole-life costs; reduction in delivery time; reduction in productivity gap; higher levels of lifetime built asset performance; improved assurance of buildings; Improved health and safety.

PROJECT DETAILS

Sector:
Housing, Education, Commercial, Other Social Infrastructure, Transport, Infrastructure

Focus:
Digital, Performance, Financial and assurance

Innovation Lead:
Liam Winder

Project participants:
Process Innovation Forum Ltd (lead), PassivSystems Ltd, Highways England, Sero Technologies Ltd, Solibri UK Ltd, AEC3 UK Ltd

Project number:
105883

UKRI funding:
£371,486

Digitally Connected Supply Chains

A platform to provide visible, up-to-date and auditable procurement information.

Much of the whole-life value of a building is determined by the supply chain that creates it. Desired outcomes, such as reducing waste, won't be achieved if decisions throughout construction manufacturing supply chains don't bear them in mind. If this information isn't visible to the procurers of buildings, inefficiencies and waste will come embedded in the materials used.

An outcome-based procurement platform, incorporating a live digital twin of the supply chain, provides visibility and auditability of what is being procured at every step, ensuring better whole-life decisions. All parties throughout the construction manufacturing supply chain can see up-to-date information relating to asset outcomes at each transaction point. Increased client visibility and auditability of all products and services allow procurement decisions to be made based on whole-life value.

This transparency opens the market for new services and products that improve delivery and quality throughout the life cycle of a building, helping create a circular construction economy where products are designed to be reused, repaired or remanufactured.

PROJECT IMPACTS

Outputs:
Information (knowledge, processes and standards)
Digital application/software.

Information and digital application:
An outcome-based procurement platform, incorporating a live digital twin of the supply chain.

Benefits:
Reduction in delivery time
Reduction in greenhouse gas emissions
Reduction in productivity gap
Improved assurance of buildings
Improved regional balance.

PROJECT DETAILS

Sector:
Housing, Education, Commercial, Healthcare, Other Social Infrastructure, Infrastructure

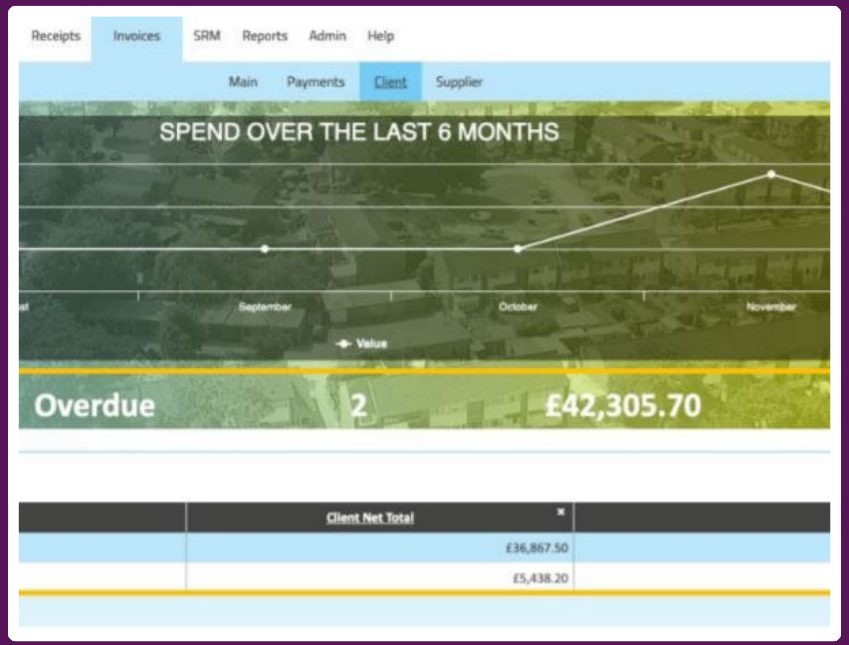
Focus:
Digital

Innovation Lead:
Liam Winder

Project participants:
Professional Construction Strategies Group Ltd (lead)
Construction Products Association
MK9 Development Ltd

Project number:
104787

UKRI funding:
£331,068



Distributed Manufacturing for Offsite Construction (DMOC)

A system that communicates manufacturing information and automatically dispatches production tasks.

DMOC lowers barriers to entry of automation in offsite construction by simplifying programming of assembly robots, increasing utilisation of machinery and reducing the capital investment required by leveraging existing facilities.

At the heart of the DMOC solution is a cloud-based orchestrator that considers each DMOC Cell, for example, as a factory that can produce a wall cassette, another cell as a factory that can produce roof tiles and any other product that is required for a particular build. The orchestrator sits in the middle of all of this and understands which factories have the necessary facilities, materials, tooling and so on to complete the build. This communicates with connected production cells to distribute workloads and reassign tasks based on production faults and facility issues, ensuring continuity, increasing efficiency and allowing just-in-time delivery.

PROJECT IMPACTS

Outputs:
Information (knowledge, processes and standards)
Digital application/software

Benefits:
Reduction in delivery time
Reduction in productivity gap
Improved health and safety
Improved regional balance.

PROJECT DETAILS

Sector:
Housing, Education, Commercial,
Other Social Infrastructure

Focus:
Digital, Manufacturing/MMC

Innovation Lead:
Liam Winder

Project participants:
All Design London Ltd (lead)
Hal Robotics Ltd
Hoare Lea LLP
Konica Minolta Business Solutions (UK) Ltd

Project number:
105864

UKRI funding:
£440,826

eDigiT2Life

A digital twin to improve a building's performance while it's in operation.

The power of digital twins is their ability to help visualise data and use it to make predictions about the performance of a building while it is being designed and constructed. So, imagine if you could create a digital twin of a building that lasted its entire life cycle? IES has developed an approach called eDigitT2Life that creates a digital twin at the earliest stage of the project and then transitions through the design-construct-handover phases. The digital twin can continue to be used while the building is in operation right through to end of life decision support. IES tested eDigiT2Life with the University of Glasgow across much of the campus, and it has allowed the estate team to make more informed decisions about how to manage the buildings more effectively, reduce the carbon footprint of the campus overall, and transition the estate towards net zero carbon.

PROJECT IMPACTS

Outputs:
Digital application/software.

Digital application:
IES has developed a digital twin that can optimise whole-life performance by combining data collected inside and outside the building with ongoing user feedback throughout its whole life cycle.

Benefits:
Reduction in greenhouse gas emissions; higher levels of lifetime built asset performance; improved assurance of buildings.

Reducing greenhouse gas emissions:
The eDigit2Life Digital Twin updates right through to the operation phase of a building and is then used for Measurement and Verification and Monitoring and Targeting once the building is occupied. In this way, the building manager can ensure that the building is meeting its design objectives with respect to carbon emissions and where deviations occur, corrective actions can be taken immediately.

PROJECT DETAILS

Sector:
Housing
Education
Commercial
Other Social Infrastructure

Focus:
Digital

Innovation Lead:
Liam Winder

Project participants:
IES Ltd (lead)
ScienceScope Ltd
Multiplex Construction Europe Ltd
Hlmad Ltd
University of Glasgow

Project number:
105871

UKRI funding:
£850,835

FAIRCOP

Measuring wind conditions with lasers for the safer, more productive use of cranes.

Converging-beam Light Detection and Ranging (LiDAR) uses laser technology to measure three-dimensional wind velocity at a particular point and time. After observing how LiDAR can optimise outputs from wind turbines, Triple Lidar Technology set out to test it on tower cranes in construction. The feasibility study – FAIRCOP (The Feasibility of Converging Beam LIDAR for Improving Crane Operational Productivity) – showed that accessing real-time 3D data on localised wind speed and direction can help the construction industry maximise the productivity of cranes, scheduling them when they can be used most effectively and most safely.

Cranes are increasingly important for fast construction of large structures such as wind turbines but also for modular construction where factory prepared structures need to be lifted into place. With the improved data on localised wind conditions that FAIRCOP provides, scheduling of crane use can be better optimised and they can be more productive on site.

PROJECT IMPACTS

Outputs:
Digital application/software, hardware.

Digital application:
LiDAR data provides a 3D model of wind vectors to enable a better assessment of risk to crane use.

Benefits:
Reduction in delivery time; improved health and safety.

Reduction in delivery time:
Crane operations are suspended when (often inaccurate) wind speeds are forecast. Better data will expand the operating window for cranes on sites.

Safety:
LiDAR data provides a 3D model of wind vectors to enable a better assessment of risk to crane use.

PROJECT DETAILS

Sector:
Infrastructure

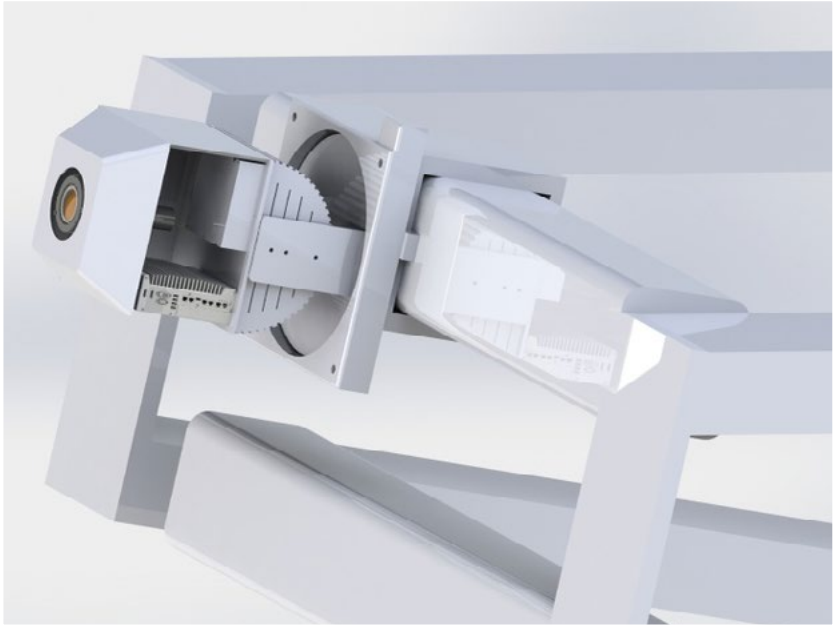
Focus:
Digital

Innovation Lead:
Sherrie Rad

Project participants:
Triple Lidar Technology Ltd (lead)
Fraunhofer UK Research Ltd

Project number:
104790

UKRI funding:
£39,221



From RIBA to Reality

An estate-wide digital twin to help building operations adapt to changes in user behaviour.

The COVID-19 pandemic and climate breakdown is changing the way people use and interact with buildings, and changes in people's behaviour can have a huge impact on a building's overall performance. City Science is leading an industrial research project to embed the Royal Institute of British Architects (RIBA) design process right through to delivery to improve operational performance. It uses digital twinning technology to elevate building information modelling (BIM) so operations teams can simulate or track human usage and energy demands to build a live heat map.

The project is centred around two university buildings as a real-world test-bed with the aim of making them carbon neutral buildings of the future. It blends the RIBA Plan of Work with digital technologies to create a digital twin that can be paired to its real-world counterpart.[9] This will allow estate managers to monitor and model the whole-life performance of its buildings in real-time, to increase efficiency and productivity for the building owners and users.

PROJECT IMPACTS

Outputs: Information (knowledge, processes and standards), digital application/software.

Information and digital application: Advance use of digital technologies – including BIM, sensors, data analytics and smart systems – to pair a digital system to its real-world counterpart.

Benefits: Reduction in delivery time; reduction in greenhouse gas emissions; higher levels of lifetime built asset performance; improved assurance of buildings; improved health and safety; improved regional balance; development of skills.

Reduction in greenhouse gas emissions: Companies can routinely save around 10% on energy bills by improving their Building Management Systems usage. One of the technology packages in this project looks to take that further. Current estimates provide a further 5 to 10% improvement for purely energy benefits.

Improved regional balance: Estimated to create over 50 new high-tech jobs and strengthen a research partnership in the South West.

PROJECT DETAILS

Sector:
Education
Commercial
Other Social Infrastructure

Focus:
Digital

Innovation Lead:
Liam Winder

Project participants:
City Science Corporation Ltd (lead)
University of Exeter

Project number:
105874

UKRI funding:
£886,295

Enabling Housing Innovation for Inclusive Growth

A value-led approach to modular social housing.

Faced with a rising demand for housing, and motivated by its commitment for everybody to have access to affordable and sustainable housing, Bristol City Council is leading the way in applying modern methods of construction (MMC) to create more quality homes, quicker and in a more cost-effective way. The council is working with YTKO and Building Research Establishment to capture evidence around using MMC for social housing and to give other councils a framework to follow. The project has tested offsite and modular building techniques on nine demonstrator projects across the South of England, creating nine new local supply chains in the process. A data toolkit with learnings from the project will help local authorities understand the rapidly evolving MMC market and offer a procurement pathway to address their own housing challenges, leading to social housing contracts awarded on value, not just low cost.

MMC and offsite production is supporting Bristol City Council's commitment to ensuring social good comes out of its procurement of new homes. This project will allow the council to create a tested and nationally replicable delivery model that encourages the use of MMC solutions and modular building techniques, within a local authority context. This is leading to better quality homes that support a community and improve the life and wellbeing of the household, as well as being more sustainable, more affordable to run and maintain, and use less waste and embodied carbon at the design stage and throughout the life of the building.

The impact of this programme has been recognised by the residents of Hope Rise, 11 sustainable, beautifully designed apartments on top of a working car park. These zero-carbon modular houses can be designed, produced and constructed in half the time of traditional builds and with minimal disruption to local communities. They now provide safe and sustainable spaces for young people and families who were at risk of homelessness. In October 2021, the consortium won the (Project) Masterplanning Award at the prestigious Housing Design Awards for its Bonnington housing development.

PROJECT IMPACTS

Outputs:
Built asset, information (knowledge, processes and standards).

Built asset:
Modulous has led sites such as The Bear in Lewisham, which has created 33 affordable halfway homes over a replacement church and community facility, while Greenacre Independent Living in Faversham is building 12 assisted living homes for those with autism, where the acoustic performance is particularly important. Zed Pods has built 11 homes for people leaving care; Hope Rise, Bristol.

Benefits:
Reduction in whole-life costs; reduction in delivery time; reduction in greenhouse gas emissions; uptake of concepts at scale; higher levels of lifetime built asset performance; improved regional balance; equality, diversity and inclusivity.

Reduction in greenhouse gas emissions and delivery time:
These low-carbon modular houses can be designed, produced, and constructed in half the time of traditional builds and with minimal disruption to local communities.

PROJECT DETAILS

Sector:
Housing

Focus:
Digital, Manufacturing/MMC, Performance, Financial and assurance, Business models

Innovation Lead:
Sherrie Rad

Project participants:
YTKO Ltd (lead)
Boklok Housing Ltd
Zed Pods Ltd
Totally Modular Ltd
Bristol City Council
Tempo Housing Modular UK Ltd
Legal & General Homes Holdings Ltd
Unit 9 Ltd
Snug Homes Ltd
Project Etopia UK Ltd
Knowle West Media Centre
Arcadis (Bac) Ltd
Modulous Ltd
Building Research Establishment Ltd

Project number:
106167

UKRI funding:
£2,038,191

Fabrication Automation for Steel Lattice Trusses (FASTtruss)

Robotics manufacturing to automate the design and manufacture of steel lattice trusses.

Tata Steel UK, Bryden Wood and the Advanced Manufacturing Research Centre (AMRC) have produced a robotically-welded demonstrator called FASTtruss. It can automate the design and manufacture of steel lattice trusses. When scaled, it will transform the way superstructures such as warehouses, industrial buildings and other long-span structures are constructed. The FASTtruss demonstrator tests the most challenging part of automated truss manufacture, robotic fixturing and welding.

The project set out to show that automated design and manufacture of steel trusses is both feasible and cost-effective, as well as providing additional benefits such as increased productivity, predictable lead times, improved construction programmes and safer working conditions. Initially designed for warehouse construction, the method can be adapted for long-span structures in the public and private sectors, including schools, retail parks, leisure centres and airport terminals.

PROJECT IMPACTS

Outputs:
Digital application/software, hardware.

Built asset:
The 3D truss model created by Bryden Wood was used by the AMRC to create a physical prototype of the FASTtruss. The AMRC demonstrator involves one gantry robot picking and placing parts into a welding fixture, and one cartesian robot welding the parts to form a truss. AMRC carefully selected the most suitable equipment for the demonstrator, allowing different welding techniques to be trialled and ensuring equipment was suitable for the harsh environment within the welding cell, such as with heat-shielded motors, cables and sensors.

Digital application:
Design and optimisation tool, allowing design engineers to customise the variables to suit the requirements of each building.

Benefits:
Reduction in delivery time; reduction in productivity gap; increase in trade; uptake of concepts at scale.

Reduction in delivery time:
While a manual would have taken months, with many more steps, FASTtruss is already showing that this could be reduced to hours.

Reduction in productivity gap:
Traditionally, the accuracy of fitting parts of the lattice that forms the truss is around 10mm to 20mm differential when it is done manually. The robotic demonstrator is showing it is around 0.1mm. The design and optimisation tool generates and compares 2,000 different truss designs, ranking these against various criteria to arrive at truss design that is optimised for that building. The design tool takes only one to two hours to run, providing significant time savings during the design stage.

PROJECT DETAILS

Sector:
Education, Commercial
Other Social Infrastructure
Transport
Infrastructure

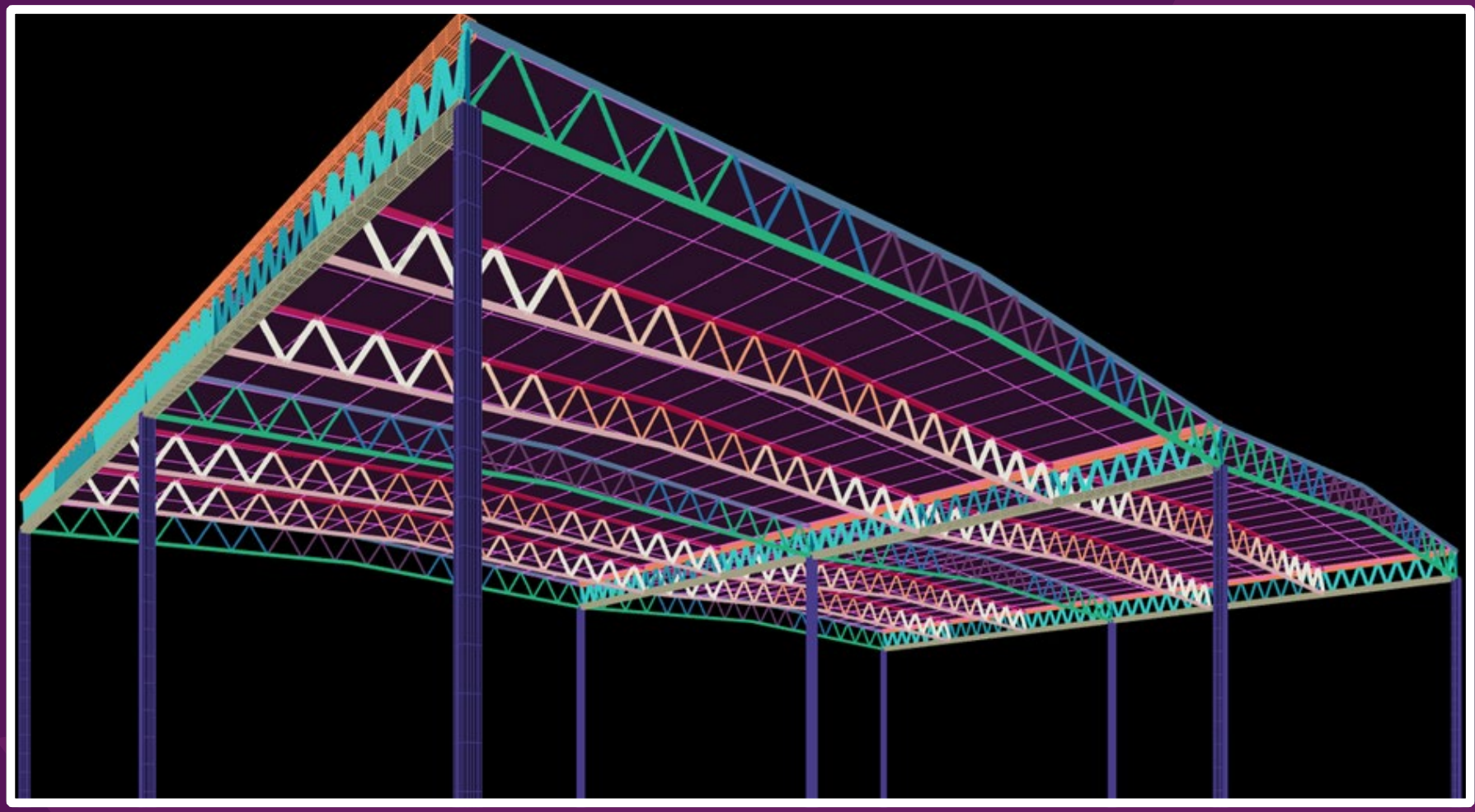
Focus:
Manufacturing/MMC, Digital

Innovation Lead:
Hannah Gibson

Project participants:
Tata Steel UK Ltd (lead)
Bryden Wood Technology Ltd
The University of Sheffield

Project number:
105875

UKRI funding:
£334,399



HEAT3D

Quick, affordable and scalable measurement of the energy performance of buildings.

HEAT3D takes technology that helps find people lost at sea and uses it to measure the energy performance of a building. Based on infrared thermal imaging, HEAT3D measures the U-value – the rate of heat flow through building elements such as walls, floors and roofs. But unlike other measurement techniques, it assesses the entire wall, not just a single point. The app-based technology also delivers results in less than two hours rather than several days, and presents the results as a 3D visual image. Site teams can use this highly visual data to improve energy loss and make buildings more efficient. As well as improving current energy-saving measures in new builds and retrofits, HEAT3D can help provide a blueprint for more efficient buildings in the future.

The level of accuracy that HEAT3D offers as a new measurement tool will improve the quality of insulation and overall energy performance of buildings. This is invaluable for new buildings, but also critical for retrofit and refurbishment. It will help construction teams better understand how heat flows through a building (U-value) and how to improve energy-loss levels making buildings more energy efficient. And the comprehensive and affordable nature of the tool means that cost and skills are not a barrier because this level of knowledge is accessible to as many people in the industry as possible.

PROJECT IMPACTS

Outputs: Digital application/software, hardware.

Digital application: Based on infrared thermal imaging, HEAT3D measures the U-value – the rate of heat flow through building elements such as walls, floors, and roofs.

Benefits: Reduction in whole-life costs; reduction in delivery time; reduction in greenhouse gas emissions; higher levels of lifetime built asset performance.

Reduction in whole-life costs: HEAT3D reduces cost compared with traditional methods of measurement: traditionally, it costs around £4,000 to undertake heat loss measurement; with HEAT3D the cost is £400.

Reduction in greenhouse gas emissions: HEAT3D can measure heat flow to a proven accuracy of 5% for a 20W/m^2 heat flow. This level of accuracy that the HEAT3D app offers will allow site teams to understand and identify where in the structure heat escapes most easily so that it can be rectified.

Reduction in delivery time: The measurement can be completed in under two hours compared with the three to five days taken by the incumbent techniques.

PROJECT DETAILS

Sector:
Housing, Education, Commercial, Other Social Infrastructure

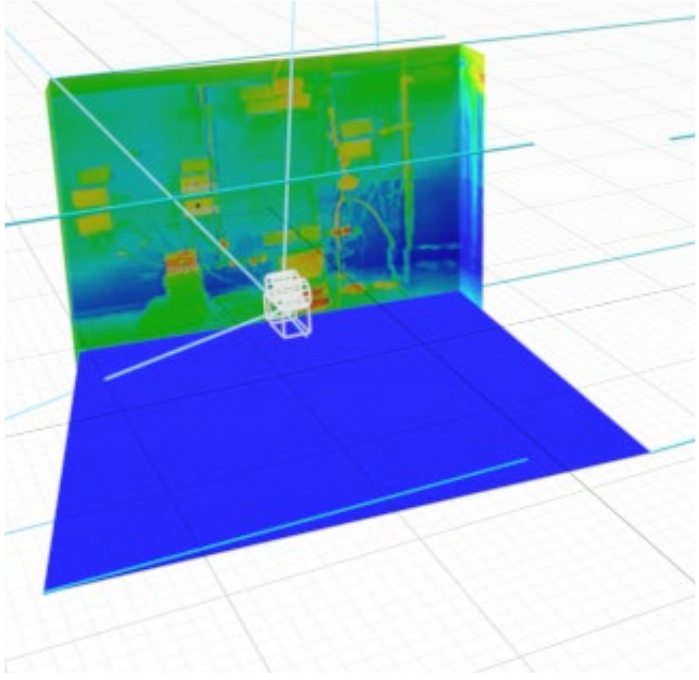
Focus:
Digital
Performance
Financial and assurance

Innovation Lead:
Liam Winder

Project participants:
Build Test Solutions Ltd (lead)
Electric Pocket Ltd
University of Salford

Project number:
104804

UKRI funding:
£214,461



Hyb-ISS

Safer, lightweight insulation methods for offsite light-gauge steel structures.

Hybrid Insulated Steel System (Hyb-ISS) combines the proven structural efficiency of Light Gauge Steel (LGS) with a patented, low-density, injectable mineral foam called Airium. It overcomes the challenge of achieving high fire protection to multi-storey buildings at scale. It is strong and very structurally efficient, and at the same time is super-lightweight and solid. And because it can be manufactured, built and tested entirely offsite, it vastly improves the time it takes to construct, insulate and fire-proof structures up to 10 levels high. Initial tests have shown Hyb-ISS is twice as fire resistant as current alternatives, which will lead to a greater number of safe, quality and sustainable multi-storey constructions.

This novel insulation means more residential structures of up to 10 floors could be built more quickly and more accurately – with faster and easier finishing, less resource and waste, and vastly improved acoustic, thermal and fire-proof properties. This reimagining of insulation production and installation is suitable for a third of the housing market, satisfying the demand for multi-storey housing and ensuring it is built faster, more accurately and, more importantly, with greater safety.

PROJECT IMPACTS

Outputs: Built asset, hardware.

Hardware/built asset: Hyb-ISS combines the proven structural efficiency of LGS with a patented, low-density, injectable mineral foam called Airium.

Benefits: Reduction in whole-life costs; reduction in delivery time; reduction in greenhouse gas emissions; uptake of concepts at scale; improved assurance of buildings; improved health and safety.

Reduction in whole-life costs: The Hyb-ISS Airium/LGS floor weighs 75kg/m^2, so is significantly lighter than current alternatives for multi-storey buildings. The structure and foundations required to support the floor are less due to the lower mass, and this translates into lower costs. For example, composite metal deck/concrete (160mm) weighs 320kg/m^2, four times heavier than Hyb-ISS; Hollowcore 200mm with 65mm screed (265mm) weighs 400kg/m^2, which is five times heavier than Hyb-ISS; and concrete frame, plus 65mm screed (315mm) weighs 730kg/m^2, which is 10 times heavier than Hyb-ISS.

PROJECT DETAILS

Sector:
Housing
Education
Commercial
Other Social Infrastructure

Focus:
Manufacturing/MMC

Innovation Lead:
Sherrie Rad

Project participants:
Salvesen Insulated Frames Ltd (lead)
Aggregate Industries UK Ltd
Crest Nicholson PLC

Project number:
104789

UKRI funding:
£222,868

Futureproof

A disruptive value-based funding model for housing.

Daedalus Environmental has created an alternative finance and delivery model to break the cycle of homes built on short-term cost or shareholder return. Futureproof spreads the risk and shares the reward of investing in housing. It draws on modern methods of construction (MMC), digital platforms, active energy technology and data-monitoring systems to deliver new homes in days rather than months. This high level of productivity and precision creates certainty for investors who stand to benefit from a consistent level return over the lifetime of the development. For residents, they can rent or buy higher-quality, zero-emission homes that require less maintenance, generate their own energy and can adapt to their longer-term needs. And if their income changes, the flexible ownership model adapts to their means.

Daedalus believes it is possible to create a housing finance model where everybody benefits – from investors to the supply chain to households. It's based on the principle of spreading the risk and sharing the reward across the life cycle of these new homes. By drawing on MMC, there will be added certainty around delivery times and costs to build the houses, and they will have improved performance with more predictable repair and maintenance costs. Reliable access to homes is a fundamental tenet of Futureproof. The development of a new, flexible means of owning property for the first time will give people access to high-quality homes in a way that meets their needs, not in a way dictated to them by the market.

PROJECT IMPACTS

Outputs: Information (knowledge, processes and standards).

Information: Swan Housing Association, the manufacturing partner on the project, developed an Offsite Manufacturing Strategy (OSM). The OSM draws on MMC and offers a viable superstructure proposition that could increase the capacity, speed, quality and performance of new homes. By applying the Project 13 principles from the Institute of Civil Engineers, Futureproof integrates engineering and digital technology, and the use of data and information to improve customer outcomes.[10]

Benefits: Reduction in whole-life costs; reduction in delivery time; reduction in greenhouse gas emissions; active energy positive buildings; higher levels of lifetime built asset performance; improved assurance of buildings; improved regional balance.

Reduction in greenhouse gas emissions: Futureproof seeks to anticipate societal and environmental change and delivers a business model to enable zero-emission development. Zero-emission homes are standard within Futureproof developments, where active energy technology can produce, monitor and store energy – and are even designed to enable grid flexibility and community energy storage.

Higher levels of lifetime build asset performance: Futureproof redistributes the value in home construction across the supply chain, incentivising quality-focused outcomes rather than a transactional, lowest cost approach. Its model is more attractive to investors as it minimises short-term risk and creates longer-term reward through flexible tenure models and properties that generate their own revenue from energy. It also bakes whole-life value into the techniques and technologies used in the construction process.

PROJECT DETAILS

Sector:
Housing

Focus:
Digital, Manufacturing/MMC, Performance, Financial and assurance, Business models

Innovation Lead:
Christine Coonick

Project participants:
Daedalus Environmental Ltd (lead)
Swan New Homes Ltd
Homes England
Haven Gateway Partnership

Project number:
105865

UKRI funding:
£454,147

HIPER Pile

Hollow, monitored piles that can be reused and incorporate services.

A collaboration of leading construction firms has reimagined foundations. Keltbray Piling, Converge, DB Group and Arup have turned passive, static piles that only load bear, into hollow and impression piles that offer greater value to a building throughout its life cycle. HIPER Pile (Hollow, Impression-enhanced, Precast, Energy-generating and Re-useable piles) uses a hollow and impression pile design and lightweight cement-free concrete to provide the same shaft-bearing capacity with fewer piles or narrower piles. The pile incorporates smart technology to monitor performance and the void can be used to integrate renewable technologies. With up to 80% reduction in materials and emissions possible, and greater on-site productivity, HIPER Pile helps achieve carbon reduction and circular economy aims.

HIPER Pile offers technological advancements in deep foundations that will revolutionise the productivity of large-scale construction programmes, and make foundations a smart component in the life of the building. Bored piles no longer just deliver dumb foundations with a single load-bearing function. HIPER Pile has the potential to incorporate offsite manufactured components, increase the shaft-bearing capacity, while using significantly less material and reducing embodied and construction-related carbon emissions. It enhances the whole-life cycle of a building by offering better use of space and the ability to reuse piles at the end of building life. They can also enable integration of renewable technologies that enhance building use.

PROJECT IMPACTS

Outputs: Built asset, digital application/software.

Built assets: Hollow, Impression-enhanced, Precast, Energy-generating and Re-useable piles.

Digital application: Sensors embedded within the HIPER Pile continually record and transmit live data relating to strength gain, and will also include strain, tilt and relative humidity capabilities.

Benefits: Reduction in whole-life costs; reduction in delivery time; increase in trade; reduction in greenhouse gas emissions; reduction in productivity gap; active energy positive buildings; uptake of concepts at scale; higher levels of lifetime built asset performance; improved health and safety; improved regional balance.

Reduction in productivity gap: The innovation uses lightweight cement-free concrete to provide the same shaft-bearing capacity while using fewer piles or piles with a reduced diameter. This reduces the material needed, but it also dramatically increases the rate of production on site per day by 20 to 50%.

Reduction in whole-life cost: HIPER Pile provides a competitive engineering solution and enables the client to consider otherwise unachievable alternatives such as shorter, more efficient piles. This means structures can be supported on fewer or reduced diameter HIPER Piles, cutting material usage and cost by up to 70%.

Reduction in greenhouse gas emissions: HIPER Pile can be constructed using Cemfree, a material developed by DB Group. Cemfree is an ultra-low-carbon, cement-free alternative to concrete. Field trials have shown that Cemfree can save as much as 80% of the carbon emissions involved in its manufacture, transport and use in construction.

PROJECT DETAILS

Sector:
Housing, Education, Commercial,
Other Social Infrastructure, Infrastructure

Focus:
Digital, Manufacturing/MMC, Performance

Innovation Lead:
Christine Coonick

Project participants:
Keltbray Group Ltd (lead)
DB Group (Holdings) Ltd
Octagon I/O Ltd
City University of London

Project number:
104797

UKRI funding:
£614,357


SR-75
soilmec
keltbray
soilmec

IGNITE

An integrated software solution to enable the effective, efficient delivery of modular housing products and services.

IGNITE (Integrated Intelligent Digital Tendering System) has developed digital processes to reflect that of architects, designers and quantity surveyors into a manufacturing supply-chain system (AQMSS). The system enables a more agile, dynamic supply chain for modular housing, delivering a full digital record of procured houses with transparency of product design and cost to enable and support whole-life asset management.

AQMSS will be available commercially to all modular construction enterprises throughout the supply chain. This expands the ecosystem for integrated and improved housing development planning, allowing developers to communicate with multiple modern methods of construction (MMC) systems, facilitating a digital tendering and schedule process and allowing developers to maintain control of design, supply chain components and project delivery costs.

PROJECT IMPACTS

Outputs:
Digital application/software.

Digital application:
A Places for People Rule Book allowing multiple MMC providers to propose design and building methodologies.

Benefits:
Reduction in whole-life costs, reduction in delivery time, reduction in productivity gap, improved assurance of buildings.

PROJECT DETAILS

Sector:
Housing

Focus:
Digital, Manufacturing/MMC,
Financial and assurance, Business models

Innovation Lead:
Christine Coonick

Project participants:
Places for People Group Ltd (lead)
ModularWise Ltd
Project Etopia UK Ltd
Lynq Ltd
Totally Modular Ltd
Northmill Associates Ltd
The Manufacturing Technology Centre

Project number:
105880

UKRI funding:
£1,121,235

Increasing Construction Sector Productivity Through Integrated Offsite Steel Modules

Boosting productivity with the offsite manufacture of steel modules.

The British Constructional Steelwork Association set out to improve construction sector productivity through the use of offsite manufactured integrated steel modules, rather than frames being assembled on site. Best practice prototypes will provide efficient, standardised and cost-effective designs that can be implemented easily. Clients will therefore be reassured that designs meet regulatory requirements, relevant codes and standards.

PROJECT IMPACTS

Outputs:
Built asset, information (knowledge, processes and standards).

Built asset and information:
The project published free design prototypes that can be used by engineers, main contractors, steelwork contractors, M&E contractors and others. These will provide the steel construction supply chain with the knowledge and confidence to design, manufacture and construct mainstream steel-framed buildings that include integrated offsite steel modules.

Benefits:
Reduction in delivery time; reduction in productivity gap; uptake of concepts at scale; improved assurance of buildings; improved health and safety.

Reduction in delivery time:
The use of steel composite cores could shorten a construction programme from approximately 18 months with a traditional core to 10 months.

PROJECT DETAILS

Sector:
Housing
Education
Commercial
Other Social Infrastructure

Focus:
Manufacturing/MMC

Innovation Lead:
Liam Winder

Project participants:
The British Constructional Steelwork Association Ltd (lead)
WSP UK Ltd
Severfield PLC
The Steel Construction Institute

Project number:
104786

UKRI funding:
£97,627

BCSA

Intelligent Control Room

An analytics platform providing automated construction progress, installation quality and predictive risk management in real-time.

Contilio's Intelligent Control Room turns 3D site data into actionable insights in real-time. It applies the same advanced technology used in autonomous driving to translate Light Detection and Ranging (LiDAR) and laser scans and 360-degree photos into critical information to make smart decisions on site. Artificial intelligence (AI) classifies all structural, architectural, mechanical, electrical and plumbing elements and automatically compares them with the building information model and the programme schedule. The insights are then visualised on an easy-to-use and intuitive cloud dashboard to help site and control teams access information at any time, from anywhere in the world. For the first time, stakeholders will be able to remotely track progress and swiftly eliminate risk of delay and installation errors.

PROJECT IMPACTS

Outputs: Digital application/software.

Digital application: Contilio's technology helps eliminate slow, manual spot-checks and forecasts operations and maintenance costs throughout the life of the asset. The technology can also be applied to the operations phase of a building to help more accurately forecast and manage operations and maintenance costs throughout the life of the asset.

Benefits: Reduction in whole-life costs; reduction in delivery time; reduction in productivity gap; improved assurance of buildings; improved health and safety.

Reduction in productivity gap and whole-life costs: Swiftly identified and resolved risks to reduce critical delays and waste by up to 5% and rework costs up to 25%.

Reduction in delivery time: Since the beginning of its development, Contilio's platform has reduced the time it takes for its 3D AI to deliver its actionable insights from over 80 to 160 hours to between four and 16 hours, putting critical information in the hands of key decision makers sooner and with increased accuracy.

PROJECT DETAILS

Sector:
Education
Commercial
Other Social Infrastructure

Focus:
Digital, Performance

Innovation Lead:
Hannah Gibson

Project partners:
Contilio Ltd (lead)
Imperial College London

Project numbers:
104783 and 105870

UKRI funding:
£893,074

Intelligent Design for Manufacture and Assembly (IDEMA) Panel House

A repeatable model for desirable, quick-to-build net zero housing.

Inspired by the Rubik's Cube and flatpack furniture, Mills Power Architecture had a vision of using precision manufacturing, robotics, sensor technology and onsite factory processes to create easy to assemble homes. To realise this idea, they worked together with a team of diverse partners and researched the techniques and technology needed to develop a new era of efficient, affordable click-and-build houses. The result? The IDEMA Panel House.

PROJECT IMPACTS

Outputs:
Information (knowledge, processes and standards), digital application/software.

Information and digital application:
IDEMA Panel House concept. The connection system has been designed so that panels can be made in a local or floating factory on site, using programmed robots and techniques developed by i3D Robotics for both constructing the panel frames and depositing the insulation.

Benefits:
Reduction in whole-life costs; reduction in delivery time; reduction in productivity gap; reduction in greenhouse gas emissions; active energy positive buildings; higher levels of lifetime built asset performance.

Reduction in whole-life costs and reduction in productivity gap:
Incorporating low-carbon materials and a new class of insulation for autonomous manufacture of the panels has led to an estimated 15% improvement in construction productivity and a 30% reduction in costs.

Reduction in greenhouse gas emissions and active energy positive buildings:
The IDEMA Panel House can meet its own energy requirements and generate enough surplus energy to charge a small electric car. This will reduce energy requirements by 1,300kWh/yr.

PROJECT DETAILS

Sector:
Housing

Focus:
Digital
Manufacturing/MMC
Performance

Innovation Lead:
Christine Coonick

Project participants:
L&B Care Services Ltd (lead)
DG Cities Ltd
Mills Power Ltd
I3D Robotics Ltd

Project number:
104793

UKRI funding:
£211,123

Increasing Productivity and Quality in Mass House Building

Smart mass-market homes that adapt to changing lifestyles.

With research showing that 1.7 million people are in unsuitable housing, MyGlobalHome developed a new approach to home production that has connectivity, whole-life performance and value at its heart. The team set about creating a prototype home that can not only improve lives now, but adapt to the lifestyles of households as they change and grow, and as communities around them become more connected. The demonstrator home sits on site at the University of Surrey's Guildford campus and uses factory-built frameworks, modular components, smart sensors and active energy technologies. Residents will be able to easily modify, upgrade, repurpose and change their home environment as their lifestyle needs evolve – whether that's as they grow older, any changes to family status, or increased accessibility needs. Not only can the home adapt to the changing needs of its resident, it will also be able to adapt to the modern world around it as smart communities and cities evolve.

This level of technology, design and adaptability is normally the reserve of the luxury housing market, but MyGlobalHome has developed a concept for mass affordable housing that can increase productivity, reduce waste and incorporate sustainable materials along the way.

PROJECT IMPACTS

Outputs: Built asset, digital application/software, hardware.

Built asset: Prototype home (GH1), a modular product designed to exacting tolerances allowing it to expand vertically, horizontally and technologically. At the touch of a button, the interior areas can expand or contract through modules that move around a structural central core, from which the home's services are managed and distributed. GH1 prototype building has been repurposed as an Innovation Centre for MyGlobalHome's second Transforming Construction Challenge funded project, moving from proof of concept to demonstrator buildings that will be lived in by the University of Surrey staff and researchers.

Digital application: MyGlobalHome's ULTRA™ is a hardware and software-based technology platform enabling any property development to be made smart. Residents will have access to: a Marketplace through which they can order home upgrades; a Community Hub that connects the home with events, activities and a local support network; and a Concierge through which they can schedule maintenance tasks and request other home assistance.

Benefits: Reduction in whole-life costs; reduction in delivery time; reduction in greenhouse gas emissions; reduction in productivity gap; active energy positive buildings.

Reduction in whole-life costs: Across a development of 500 1,200sqft homes, MyGlobalHome can deliver cost savings of over 30% in comparison to a traditional build, making smart homes more affordable.

Reduction in greenhouse gas emissions: MyGlobalHome uses technology and software solutions that can halve the lifetime carbon emissions of a home, compared with traditional construction methods.

Reduction in productivity gap: The productivity of a team of onsite assembly technicians improves by up to 30%.

PROJECT DETAILS

Sector:
Housing

Focus:
Digital, Manufacturing/MMC

Innovation Lead:
Christine Coonick and Hannah Gibson

Project participants:
Global Home Technology Ltd (lead)
Environ Audio Ltd
Beckhoff Automation Ltd
Supermassive UX Ltd
Buro Happold Engineers Ltd
University of Surrey

Project numbers:
104782 and 106168

UKRI funding:
£4,410,710

Landsec Office 1.0, The Forge

World-first kit of parts office block paving the way for more productive and sustainable automated builds.

How can the construction sector emulate the productivity gains seen in the manufacturing sector over the past 20 years? Landsec, Easi-Space and Bryden Wood Technology led a collaborative project to develop and test automated construction on a real site and compare the efficiencies against a traditional office build. Using platform-design for manufacture and assembly (P-DfMA), kit of parts frames and BIM technology, the partners created a structural frame suitable for a commercial office that could be manufactured offsite and assembled on site using an automated assembly process. In doing so, they demonstrated that office construction could be faster, more reliable, more productive and cost less – leading the way to an increase in quality, sustainable working environments and a new creation of skills and jobs in the construction workforce.

Adopting a more consistent kit of parts approach to office design and builds will increase UK construction productivity, accuracy and quality, and see costs come down by as much as a third when applied to the whole build. This best-practice model will also have environmental benefits, minimising waste and reducing carbon impact. Projects will be delivered faster and users will have more space for the same building envelope, while enjoying a more sustainable working environment.

PROJECT IMPACTS

Outputs:
Built asset.

Built asset:
Kit of parts highly energy efficient office (targeting net zero in use).

Benefits:
Reduction in whole-life costs; reduction in delivery time; increase in trade; reduction in greenhouse gas emissions; reduction in productivity gap; improved assurance of buildings; improved health and safety; improved regional balance.

Reduction in greenhouse gas emissions:
The efficiencies gained from using P-DfMA and kit of parts approach on Office 1.0 has demonstrated a reduction in embodied carbon of 19.4%. Internal utility equipment is also designed to work with the all-electric central plant, making use of LED lights, procuring 100% renewably sourced energy, and using high-efficiency heat pumps to bring down energy use by 73%.

Reduction in productivity gap:
The kit of parts approach that has been applied to the structure and cladding, and the digital tools adopted will require 50% fewer workers on the install teams. Overall on the build, this equates to a 13.5% productivity gain. Once the scope of the kit of parts is expanded, Landsec expects to hit a target of 35%.

PROJECT DETAILS

Sector:
Commercial

Focus:
Digital, Manufacturing/MMC, Performance

Innovation Lead:
Mike Pitts and Mat Colmer

Project participants:
Land Securities PLC (lead)
Easi-Space Ltd (lead)
Bryden Wood Technology Ltd

Project numbers:
104784 and 106164

UKRI funding:
£2,693,989

The Learning Camera

Automating routine checks on sites.

To ensure the safety and compliance of construction sites, resource must be dedicated to routine monitoring of equipment. This is repetitive, time consuming and low-skilled work. The Learning Camera can be fixed in place to monitor such situations using artificial intelligence, alerting the site team only if the condition changes in a way that requires attention. This is particularly useful in hazardous areas and has been pioneered by BAM Nuttall, one of Europe's largest contractors operating a large number of complex construction projects.

The Learning Camera is a flexible, scalable solution that allows users to train a standard web camera attached to a computer, linked to an online dashboard. The camera is programmed to recognise a scenario on site and when the content of that view differs then an alert or action is automatically issued so that someone can attend to the situation.

PROJECT IMPACTS

Outputs:
Digital application/software.

Hardware:
80% of BAM Nuttall's current sites have at least one application of The Learning Camera. A typical use is monitoring the accident response board. The site Health and Safety Office is alerted when it is used, and the camera detects any missing or displaced items to be replaced. Therefore, should a serious incident occur on site, the relevant equipment is always available.

Benefits:
Reduction in delivery time; reduction in productivity gap; improved health and safety.

Reduction in delivery time:
Removing the need for routine, repetitive, low-skilled tasks frees up productive time for the site workforce.

PROJECT DETAILS

Sector:
Housing, Education, Commercial,
Other Social Infrastructure, Transport, Infrastructure

Focus:
Digital, Performance

Innovation Lead:
Sherrie Rad

Project partners:
Bam Nuttall Ltd (lead)
Iotic Labs Ltd
Cranfield University

Project number:
104794

UKRI funding:
£190,239

Live Automated Materials Plan (LAMP)

Technology to optimise how construction materials are tracked, delivered and used on site.

Scheduling material deliveries to construction sites can be complicated because, overall, it is a manual process. To help manage this, site teams may arrange for materials to be delivered before they are needed. Those materials end up being shifted around the site to accommodate work and are double- or triple-handled, or materials are unintentionally over-ordered. As a result, they get damaged, wasted or stolen. Skanska led a team to improve supply chain analytics so project leads can better coordinate when materials are arriving, are used and leave the site. It saves time and waste and means every piece of land on site is used most productively. Simply put, it helps the delivery of the right materials at the right time.

PROJECT IMPACTS

Outputs: Digital application/software.

Digital application: LAMP uses artificial intelligence and geospatial data to optimise existing tag and track technology around material supply levels, waste requirements, and traffic conditions – and can create almost pinpoint accuracy around the delivery of materials to site. It removes inefficiencies that slow down a project.

Benefits: Reduction in delivery time; reduction in greenhouse gas emissions; reduction in productivity gap.

Reduction in whole-life costs: Improved materials management could reduce logistics costs onto and from construction sites, reaching savings of around 18% of total costs. Across Skanska's UK operations this is the equivalent to efficiency savings of £0.32bn per year. And across the UK construction sector, it would save £10.8bn per year as Skanska operates around 3% of UK construction.

Reduction in greenhouse gas emissions: LAMP has the potential to reduce embodied carbon by 11% from 875kg CO^2/m^2 to 780kg CO^2/m^2, and the waste generated is reduced by 18% from 10.2 to 8.4 m^3 waste per £100,000 project value.

PROJECT DETAILS

Sector:
Housing
Education
Commercial
Other Social Infrastructure
Transport
Infrastructure

Focus:
Digital

Innovation Lead:
Mat Colmer

Project participants:
Cartoconsult Ltd (lead)
Skanska Technology Ltd
Building Research Establishment Ltd

Project number:
104791

UKRI funding:
£312,831

Modular Automated Roof Tile Factory (MARTF)

Sustainable slate roofing tiles made using a modular factory in a box production process that can be taken on site.

The roofing tile industry was crying out for innovation and husband-and-wife team, Martyn Lucas and Amy Sheldrake, had the answer in the form of Carapace Slate. Working with The Manufacturing Technology Centre, they have developed a single cell factory in a box production line for bio-composite slate tiles that can be installed onto any site to create an instant in-house supply chain. The tiles themselves are highly sustainable as they are made using 80% waste slate. The design means the slates self-align and interlock without nails or screws identical to natural slate, reducing the need for declining specialist roofing skills. Plus, it has a faster build time, reducing time needed to be spent at height, and reducing all the associated delays and costs currently associated with roofing. It is a much more productive and sustainable solution with the potential to support the UK supply chain and scale globally.

PROJECT IMPACTS

Outputs: Built asset, information (knowledge, processes and standards).

Built asset and information: Carapace Slate bio-composite roof tiles that self-align and interlock without nails or screws and look identical to natural slate. A robotic assembly line that can fit into a shipping container – hence referred to as a factory in a box.

Benefits: Reduction in whole-life costs; reduction in delivery time; increase in trade; reduction in greenhouse gas emissions; reduction in productivity gap; uptake of concepts at scale; improved health and safety.

Reduction in productivity gap: The simple fitting techniques require a less specialist workforce, and with a 90% quicker build speed it can reduce labour and overall projects costs.

Reduction in greenhouse gas emissions: Carapace Slate is made of 92% natural material. It is manufactured using >80% local waste slate aggregate, combined with a 20% resin. It is recyclable and lightweight with a lower carbon footprint. MARTF uses low-power manufacturing process. It does not require high pressures, high temperatures or material extraction. With optimised footprint and environmental conditions controlled within the envelope, the MARTF system will occupy a fraction of the space and energy normally required.

PROJECT DETAILS

Sector:
Housing
Education
Commercial
Other Social Infrastructure

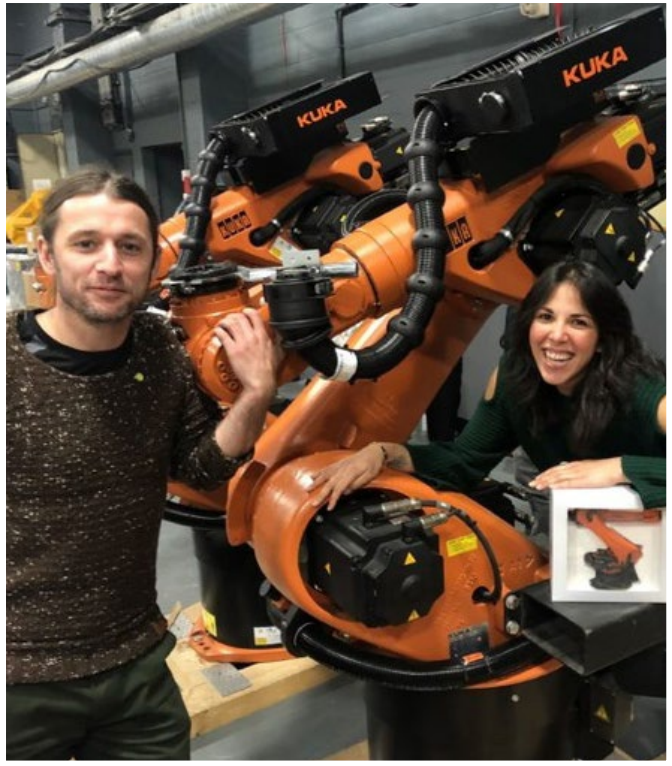
Focus:
Digital
Manufacturing/MMC

Innovation Lead:
Liam Winder

Project participants:
Sunscape Systems Ltd (lead)
The Manufacturing Technology Centre

Project number:
104788

UKRI funding:
£134,739



Morta

Automating data flow to improve accuracy, remove risk and enhance decision-making.

The successful delivery of assets requires accurate, reliable information. Too often, complex projects use disconnected datasets, documents and systems that handle hundreds of thousands of data points that could hide inconsistencies or errors. Morta led a project with Mott MacDonald to develop an end-to-end customisable information hub that blends the familiarity of spreadsheets with the utility of a database. Organisations can use Morta to connect information from different sources and automate up to 93% of time-consuming manual processes. It gives organisations a golden thread of data and an audit trail throughout the programme, as well as the confidence that all necessary checks are taking place. It pulls all the information into a dashboard that acts as a single source of truth for the entire project team to work to, which lives with the asset – not only during the build itself, but for its entire life cycle.

Morta works by pulling data from multiple sources to create a single source of data across all programme partners. It can run automated error checks to clean and qualify the data, and it can also create a detailed and transparent audit trail between the users of the platform. It replaces resource-intensive processes and smooths the workflow between different partners and contractors.

PROJECT IMPACTS

Outputs: Digital application/software.

Digital application: Morta allows users to create a customised information hub that has the familiarity of spreadsheets and documents, and the utility of databases.

Benefits: Reduction in delivery time; reduction in productivity gap; improved assurance of buildings.

Reduction in delivery time: Morta reduces the cycle time of checking labour cost claims from three weeks to two days, when tested on a $1.7bn project for payments. It also reduces the cycle of handover requirement checks from 24 days to a three-day process.

Reduction in productivity gap: Organisations can use Morta to connect information from different sources and automate up to 93% of time-consuming manual processes.

Improved assurance of buildings: Morta's platform enables automated assurance of deliverables against requirements. Crucially, with the increasing complexity and volume of datasets, individuals cannot keep up with the thousands of checks they have to perform, often relying on memory and spot-checks leaving tremendous room for errors. Automated assurances means that parties can have the confidence that all the necessary checks are being performed.

PROJECT DETAILS

Sector:
Housing
Education
Commercial
Other Social Infrastructure

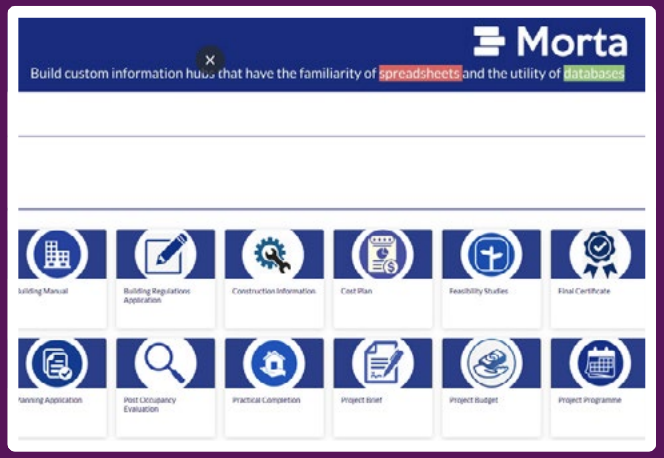
Focus:
Digital
Financial and assurance

Innovation Lead:
Liam Winder

Project participants:
Morta Technology Ltd (lead)
Mott MacDonald Ltd

Project number:
105873

UKRI funding:
£261,225



One Source of Truth

Technology that delivers objective insights on project progress to improve productivity and minimise disputes.

Consensus in a supply chain makes programmes more productive yet information flow through a supply chain can be sporadic, subjective or unreliable. One Source of Truth creates a single, objective perspective on project delivery and accountability. Through onsite cameras and digital tools, One Source of Truth automates data collection and assesses it for progress, effort employed by each partner, and any errors against design. This is all pushed through into a tailored dashboard of information that is visible to all. The complete digitised record that it creates during and post-build improves project management, carbon accounting, quality assurance and productivity. Importantly, errors and rework can be tracked and assigned to the right partner, minimising disputes over contracts and the delays or additional costs they may cause.

Mobile power-independent cameras capture time-lapse footage of large sections of construction sites autonomously through remote control. Artificial intelligence (AI) is then trained to analyse the footage received and automatically monitor progress, track moving parts on site (such as construction plant and people), and improve site security. The technology feeds the data through to a digital twin and event streams of the construction site through a bespoke dashboard that acts as an objective one-stop-shop record of site activity.

PROJECT IMPACTS

Outputs: Digital application/software, hardware.

Digital application: The dashboard delivers insights to the site team about the effort employed by each partner, information about progress and conditions on site and, importantly, can act as an objective source of information about errors in the build process so they can be traced and determine who needs to rectify them.

Benefits: Reduction in delivery time; reduction in productivity gap; improved health and safety.

Reduction in productivity gap: The technology overlays information on errors to the contract teams between the supply chain to minimise disputes around responsibility for rework and to reduce delay and cost associated with contractual issues. Improved monitoring allows for health and safety on site to be monitored more closely.

Health and safety: This project develops a novel practical solution powered by AI to measure PPE compliancy in real-time. The algorithm has been published in the journal, Sensors.[11]

PROJECT DETAILS

Sector:
Housing, Education, Commercial,
Other Social Infrastructure, Transport, Infrastructure

Focus:
Digital
Performance

Innovation Lead:
Sherrie Rad

Project partners:
Bam Nuttall Ltd (lead)
Werner Homes Ltd
Building Research Establishment Ltd
Glideology Ltd
Cranfield University

Project number:
105881

UKRI funding:
£653,000

Optimising Equipment-Use in Construction

Tracking how, when and where machinery is being used to improve site productivity.

Construction programmes are less productive, and more expensive, when equipment is left unused, machinery orders are duplicated, or vehicles must be taken out of service because of unscheduled repairs. This waste is often hidden in plain sight because there is little real-time data that shows plant use on site. BuildStream and Costain are using the latest technology to track how equipment is being used across the site and how to optimise it. A digital platform visualises the data and makes recommendations about ways to improve utilisation, any maintenance that's required, and it can even predict demand for machinery to avoid it sitting idle.

BuildStream has applied its Internet of Things (IoT) solution to track plant hire in operation on construction sites. Its telematics-based system provides information on the location and utilisation of construction equipment in a way that is frequent, consistent and can support real-time analysis. Its machine-learning algorithms can then both recommend optimum plant requirements for existing sites as well as predict future utilisation.

PROJECT IMPACTS

Outputs:
Digital application/software, hardware.

Digital applications:
IoT solution to track plant hire in operation on construction sites.

Benefits:
Reduction in whole-life costs; reduction in delivery time; reduction in greenhouse gas emissions; reduction in productivity gap; improved health and safety; equality, diversity and inclusivity.

Reduction in delivery time:
The service will enable contractors and subcontractors to improve utilisation rates to at least 70% from a current average of 30%. It can reduce equipment duplication by 60% and significantly reduce crossover of equipment requirements – easing site congestion.

PROJECT DETAILS

Sector:
Housing, Education, Commercial, Other Social Infrastructure, Transport, Infrastructure

Focus:
Digital

Innovation Lead:
Liam Winder

Project participants:
BuildStream Ltd (lead)
Costain Ltd
BIM Academy (Enterprises) Ltd
Northumbria University

Project number:
104785

UKRI funding:
£242,803

PLASMA

A smart digital platform that uses data to map the most efficient programme plan for a more productive supply chain.

PLASMA is a digital platform that has the potential to transform the productivity of construction. Vinci and Skanska set out to improve supply chain processes through greater collection, sharing and access to historic and live site data, allowing teams to plan better and, importantly, learn from how projects performed and where improvements could be made. Working with SME partners, Vinci and Skanska created a smart contract system – PLASMA – that lifts data from site sensors and project management systems. This data satnav then gives a 360-degree picture of the supply chain flow, allowing project planning teams to map programmes, test project delivery scenarios and identify supply chain pinch-points.

PROJECT IMPACTS

Outputs: Digital application/software

Digital application: PLASMA captures data throughout the life cycle of a build and shares it up and down the supply chain. It works by analysing data from onsite sensor networks and through supply chain tracking systems. The data then creates a 360-degree view of the entire build to plan the most efficient programme, identify the most suitable suppliers, embed modern methods of construction approaches and suggest workflows with the lowest carbon footprint. In the application, project teams can create orders, raise invoices and send requests to the entire supply chain, so everyone is aware of project progress and interdependencies.

Benefits: Reduction in whole-life costs; reduction in delivery time; improved health and safety.

Reduction in whole-life cost and delivery time: PLASMA can help make significant gains, through an estimated 25% saving in programme cost and an estimated 28% saving in delivery time.

Uptake of concepts at scale: nPlan worked with the Department for Transport (DfT), using PLASMA's risk tool on an East West Rail project bid. DfT and nPlan employed the tool to assess risk and the extent to which proposals put forward in the bid process could be achieved.

PROJECT DETAILS

Sector:
Education
Commercial
Other Social Infrastructure
Transport
Infrastructure

Focus:
Digital

Innovation Lead:
Hannah Gibson

Project participants:
Vinci Construction UK Ltd (lead)
Skanska Technology Ltd
Assentian Ltd
nPlan Ltd
Building Research Establishment Ltd

Project number:
104801

UKRI funding:
£590,540

SEISMIC

Collaboration to standardise and optimise the design for school building steel frames.

The Elliot Group and The McAvoy Group both produce steel frames for building schools. Their slightly different designs were incompatible and created inefficiencies up their supply chains. In this project they collaborated with Bryden Wood and Blacc to adopt a joint design that could be assembled from a kit of parts and was optimised to reduce emissions, cost and assembly time. Having standardised the system, the consortium developed a digital tool to enable design of a school building in minutes rather than weeks. Blacc, modern methods of construction (MMC) management experts, have progressed this work – SEISMIC II – to understand how the deployment of this platform could benefit different market sectors and client types.

PROJECT IMPACTS

Outputs: Built asset, information (knowledge, processes and standards).

Information and built asset: Two major supply chain companies collaborated to use the same modular steel-frame design rather than their non-identical competing versions.

Benefits: Reduction in whole-life costs; reduction in delivery time; reduction in greenhouse gas emissions; reduction in productivity gap; uptake of concepts at scale; improved assurance of buildings.

Reduction in greenhouse gas emissions: The use of a modular frame design and lightweight materials reduces the amount of steel normally used in an average primary school, built offsite, by 25%. This in turn reduces the emissions associated with transport and steel by 25% – the equivalent to over 155,000 miles of car travel or 17 flights from London to Sydney.

Reduction in delivery time: The digital tool developed means designs for schools can now take minutes rather than weeks, which saves on development costs and time. The redesigned frame could be erected more quickly, showing a 52% reduction in assembly time.

PROJECT DETAILS

Sector:
Education

Focus:
Digital
Manufacturing/MMC
Performance
Financial and assurance

Innovation Lead:
Mike Pitts and Liam Winder

Project participants:
Blacc Ltd (lead)
Bryden Wood Technology Ltd (lead)
NCC Operations Ltd
Elliott Group Ltd
Tata Steel UK Ltd
McAvoy Group Ltd
The Manufacturing Technology Centre
Swansea University

Project numbers:
133468 and 106165

UKRI funding:
£3,667,118

Product Based Building Solutions (PBBS)

A physical and digital building system that standardises the invisible, while customising the visible.

PBBS aims to streamline the end to end project delivery process with a physically and digitally configurable kit of parts. It catalogues facades, structures, and mechanical and electrical elements that can all integrate to form complete buildings. It means designers can not only select the best individual parts, but can make data-driven decisions about which components work best with each other, and are most effective and efficient to assemble. Rather than creating identikit buildings, PBBS helps standardise invisible elements in a build and create greater certainty and productivity throughout the design manufacture and assembly process so builds can be installed quicker and cost less. Importantly, the software allows designers to customise the final building around the needs of the customer and end users. PBBS doesn't standardise the outcome, it standardises the way the building is put together.

PROJECT IMPACTS

Outputs: Built asset, digital application/software, hardware.

Built asset: PBBS has built a demonstrator school and apartment.

Digital application: The PBBS digital product library holds each configurable component including important associated information such as quality and sustainability. PBBS embeds engineering and assembly rules into each component. Therefore, when a designer is creating a digital twin of the building, they can see all the attributes and benefits of individual, standardised products as well as their attributes when combined, enabling them to make selections based on how they best integrate with each other.

Information: Dynamic Knowledge is embedding competency frameworks and skills development to provide greater assurance that project teams will possess the skills required effectively to use PBBS to deliver projects, maximising its benefits.

Benefits: Reduction in whole-life costs; reduction in delivery time; reduction in productivity gap; uptake of concepts at scale; improved assurance of buildings.

Reduction in delivery time and productivity gap: The manufacturing processes can save nearly 16 weeks of onsite time, which would reduce the time it takes to put up a school by 29%. The project has seen a 40% reduction of lead time in the manufacturing phase, against a target to reduce onsite building time by 30%. For example, on the demonstrator, bathroom pods were installed in 30 minutes, from truck to final position. The team has also assessed how to manufacture the most effective hybrid walls. Tested on Trinity School, the team found that previous lattice solutions to wall frames took 18 weeks and two days, while PBBS's frame takes 11 weeks and four days – a 50% time saving just for frames.

Reduction in greenhouse gas emissions: Generating 50% saving in embodied carbon by using an offsite manufactured concrete structural system made from an optimised, low-carbon concrete mix. When factoring in the reusable and demountable nature of some of these offsite manufactured concrete structural systems, this increases to a 70% carbon saving.

PROJECT DETAILS

Sector:
Housing, Education, Commercial

Focus:
Digital, Manufacturing/MMC, Performance

Innovation Lead:
Hannah Gibson

Project participants:
Laing O'Rourke PLC (lead)
ActivePlan Consulting Ltd
Building Research Establishment Ltd
Project Frog
Octagon I/O Ltd (Converge)
Hoare Lea LLP
Autodesk Ltd
Defenceknowledge Ltd
The University of Sheffield
University of Cambridge

Project number:
106163

UKRI funding:
£1,974,429

Specwall-Load Bearing (LB)

Factory-built load-bearing walls that transform the productivity of housebuilds.

Specwall-LB helps us build with greater ease, accuracy and efficiency. Wall systems normally built on site, and that are heavily labour, skills and weather dependent, can now be manufactured entirely offsite in factories as modular load-bearing panels that can be used in multi-storey builds. The result of academic and industry expertise working together, Specwall-LB's precise manufacturing processes mean the walls are produced accurately and delivered to the site pre-finished, insulated, sound and fireproofed, and ready to paint – making light work for the site team. They can even be moved or repurposed, making them the first reusable, load-bearing, modular wall.

Offsite, factory-built load-bearing walls bring new levels of productivity and quality to multi-storey housebuilding. Specwall-LB walls address many of the challenges that come with traditional methods.

PROJECT IMPACTS

Outputs: Built asset.

Built asset: Quality, precision-engineered, load-bearing, interlocking 'A Grade' concrete panels.

Benefits: Reduction in whole-life costs; reduction in delivery time; reduction in greenhouse gas emissions; reduction in productivity gap; higher levels of lifetime built asset performance; improved health and safety; improved regional balance; development of skills; equality, diversity and inclusivity.

Reduction in productivity gap: With faster build times and reduced labour and material costs, Specwall-LB has improved productivity by 40% on average, when it has been used in the housing and multi-storey markets.

Reduction in delivery time: Three people, rather than nine, can install the walls – entirely independent of weather conditions and requiring no wet work, so it's all ready to paint. Labour production is around 50% less hours per m^2.

Reduction in whole-life costs: The cost of Specwall-LB's materials is 20% less than plasterboard. With fewer people needed on site to install the walls and less materials used, associated labour and material costs are reduced by up to 70%. Panels are 100mm thick and so are smaller than normal. This reduces the size of the building, saving £1.4m on a 30-storey tower and achieving up to 5% more sellable floor space than when using traditional partitions.

PROJECT DETAILS

Sector:
Housing
Education
Commercial
Other Social Infrastructure

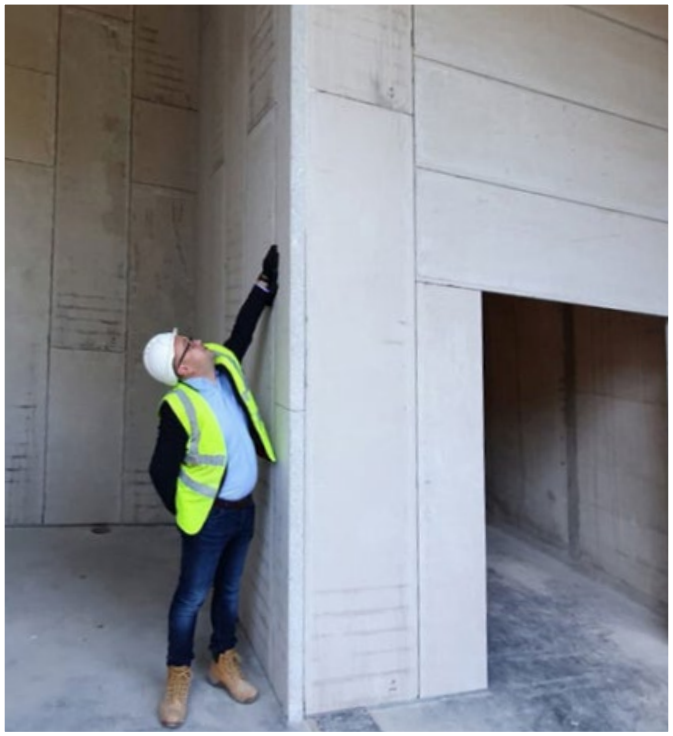
Focus:
Manufacturing/MMC

Innovation Lead:
Hannah Gibson

Project participants:
Specwall Alliance Ltd (lead)
Loughborough University

Project number:
105884

UKRI funding:
£447,125



STELLAR

Reimagining the supply chain so SMEs can benefit from modern methods of construction (MMC).

Small house-builders and contractors want to unlock the opportunities around MMC and compete for social housing projects, but the capital costs are too prohibitive. Totally Modular has pulled together a consortium to create STELLAR – a hub and spoke model that is reinventing the supply chain. Central hub factories manufacture structural frameworks at scale, while regional spoke factories satisfy those areas with highest demand, and use local trades to finish off the MMC process. Regardless of their size, SMEs can now benefit from lower cost, increased productivity and quality, and help deliver social homes using MMC that meet community needs.

PROJECT IMPACTS

Outputs: Digital application/software, information (knowledge, processes and standards).

Digital application: Modular Build Design App to track the process and progress of housing delivery through the hub and spoke factories, onto site and all the way through to handover and occupation, including sign-off on competency and quality. It creates a golden thread of data – a digital passport – for each home and gives social landlords visibility of where orders are in the process at any one time, and an accurate record of the components and suppliers involved in the delivery of their homes.

Information: Open-source patent book for hot rolled and light gauge steel elements that provides a common steel framework approach for UK housing, standardising details for manufacturing and construction, and simplifying build-ability.

Benefits: Reduction in whole-life costs; reduction in greenhouse gas emissions; reduction in productivity gap; improved assurance of buildings; improved health and safety; improved regional balance; development of skills; equality, diversity and inclusivity.

Reducing greenhouse gas emissions: The combination of lighter-weight materials, digital planning and production technologies will enable the homes to attain new levels of quality and energy efficiency. These housing designs offer an EPC A rating as standard. The common steel framework approach has been designed to optimise the use of steel with minimal waste, and any waste steel will be repurposed to manufacture sheds or pods.

PROJECT DETAILS

Sector:
Housing

Focus:
Digital
Manufacturing/MMC
Performance
Business models

Innovation Lead:
Chris Coonick

Project participants:
Totally Modular Ltd (lead)
Jali Ltd
TDS Midlands Ltd
Citizen Housing
Spacious Place Construct Ltd
University of Wolverhampton

Project number:
106166

UKRI funding:
£1,181,172

Transport Infrastructure Efficiency Strategy (TIES) Living Lab

Using real-world demonstrators to modernise the way we build infrastructure.

The Department for Transport (DfT) delivers large, complex infrastructure projects. To increase value and reduce inefficiencies, DfT recruited 25 partners across industry to create a new model for infrastructure builds. Through a series of live demonstrators, the TIES Living Lab is testing modern methods of construction (MMC) and digital and data-driven technologies to improve forecasting, planning and benchmarking. In doing so, DfT will drive down delivery times, increase productivity, reduce carbon impact, and create safer sites for construction workers on large-scale infrastructure programmes.

Physical demonstrators, digital demonstrators and data tools show how standardised approaches, MMC, improved information management and resilient data-sharing can make transport infrastructure better value for money, safer, greener, and more productive during design, construction and operation. Benchmarking intelligence will also help shift the focus in infrastructure delivery decision-making from cost of construction to an understanding of value across the whole asset life cycle.

PROJECT IMPACTS

Outputs:
Built asset, information (knowledge, processes and standards), digital application/software.

Built asset:
In one demonstrator, AVA footbridge, the adaptable bridge was created through innovative design, configurator technology and precision manufacture.

Digital application:
The SMART Infrastructure Calculator works by assessing the socio-economic value generated by historic construction projects to predict the future value of the current project based on multiple criteria, such as build type (MMC or conventional), location of the project and level of investment.

The Cable Route Management System Project within TIES Living Lab will help automate mapping of the cables on the tube, which will reduce the need and amount of time required for working on tracks. A digital system will 3D scan and analyse the existing tunnel surface to determine available space for new cable routing. The system can then evaluate the surface for suitability in cable routing, effectively creating a heat map of the tunnel surface to identify risks, opportunities and the level of effort involved.

Benefits:
Reduction in whole-life costs; reduction in delivery time; reduction in greenhouse gas emissions; reduction in productivity gap; improved health and safety; improved regional balance.

Reduction in greenhouse gas emissions:
The AVA footbridge project expects its approach will reduce embodied carbon content by up to 50% and operational energy emissions by up to 60%.

PROJECT DETAILS

Sector:
Transport
Infrastructure

Focus:
Digital, Manufacturing/MMC, Performance
Business models

Innovation Lead:
Sherrie Rad

Project partners:
NSAR Ltd (lead)
Whole Life Consultants Ltd
Akerlof Ltd
Transport for London Finance Ltd
Strategic Rail Consultants Ltd
Network Rail Infrastructure Ltd
The Manufacturing Technology Centre
Office for National Statistics
Expedition Engineering Ltd (Useful Simple Group Ltd)
Powercube Ltd
X-Treme Systems Ltd
Highways England
Bryden Wood Technology Ltd
Walker Construction (UK) Ltd
Kier Construction Ltd
Costain Ltd
HS2 Ltd
Social Profit Calculator Ltd
Royal Institution of Chartered Surveyors
Accelar Ltd
Department for Transport
University of the West of England
University of Dundee
University of Leeds

Project number:
106171

UKRI funding:
£6,300,000

West Midlands DfMA

Factory-assembly social homes.

Walsall Housing Group (whg) led a collaborative to improve local neighbourhoods with sustainable and affordable homes. The partners applied design for manufacture and assembly (DfMA) to a proof-of-concept project. These factory-built houses have gone on to prove that it is possible to build cost-efficient, low-impact and high-performing houses at scale using automated manufacture and assembly processes. As well as helping tackle a growing need for high volumes of quality social housing, these homes will ultimately improve the lives of those who live in them because they will be more cost efficient and require less repair and maintenance.

A shift in focus to life-time homes and placing long-term value over low-cost construction will mean that homes will be built in a better way. A more innovative, collaborative approach to the design, manufacture and assembly of new homes will lead to a greater number of environmentally-friendly homes. This will mean more people can live in safe, sustainable, affordable homes. Not only that, but the repair and maintenance of these homes will be cost-efficient for the provider and of good quality to the resident.

PROJECT IMPACTS

Outputs: Built asset, Digital application/software.

Built asset: Home built, based at Hadley's offices.

Digital application: To optimise the installation of the prototype, the collaborative developed a Knowledge-Based Engineering tool (KBE) that estimates where the greatest emissions and costs come from, across both the life cycle of the build and home once in use, and adjust the design to minimise investment and carbon footprint.[12] The project also pioneered the application of the Home Energy Dynamics (HED) model – a modelling tool to assess energy consumption – developed by the Energy Systems Catapult.

Benefits: Reduction in whole-life costs; reduction in delivery time; increase in trade; reduction in greenhouse gas emissions; reduction in productivity gap; higher levels of lifetime built asset performance; improved health and safety; improved regional balance; equality, diversity and inclusivity.

Reduction in whole-life cycle costs: 33% reduction.

Reduction in greenhouse gas emissions: The collaborative originally predicted a 30% reduction of household energy consumption and a carbon emissions reduction of 50%. Energy Systems Catapult has now created a HED model that proves that household energy consumption is reduced by 86% when using the full toolkit developed by the team.

Increased industry investment: Hadley Group is investing £3m in expanding its facilities based on the findings and outcomes of this project.

Reduction in productivity gap: According to the DfMA house assembly report prepared by QM Systems, it takes eight minutes to assemble one panel frame, a sub-assembly unit of the DfMA house.[13] The time is compared with the manual production time for the prototype DfMA house. The corresponding time required to produce one panel frame by a gang of two laborers and a supervisor is 45 minutes. Thus, the production line speeds up the production of the panel sub-assembly for the DfMA house by more than five times.

Reduction in delivery time: With so much of the manufacture and assembly being done on a factory production line, this new modular building technique has delivered a 50% reduction to the design and construction time. The use of the KBE tool also showed a reduction in the time spent planning the project.

PROJECT DETAILS

Sector:
Housing

Focus:
Digital
Manufacturing/MMC
Performance

Innovation Lead:
Hannah Gibson

Project participants:
WHG Trading Company Ltd (lead)
QM Systems Ltd
Hadley Industries Holdings Ltd
Northmill Associates Ltd
Energy System Catapult Ltd
Birmingham City University

Project number:
104798

UKRI funding:
£727,923

The Weather Ledger

Taking the subjectivity out of weather disputes.

Risk management around weather has been a big challenge for the industry. Neither client nor contractor wants to carry the risk, leading to disputes and costly delays. EHAB has led a consortium of businesses to create The Weather Ledger – a data-enabled system that can automatically trigger weather clauses when terms are breached. The digital ledger technology gives everyone in the supply chain access to real, accurate and objective datasets, removing human interpretation often at the heart of these disputes. Money, time and supply chain relationships can all be saved, leading to programmes delivered on time and on budget.

This innovation will improve the way claims around weather-related risk are settled, and reduce admin, delays and costs. By drawing on big weather data, Internet of Things sensors and blockchain technology, The Weather Ledger essentially digitises the NEC3 weather clause and automatically triggers claims if clause thresholds are breached. And because the data reflects reality and is captured in an accurate and transparent way, everyone across the supply chain will have access to the same data at the same time removing subjective interpretations.

PROJECT IMPACTS

Outputs:
Digital application/software, hardware.

Digital application:
A data-enabled system that can automatically trigger weather clauses when terms are breached. The digital ledger technology gives everyone in the supply chain access to real, accurate and objective datasets.

Benefits:
Reduction in whole-life costs; improved assurance of buildings; improved regional balance.

Reduction in whole-life costs:
It's estimated that an extra day of delay on a £100m project could cost £125,000. As weather is responsible for extending projects by 21%, the potential cost impact can be enormous. More efficient contract management will have a positive impact. For example, the tool reduces the time it takes to establish that a compensation event has occurred from as much as 12 weeks to just a few minutes.

PROJECT DETAILS

Sector:
Housing, Education, Commercial, Other Social Infrastructure, Transport, Infrastructure

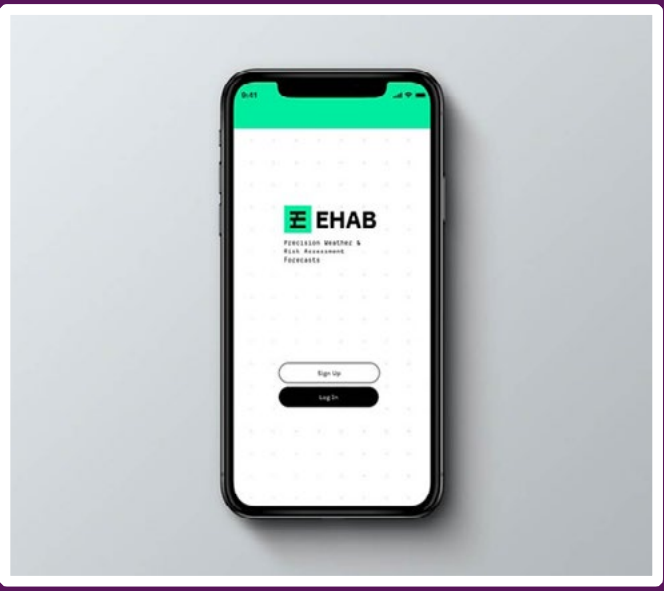
Focus:
Digital, Financial and assurance

Innovation Lead:
Liam Winder

Project participants:
EHabitation Ltd (lead)
Bam Nuttall Ltd
Clyde & Co LLP
Ferrovial Corporation UK
Connected Places Catapult Ltd
Digital Catapult Ltd

Project number:
105876

UKRI funding:
£588,699



Academic led research projects in conjunction with EPSRC

Applied Offsite and Onsite Collective Multi-Robot Autonomous Building Manufacturing

Investigating new operational and delivery strategies for automation.

This project developed an innovative multi-agent control framework that enables a distributed team of robots to operate in a similar way for the manufacture and assembly of buildings undertaken by offsite manufacture, onsite construction, or hybrid solutions using onsite factories. This requires the enhancement of existing robots, and development of new capabilities for collision avoidance and collaborative working. As many building tasks require specialist equipment, heterogenous teams consisted of different robot platforms such as agile mobile ground vehicles, aerial vehicles, alongside larger scale industrial robot arm, track and gantry systems are able to collaborate, and collectively undertake tasks beyond the capabilities of each individual robot such as lifting objects heavier than any one robot's payload capacity.

Automated Concrete Construction

Decarbonising construction by rethinking the way that concrete is used in buildings.

As the industry tackles the huge level of carbon emissions from concrete, a partnership between the Universities of Bath, Cambridge and Dundee is leading an alliance of nearly 30 industry partners to reimagine the way concrete is used in construction. Called ACORN, the alliance is saying goodbye to traditional concrete beams, columns and slabs that are made and cast onsite, wasting more concrete than is needed. Instead they are testing out new design approaches, manufacturing processes and robotic technology to spray and mould concrete into more efficient forms. These forms still have high structural integrity but use the minimum amount of materials, reducing carbon impact by an estimated 50%.

Conversational-BIM

A virtual assistant for better onsite assembly.

Imagine how easy, quick and accurate onsite assembly would be if workers didn't need to refer to poorly written instructions or navigate complex systems; if they just had to ask a question to hear and see step-by-step instructions based on up-to-date information; if all of this was done hands-free so they didn't need to stop what they were doing to access information. Conversational-BIM is combining several disruptive technologies into one practical tool to make this a reality.

Hybrid Concrete Printing

The next generation in 3D concrete printing.

The design of buildings has been freed up by architects adopting computer modelling technologies. These designs are now constrained, not by what can be imagined, but by traditional methods of construction, such as casting concrete. Hybrid Concrete Printing can manufacture high precision surfaces, interfaces and features, with a much shorter lead-time than traditional methods – realising the potential of 3D Concrete Printing to deliver cost, waste, safety and time benefits for the construction industry.

Wider context and Challenge influence

Wider context and Challenge influence

Transforming Infrastructure Performance (TIP) Strategy

In September 2021, the Infrastructure and Projects Authority (IPA) published its Transforming Infrastructure Performance (TIP): Roadmap to 2030 strategy update.[14] IPA is a part of the government operating between the Cabinet Office and HM Treasury to ensure best practice is applied to major government projects, many of which are large infrastructure procurements such as HS2.

The TIP Roadmap takes a systems-of-systems approach to look holistically at what is needed for government procurement to work this way across different projects, from new infrastructure to retrofitting homes, while delivering for society, regions and the environment.

The Roadmap paves the way for more standardisation of the design process for public buildings, so we avoid starting from scratch each time to provide a bespoke solution that doesn't vary much from what came before.

The outputs of Transforming Construction are providing the building blocks for how this is done from the Value Toolkit to the Platform Rulebook, while results from the demonstrator projects we funded are building the confidence to embed the change (many are used as examples throughout the document).

Future of Consultancy

Consultant engineers have expertise that can help the construction industry design with long-term value in mind. And yet as a sector, construction consultancy is caught in old fashioned billing-by-the-hour models and is at risk from being overtaken by artificial intelligence and smart data that can design at greater speed and for better performance. To tackle this, Transforming Construction supported the Association for Consultancy and Engineering launched Future of Consultancy to rethink the way architects and consultant engineers add (and bill for) the value they provide. By embracing new technologies and techniques, this important sector now channels its expertise into tackling some of our bigger societal challenges around construction and infrastructure, and ultimately delivering designs that support a healthier industry, a healthier end user and a healthier planet.

The Construction Playbook

In December 2021, the government outlined bold new plans to reform and modernise the industry with a series of initiatives designed to build schemes more quickly and efficiently, ramp up the use of modern construction techniques and cut carbon emissions. The playbook underscores in clear terms the fundamental role that digital processes and technologies will play in ensuring a construction sector fit for the future.

Construction Innovation Hub's Value Toolkit provides government clients with the tools and processes needed to embed the Outcomes-Focused Approach mandated by the playbook. The Toolkit will also support the playbook's ambition to ensure that value-based procurement is adopted at an organisational level and driven through a portfolio approach to projects and programmes. Crucially, the Toolkit will also arm decision-makers with the insights and data needed to make better, more informed decisions about the schools, hospitals and homes of tomorrow.

The playbook's ambition to harmonise, digitalise and rationalise demand will be enabled by Construction Innovation Hub's Platform Design Programme, allowing government clients to create a broad range of vital public buildings from a standardised kit of parts using digitally-enabled modern methods of construction.

British Standard for Building Performance Evaluation (BS40101)

Many new, existing and retrofitted buildings exhibit large gaps between design aspirations and in-use performance. To meet policy objectives and the needs of building owners and occupants, in-use performance needs to improve rapidly and radically.

Data is the key to understanding whether we are making the right choices throughout the life cycle of the building. The UK suffers from a disjointed approach to building performance evaluation (BPE), where data are inaccessible, study methods are not clear or shared, and decisions are often made on poor or limited data. The best way to address these problems is through a common Standard and set of protocols that can be used for BPE across the whole industry.

The new British Standard for BPE addresses core aspects of sustainability and improved asset performance as laid out in the Industrial Strategy for construction. Additionally, the Standard will assist the government in the development of the Clean Growth Strategy and help the UK deliver its net zero carbon target.[15]

The Standard will provide regularisation of the approaches used to evaluate actual building performance; the identification of performance parameters that warrant attention according to specific circumstances; and the expertise required of individuals undertaking different degrees of building performance evaluation.

Appendices

Endnotes

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Acronyms

ABC	Active Building Centre
AI	Artificial Intelligence
BIM	Building Information Modelling
DFMA	Design for Manufacture and Assembly
EPC	Energy Performance Certificate
EPSRC	Engineering and Physical Sciences Research Council
HS2	High Speed Rail 2
ML	Machine Learning
MMC	Modern Methods of Construction
PPE	Personal Protective Equipment
RIBA	Royal Institute of British Architects
SME	Small and Medium-Sized Enterprise
TCC	Transforming Construction Challenge
UCL	University College London
UKRI	UK Research and Innovation

The Transforming Construction Challenge is an integral part of the Construction Sector Deal, to accelerate the shift in construction towards manufacturing and digital processes and a value outcome approach.

We would like to thank participants and supporters of the Challenge for their contribution to a transforming industry.

About UK Research and Innovation (UKRI):
UK Research and Innovation is the largest public funder of research and innovation in the UK, with a budget of over £8bn. It is composed of seven disciplinary research councils, Innovate UK and Research England. We operate across the whole country and work with our many partners in higher education, research organisations businesses, government, and charities. Our vision is for an outstanding research and innovation system in the UK that gives everyone the opportunity to contribute and to benefit, enriching lives locally, nationally and internationally. Our mission is to convene, catalyse and invest in close collaboration with others to build a thriving, inclusive research and innovation system that connects discovery to prosperity and public good.