

# FUTURE OF CONSTRUCTION

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# Construction is facing a new era of green builds

As the UK construction industry strives to rebuild itself to deliver the new homes and infrastructure the country needs, new money and new metrics apply

### OVERVIEW

JIM McCLELLAND

"It's the economy, stupid!" Given that we are in the middle of the presidential primaries in the United States, the classic campaign slogan of the Bill Clinton era offers an apt retort when asked to name the factor most likely to shape the future of construction. In the modern marketplace of 2016, however, that answer arguably only begs another question: "Which one?"

In an industry notorious for putting cost ahead of anything else, money is no longer what it was; no longer the only trade currency. This is because construction also operates now in a number of new and emerging growth economies – the low-carbon economy, circular economy and digital economy – where value is not counted exclusively in cash.

In political terms, construction made one key new economy debut on the world stage in Paris, last year. On December 3, the first-ever Buildings Day took place at the COP21 climate change negotiations, initiated by the World Green Building Council (WGBC), United Nations Environment Programme, France and other partners. For the industry, this laid down a major economic marker, explains WGBC chief executive Terri Wills.

"Buildings Day was global recognition that growth in construction need not come at the expense of the environment, and that the industry can actually thrive economically through more innovative and

responsible approaches that address climate change," she says. "The Paris agreement is the strongest signal yet that a low-carbon economy is inevitable. For construction companies, that means taking a leading approach to green buildings or risk being left behind as markets shift."

Paris was no mere public relations stunt for construction. Commitments were made to register, renovate or certify more than 1.25 billion square metres of green buildings – almost double the size of Singapore – over the next five years.

At present, the building sector is said to represent 30 per cent of global CO<sub>2</sub> emissions and playing its part in limiting global warming to two degrees will mean a reduction of 84 gigatonnes of CO<sub>2</sub> by 2050, despite population growth and urbanisation – the equivalent of not building 22,000 coal-powered energy plants.

Numbers on the delivery side are encouraging, though, with figures from Dodge Data & Analytics showing global green building continues to double every three years. In many ways, this global megatrend should play to the strengths of UK construction in particular.

"The UK is undoubtedly a mature market for green building, ranking highly in global indices. Leading companies now realise the strong economic, social and environmental benefits," says Ms Wills.

While UK construction might be in the vanguard of low-carbon economy markets, its investment in the circular economy is less advanced, in the opinion of Duncan Baker-Brown, an architect at BBM

### Leading companies now realise the strong economic, social and environmental benefits of green building



### UK CONSTRUCTION OUTPUT GROWTH

UK construction purchasing managers' index, where 50 separates growth and contraction



Source: Markit/CIPS 2016

Sustainable Design and senior lecturer at the University of Brighton. Responsible for the radical Brighton Waste House, Mr Baker-Brown is writing a book entitled *The Re-Use Atlas: A Designer's Guide Towards the Circular Economy* and views UK performance thus far as a positive start, but only a qualified success.

"I have found a number of inspiring case studies in the UK – Carmody Groarke's Maggie's Centre, LYN Atelier's Hub 67 – as well as organisations such as Recipro that redistribute unwanted construction material," he says.

"Top-tier contractors also appear to be receptive to the concept, with networks emerging such as the Supply Chain Sustainability School underlining this point. However, if you want to find real cutting-edge examples of 'cradle-to-cradle' construction, then you need to look to

wards mainland Europe, to Belgium and the Netherlands."

For Munish Datta, head of Marks & Spencer's Plan A sustainability programme, the challenge of new economies going forward lies in the need to scale operations and make best use of current capabilities – effectively doing more with what we have.

"Most of the technology the construction industry requires to harness a more environmentally and economically sustainable future exists today. Bringing innovators together with building designers, contractors and occupants is key," he says.

For M&S, initiatives such as the Big Innovation Pitch run with leading industry event Ecobuild, offer the high street retailer the chance to engage direct with the current crop of innovators and UK small and medium-sized enterprises

Mr Datta is also excited about cross-disciplinary digital economy hook-ups he sees happening. "Pockets of the construction industry are starting to harness creative solutions that are digitally minded, for example the Digital Catapult Big Data Exchange and Building Information Modelling (BIM). They're also using climate science to mitigate future risks, adapting buildings to flooding or overheating," he says.

Change is coming, like it or not, insists Guy Hammersley, executive director of the Building Research Establishment and BRE group director for BIM, who speaks frankly about the industry's lack of options. "The digital revolution is here in every aspect of our lives. I am reminded of a strapline from the 1990s: Innovate or Liquidate – if we don't embrace change, then the outcome is inevitable," he says.

"What I do see in the UK is a real impetus by innovative companies to embrace BIM, aided by the government mandate and driving change which may well make the UK a global leader."

Such forward momentum offers a much-needed boost to market confidence in UK construction capacity and skills, concludes London sustainable development commissioner Paul Toyne.

"The sector needs to show investors that it is a competitive 21st-century industry embracing the use of digital tools, innovation and collaboration to deliver the best solutions for customers and their end-users," says Dr Toyne.

Whether contributing to the £92-billion annual industry output on smart cities or high-speed infrastructure, via off-site methodologies or ethical sourcing, the three million employed in UK construction now operate in a multi-economy age, whatever their job title. This is a world where waste, carbon and data are the new money; circularity, efficiency and connectivity are the new metrics. It is still construction, only better.

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COMMERCIAL FEATURE



# BEAVERING AWAY SINCE 1984

Beaver 84 has strengthened its brand and diversified to thrive despite the recent recession



The construction industry has faced torrid times in recent years, with the financial crisis leading to the demise of many firms within the sector. Those that survived and continue to thrive today are the ones that are agile and able to adapt at speed to changing market conditions, and are adept at spotting opportunities in new markets. Beaver 84 is one such company.

Founded in 1984, the leading supplier of access, fencing, groundworks and events products has spent the last three decades continually expanding, innovating, and diversifying, unfazed by two recessions, and focused on maintaining the quality of its products and services that have made it a preferred supplier to the construction and events industries.

Asked what the key factors are behind the company's 32-year success story, managing director Steve Tysoe cites the versatility of their products, and their ability to diversify and penetrate new markets, capabilities that have set them apart from the competition.

"Not only did this help us to get through the recession, it has also been central to strengthening and growing our business and our brand. I think we've also been very successful at changing people's mindsets about the use of our products," he says.

The company has an impressive timeline of expansion, acquisition and product innovation, which was put to the test when the company that had bought it in 2006, SIG PLC, decided to sell to current owner Altrad in 2011. Since then, turnover increased from £24 million in 2011 to £39 million in 2015.

Mr Tysoe says: SIG PLC were overloaded so, to concentrate on their core product base, the decision was made to sell to Altrad in the depth of the recession as we were more in line with other companies within the group."

Today Beaver 84 is well established in a number of sectors outside its construction mainstay, heavily involved in brand activation through a buoyant events division, and in a number of exciting projects within the TV and film industry through its access division.

Events and film production represent two very different directions to

the construction industry, and illustrate the extent of the company's ability to diversify. Their route into the film and TV market came in 1995 via a chance call from a set provider working on a Warner Bros. Pictures production who needed some scaffolding products for behind the scenes.

Since then, Beaver 84 scaffolding and related products have been part of productions such as *Downton Abbey*, *Star Wars*, *Harry Potter*, *Pirates of the Caribbean*, plus a number of Bond movies, including *GoldenEye* and *Tomorrow Never Dies*. Film and TV is poised to be a growth area for the company in the coming months.

Beaver 84's foray into the events market began with the supply of security fencing for events such as Glastonbury, and the Leeds and Reading festivals.

“Beaver 84's strategy for seeking out and capitalising on new market opportunities and focus on ongoing product innovation have been fundamental to its ability to succeed in a challenging economic climate where others have failed

"As with our move into the TV and film market, once we'd had a glimpse of the events market, it became obvious very quickly that there was a market demand for more scaffolding-based products, for example, in staging, lighting, and camera and control towers. We started to investigate in more detail and, although it is a seasonal market, running from April until October, there were some associated companies and products in that space," says Mr Tysoe.

In 2014, Star Events Group came on to the market and Beaver 84 moved quickly to acquire it, and subsequently merged the two companies' events divisions, a decision that has paid dividends. Renamed Star

Events Ltd, the design and engineering team behind the brand are seen as the industry "go to" experts, having staged a number of show-stopping events for major brands such as Jaguar Land Rover.

Events involving water are a speciality. Last year, when accommodation website Airbnb needed a floating house to mark the introduction of new legislation on short-term lets in London, Star Events were called on to deliver. Their bespoke floating two-bedroom house, including kitchen, living room, bathroom and garden, was completed in just four weeks and attracted plenty of media coverage of its River Thames launch.

More recently Star Events worked for the LEGOLAND Windsor Resort to install a major new LEGO Star Wars-related display, a 500,000-LEGO brick recreation of Darth Vader's ultimate super weapon, the Death Star. Standing three metres high, it is the focal point of a thrilling scene depicting the Rebel Alliance attack on the moon-sized space station in *Star Wars: Episode IV A New Hope*.

Away from the entertainment and events sectors, another growth area for Beaver 84 is its Edge Protection Solutions division, vital for construction industry site safety and protecting those working at height. Two years ago the company bought into the Rapid-EPS system, one of the most effective edge protection systems, quicker to erect than conventional drill and fix systems, and requiring no tools or drilling.

"Initially we were expecting it to generate a modest turnover," says Mr Tysoe. "But once we'd got into the market, we realised it opened many more markets. There are strict health and safety laws for building in concrete, timber or steel, and the correct safety products have to be in place before anyone is allowed to work at that level. We are also the sole UK distributor of that product."

Within its scaffolding division, the Plettac Contur system is another innovative and versatile product offered by Beaver 84, which has a 40 per cent faster installation time and is designed to tackle the toughest of terrains.

Beaver 84's strategy for seeking out and capitalising on new market opportunities and focus on ongoing product innovation have been fundamental to its ability to succeed in a challenging economic climate where others have failed. But in order to achieve its business objectives, the company has also invested in its workforce of more than 200 employees based at 13 strategic locations across the UK.

Investment in training and development has been key to low levels of staff turnover, which have helped the company retain the vital industry knowledge and expertise acquired from working across multiple sectors over a period of many years. In a fiercely competitive construction industry, Beaver 84 has found a winning formula and proved that a small company can stand the test of time.

"Looking ahead there will be new products and further acquisitions, and we are aspiring to reach a £50-million turnover very quickly and build on that as we go through organic growth as well as acquisition," says Mr Tysoe.

"We have four very distinct divisions – access, groundworks, fencing and events – now within Star Events' portfolio. We are also extremely diverse. You won't find another company that is in competition with us in all four of those directions. Yes, we have a number of small competitors in each individual sector to think about, but we don't have one main competitor to worry about – and that puts us in a very strong position for future growth."

www.beaver84.co.uk



Steve Tysoe, managing director



Star Events recently installed LEGOLAND Windsor Resort's Star Wars™ related display The Death Star

# Talent pipeline runs dry for lack of recruits

UK construction is facing a crisis as industry leaders bid to attract new recruits to revitalise the sector in the wake of a prolonged recession

TALENT GAP  
MIKE SCOTT

Construction is an industry with an image problem – it is seen as old-fashioned, low tech, with little job security and no career progression.

At the same time, the construction industry is facing its biggest challenge since the Industrial Revolution, according to the Construction Industry Training Board (CITB).

There is a skills gap right across the built environment, says David Picton, chief sustainability officer at Carillion, one of the UK's biggest construction and facilities management groups. "That starts with a shortage of people entering the building trades, which has happened for a number of reasons."

These include the recession that has gripped the sector for the last six years, which led to large numbers of older workers leaving the industry, and a focus in the education sector on degrees and the academic route to qualifications that has led people away from the industry.

"In a recession, construction is always the last industry to slow down and the last to pick up," Mr Picton says. "Workers left the industry and, at the same time, young people were not inspired to join to replace them. The pipeline of talent dried up."

CITB forecasts show that the industry needs to fill 182,000 new jobs in the next five years to deliver the pipeline. In addition more than 400,000 skilled workers will hit retirement age in the next decade and will need to be replaced. Innovations in technology and new ways of working also mean the industry will need to develop new skills.

"Our industry is facing a perfect storm," says Adrian Belton, chief executive of the CITB. "The UK infrastructure plan, a housing boom, and the importance of developing new ways of working and embracing new technologies are combining to create demand for more skills, new skills and higher level skills."

There are just not enough people, says Graham Edgell, director of sustainability and procurement at Morgan Sindall Group. "It's a huge issue across the industry. The industry has moved on and there has been a recession in the sector for the last six years. Training has almost halted."

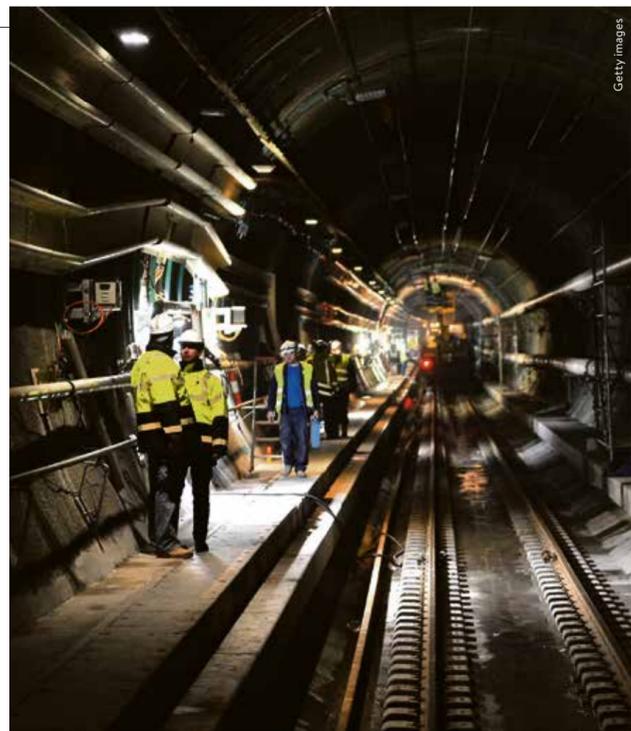
The average age of an excavator driver is 56, he says, while for bricklayers and other specific trades, "the standard and volume are not there". The problem has been disguised to a certain extent by an influx of labour from other countries in the European Union that has filled the gap.

Mr Edgell says: "In housing alone we probably need to create apprenticeships and openings for about 5,000 people per year just to get things underway. Until that happens, the situation is going to get worse. It is the collective responsibility of the whole industry."

However, there have been problems with creating enough apprenticeships because "the consistency in workflow is just not there to support it". The flip side, he says, is that the very notion of apprenticeships has been devalued.

"They're almost like work experience schemes now, rather than the old apprenticeships that turned people out through colleges. The standard is not high enough. You get someone on site for four to six months and then say they're qualified, but they're not."

The skills shortage is having a real impact on building firms, increasing costs and causing delays to projects.



12,000

vacancies in UK construction are hard to fill due to a lack of skilled applicants, more than double the number reported in 2013

Source: UK Commission for Employment and Skills 2015

One key problem for the construction sector is that it has not been seen as offering attractive career prospects. "To be a sustainable industry, we need to be a lot more attractive and show people there is a career path at every level," Mr Edgell says. "As an industry, we are world leaders, but to maintain that position we need business to pick up and we need to understand the way the education system worked in the past is no longer there."

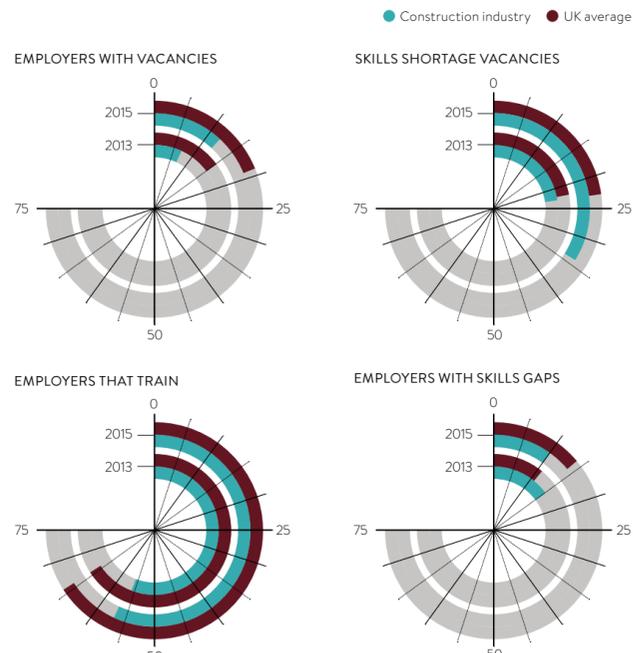
A range of new skills are needed for the future, adds Di Thornhill, human resources director for the UK, Middle East and Africa at engineering consultants Arup.

“The skills shortage is having a real impact on building firms, increasing costs and causing delays to projects

For example, in 2011, the UK government announced a Building Information Modelling (BIM) strategy that required the use of collaborative 3D BIM on government projects by 2016. BIM involves creating and using intelligent 3D models to develop and communicate project decisions.

The rise of digital construction, off-site manufacture and other modern methods

## SKILLS AND EMPLOYMENT IN THE UK CONSTRUCTION SECTOR (%)



Source: UK Commission for Employment and Skills 2015

of construction, increase the appeal of the industry to groups that have traditionally been difficult to attract, says the CITB, but they also change the range of skills the industry needs.

"A lot of young people are genuinely excited about using technology and tools like 3D drawing technologies and even things like drone technology, which more and more contractors are starting to use," says David Light, BIM consultant at Autodesk. "There are absolutely massive opportunities out there."

"We're moving into a technological era where skills like digital construction are becoming key," says Ms Thornhill. "Things like eco-cities require a more holistic set of skills and people who can take a broader view."

But, says Mr Light: "Construction is not seen as a tech business. It's still seen as old school."

Part of the problem is that schools and universities still take a traditional view of careers in the engineering industry, Ms Thornhill adds. "We suffer a bit from the perception of engineering. We're becoming aware of the need to get in earlier in the education system and show what a role in the industry could look like. When we tell people about the tallest buildings in the world, they're pretty wowed by that – it can be very inspiring."

For Carillion, part of the answer is to cast its net wider in its search for talent. "We have had to change our perception of the people we look at," says Mr Picton. "We have to convince people this is a good sector to get involved in over the long term. We have also had to look at areas of the talent pool that are often overlooked."

This includes people who have been homeless and ex-offenders: Carillion has been involved in a campaign called Ban the Box to remove the criminal conviction tick box from job application forms.

"Banning the box enables ex-offenders to compete fairly for jobs based on an assessment of their skills first, alongside regulated disclosure and barring service checks. Participating employers are able to find people from a wider pool of talent, while also contributing to reducing the estimated £11-billion annual cost of reoffending," the company says. It also targets ex-service personnel and reservists, with a target to employ 300 reservists by the end of 2016.

In addition, it is working to get more women involved in the industry, in part through its involvement in Your Life, a three-year campaign which aims to show young people, especially girls, that the mathematics and science students of today will be the chief executives of tomorrow. "We think it's our social responsibility to do these things, but it also brings more diverse thinking to our business," says Mr Picton.

Carillion is reviewing its policies and processes on maternity leave, and for people later on in their careers who may have more responsibilities for caring, as well as giving staff six days a year time off to do voluntary work. "Volunteering gives people more personal skills and a greater understanding of society. These softer skills are becoming increasingly important," he says.

"This is the new normal. Any sense that we can just put a few sticking plasters over this is naive. It's a permanent change in thinking about how we develop people."

Mr Edgell concludes: "The industry really needs to change its image. The challenges we are dealing with should be exciting enough to attract new people. Everyone is thinking about this and talking about it. It's time for action now."

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# Rebuilding UK's run-down urban spaces

The regeneration of UK towns and cities is entering an era of transformation when the needs of the community and wellbeing of individuals

**URBAN REGENERATION**  
ALISON COLEMAN

UK towns and cities are facing strategic challenges and social change as urban populations expand, exerting pressure on land, from green belt to former industrial sites with the potential for housing. Urban regeneration has been gathering speed since the late-1980s, shaped by political and economic strategies, and after the most recent recessionary slowdown is again firing on all cylinders. The lion's share of the renewal activity is in London and south-east England, where challenges around housing are at their most acute. Bracknell, for example, is the first post-war new town to have its centre comprehensively redeveloped in a £240-million project enabling it to compete with other urban centres in the Thames Valley.

Elsewhere large-scale regeneration projects are also taking place. Coal mining towns, such as Rotherham, continue to reinvent themselves, creating jobs, infrastructure for transport and new sports facilities. The successful redevelopment of Cardiff is the result of a decade of urban transformation, while Manchester and Birmingham are demonstrating how established urban centres can regenerate vibrant cities.

However, it seems that while the drivers of regeneration remain largely based on economic gains, the UK is currently going through a period of transition. And in this new era of urban transformation, there is greater consideration than ever for its impact on the local communities and the lives of those who live and work there.

Laura Alvarez, a lecturer and urban design specialist at Nottingham Trent University, says: "The pressure is on to build more, better, faster and cheaper than ever before, but at the same time more evidence-based information is emerging with regards to health and wellbeing, and this is gradually being transferred into guidance and legislation."

"All eyes seem to be now on the impact of development on people's lifestyles, a well embraced collective effort to secure the future of the NHS, as research and statistics are showing a strong connection between the quality of our environments and people's health and wellbeing."

**“**In this new era of urban transformation, there is greater consideration than ever for its impact on the local communities and the lives of those who live and work there**”**

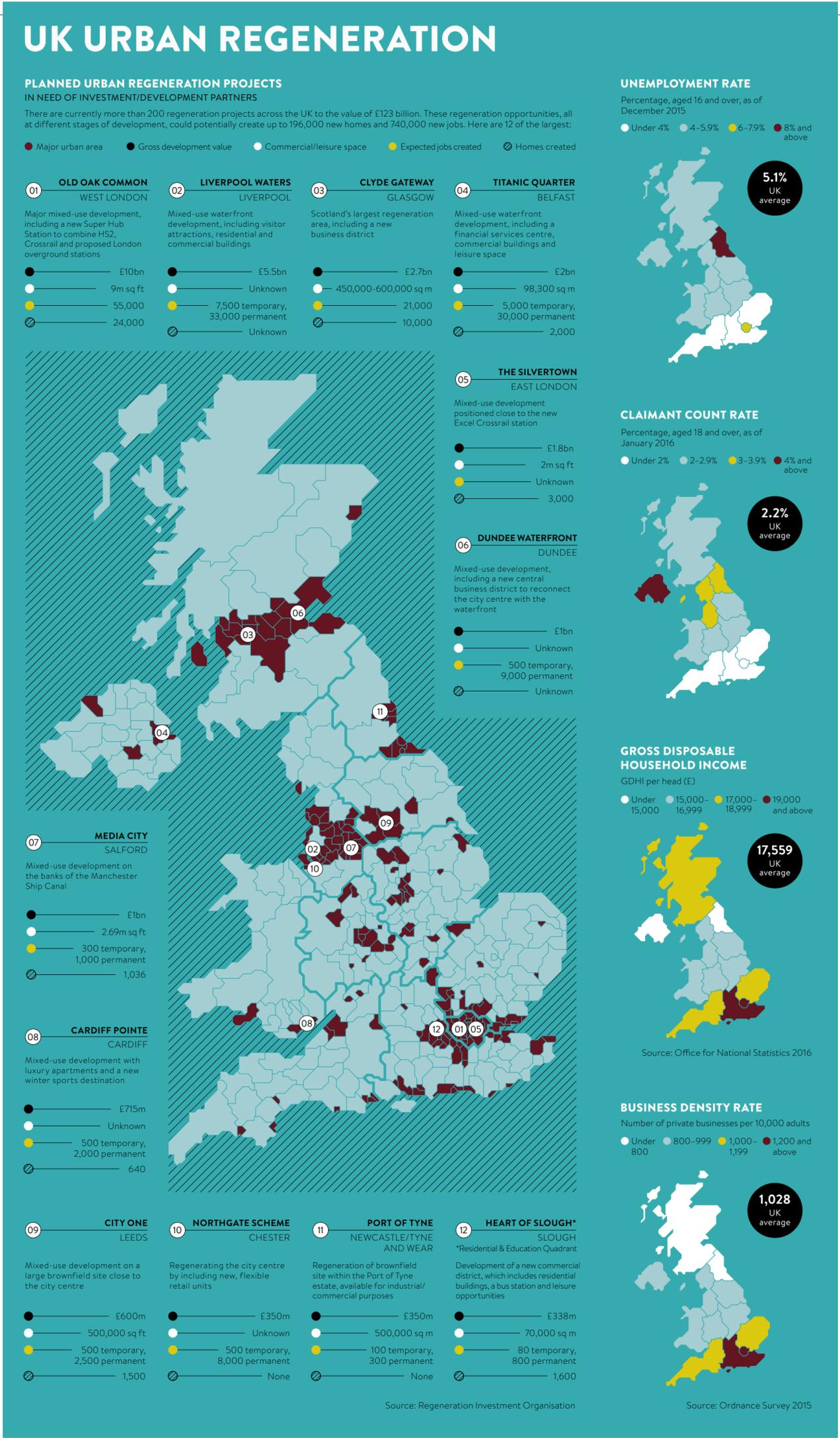
In some cases redevelopment is the direct result of the influence of those living and working in the local area. In Nottingham several urban spaces have been regenerated, some to support growth and employment, while others are a result of grassroots action. Cobden Chambers courtyard and the city's Market Square, for example, were improved as a result of student intervention.

Paul Cooke, new business and corporate social responsibility (CSR) director at Higgins Construction, goes so far as to say that the biggest single driver of urban regeneration is CSR.

He says: "Local authorities are looking at developers to demonstrate the benefits they are giving to the community as a whole. Whether it is a scheme worth £14 million or a flagship redevelopment worth £64 million, we consider the opinions of the communities in which we work and actively encourage choice from tenants, residents' associations and key stakeholders who have a better understanding of their local environment."

Central to most urban regeneration projects are brownfield sites that deliver mixed tenure housing, providing affordable dwellings through starter homes, homes for rent, shared ownership and private sale. The aim is to create balanced communities that are enhanced both physically and economically.

"Within regeneration schemes there is great emphasis on improving existing stock by introducing new private-sale homes which can be sold on to fund the improvements," says Mr Cooke. "Councils have large housing stocks, particularly in London boroughs, many of which are in need of improvement. For example, Kings Crescent in the London Borough of Hackney is the only council and resident-led regeneration estate in London to combine refurbishment of existing council blocks with construction of new homes for social rent, shared ownership and private sale." The processes of regeneration are also changing. Developers are spending more time carrying out resident engagement programmes, and being involved in planning and learning lessons from one phase to the next. The industry has moved on from one-off big projects to continuous improvement of local areas, with long-scale phasing in of projects and more schemes that are multi-phased. It is not uncommon now for those involved in the project to be



The rise and development of Business Improvement Districts (BIDs) in the UK over the last decade have transformed the way that construction projects and urban regeneration more broadly are approached. The BID model, which directly involves the local business community in both the funding and planning of regeneration projects, has allowed a more holistic approach to place-making, one that is more responsive to the needs of the broader community.

Ms Duston adds: "Place-making is key to 21st-century construction, delivering usable and special spaces that can be used by as many people as possible. Critical to this have been developments that make great use of the public realm that surrounds and joins buildings. This space is the lifeblood of cities, and will come under more and more scrutiny as construction in London continues."

In meeting the people and community-focused demands of modern urban regeneration, the construction industry faces many challenges, including restrictions on materials through supply chain and skill shortages.

**“**It's not rocket science – if you create somewhere people want to live and work, then that will attract and sustain prosperity in the area**”**

Other key issues to be addressed include urban air quality and consumption of natural resources by urban environments. George Adams, UK engineering director of SPIE and chairman of the Construction Industry Council Green Construction Panel, says: "Globally, we currently consume about 50 per cent more resources than the Earth can replenish and cities on average take about 75 per cent of these resources. Like any urban-based economy, we are on a journey to move towards a sustainable, environmentally friendly, yet economically balanced future."

"The big areas we must now address are the recycling of existing buildings to keep them useful and extend their life as much as possible, along with improvements in health and wellbeing associated with living and working in buildings, especially now that over 80 per cent of the population live in urban areas. For the future we need developers, funders, designers and planners to collaborate, and see the UK as an opportunity for integration and overall sustainability."

Delivering great places and buildings is not easy, and it can involve great risks. There are many constraints that can prevent the characteristics people and businesses value being embodied into developments, but the public is hungry for better places.

Research commissioned by law firm Trowers & Hamlin reveals that when people are looking to own or rent a home, their priorities beyond pure affordability are an area's reputation, security and good design. Partner and head of residential real estate Sara Bailey says: "A recent roundtable debate with leading real estate professionals also showed great support for measures or guides that would help them to create developments that are financially and socially prosperous. The consequence of failing to consider a true measure of value in real estate developments is we will not be creating places that encourage long-term economic prosperity."

"It's not rocket science – if you create somewhere people want to live and work, then that will attract and sustain prosperity in the area. Local authorities have the land that developers need. We need to reach an accord on the kind of places we are creating for future generations, while generating long-lasting financial benefit for the council and the private sector. What's important is to align end-goals and get the development process right from the outset."

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### CASE STUDY: SALFORD CENTRAL



Salford Central in Greater Manchester is undergoing a major regeneration programme that will revive more than 50 acres of Salford's civic and historic

centre, creating around 11,000 new jobs, 220,000sqm of commercial space, close to 1,000 new homes and 400 hotel rooms.

It is being delivered by ECF, a joint venture between Muse Developments, Legal & General, and the Homes and Communities Agency, in partnership with Salford City Council. The main driver for the redevelopment has been the need to reverse decades of decline within what was Salford's historic civic core.

"The relocation of Salford's civic functions and slum clearance programmes in the 1960s and 1970s triggered a downward spiral of business closure and de-population leaving a trail of derelict and burnt-out buildings,"

says ECF development director Phil Mayall. "At exactly the same time, the immediately adjacent Manchester city centre was enjoying an urban renaissance of exponential population and economic growth. By tackling a large area and using a cross-subsidy mechanism, by which more valuable developments support unviable schemes, a step-change has occurred."

The Salford Central regeneration programme is one of the UK's largest, with the greatest mix of uses involved. Input from those living and working in the area and those running businesses has been central to delivery of the scheme, the success of which is demonstrated by the fact that a

50-acre, transformational planning application had only four objections by the time it reached committee.

It is anticipated that it will take a further ten years to complete the scheme, after which the whole area will have been transformed. The key to delivering a project of this nature, says Mr Mayall, is detail and scale.

"Don't neglect the smallest of details, litter, graffiti, overrun landscaping and so on, but deliver on a scale that is truly transformational and ensures that all investors, including existing residents and businesses, buy in to the change with confidence that it will continue for the long term," he says.



Jason Rowley

## THE IMPORTANCE OF CONSTRUCTION

UK construction is a £125 billion industry contributing almost 10% of GDP. It employs over 3.1 million people, about 1 in 10 of the working population, and generates almost £3 for every £1 invested, driving growth and economic success.

Construction's impact is wider than the economy: it is essential to the function of everyday life. It enables manufacturers to produce and deliver their products, schools and universities to teach and hospitals to operate and provides offices to work in and homes which put a roof over people's heads.

Quite simply, construction is what everything else relies on.

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# How we are rethinking the way we build

The construction industry is going through a period of radical change, experiencing disruptive innovation through modernisation and technological evolution. Here are eight innovations changing the way the industry works

## TOP 8 INNOVATIONS

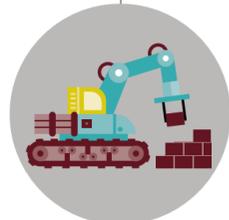
FELICIA JACKSON

### 01 BUILDING INFORMATION MODELLING

Take-up of Building Information Modelling (BIM) is accelerating. As Kim van Rooyen, director of global construction consultancy Turner & Townsend, says: "It isn't just a new technology – it's a whole new way of working. It has yet to be adopted everywhere, but

within a decade it will be as integral to the construction industry as computer-aided design is now." What makes BIM different is the way in which it enables every person involved in both design and construction to share detailed, 3D data models of every aspect of a project. It provides a way for architects, surveyors, engi-

neers and contractors to collaborate more efficiently and avoid costly mistakes – and allows a building's owner to make the right decisions before, during and after construction. The UK construction industry has been an early adopter and from April 2016 it will be compulsory in all public sector construction projects.



### 02 ROBOTS

No longer thought of as merely a gimmick or ridiculously expensive, robots are being used to plug the skills gap, drive down costs and speed up projects. According to a recent report by Bank of America Merrill Lynch, the total global market for robots and artificial

intelligence is set to reach £99 billion by 2020, and construction is going to be a key sector for this technology. To date, use of automation on construction sites has been limited, used to support basic labour or demolition. IFS global industry director, project-based industries, Kenny Ingram says: "A wealth of exciting new possibilities

are coming to the forefront, my favourite being an Australian-designed machine called Hadrian, which can reportedly build a house made of 15,000 bricks in about two days. Going forward, the clear cost-saving accuracy, and health and safety benefits created by robotics will be hard for construction firms to ignore."

### 03 VISUALISATION AND VIRTUAL REALITY

Construction is an industry where trial and error is an unacceptable approach. The first version, whether of a bridge or a building, has to be safe and functional from the get-go. It must remain so during its life cycle no matter the natural disasters or extreme human ac-

tions it may experience. Thierry Marchal, director at ANSYS, says: "Modelling inside a computer, in a virtual environment, is the only option. This becomes incredibly disruptive when it gives architects, designers and engineers the freedom to experiment with some truly staggering ideas, leading to the kind of buildings that

look like gigantic pieces of art." In the development of the new Florence train station roof, for example, virtual patterning provided analysis of the roof's performance under different rainfall and drainage situations, the erosion patterns of its many glass surfaces, and the effects of falling rainwater on pedestrian safety.



### 04 INTERNET OF THINGS

The growing network of the internet of things (IoT) and the resulting availability of data are being used to monitor and measure the performance of assets over a life cycle. As Dominic Thasarathar, strategist for the construction, energy and natural resources industries at

Autodesk, says: "Not only does this allow for predictive maintenance and repairs on structures to avoid potential hazards, but construction companies can also learn from the data and adapt future designs which can help save money." Johannes Petrowsch, partner account manager at industrial automation software expert COPA-DATA, adds:

"The IoT is expected to ease us gently into the world of the smart city. Street lights that can automatically adjust to environmental conditions and traffic levels, or water distribution systems that can identify leaks instantaneously and shut off pipes automatically are only a few of the marvels we can expect to see more of in our cities."

### 05 LOCKABLE COMPOSITE ROAD PLATES

Construction is about a lot more than buildings as wider infrastructure needs to be developed and maintained. MCL Group's lockable composite road plates could lead to a 30 per cent improvement in repair time. They allow trenches dug during road-

works to be safely covered very quickly, reopened to traffic overnight, at weekends or when work cannot be carried out instead of coning the area off. The simple interlocking composite plate system, which uses a patented locking mechanism to fasten, can be installed in minutes. According to UK government statistics,

traffic hold-ups caused by road closures cost the UK economy £4.3 billion in 2013. Given the Department of Transport's plans to fine utilities companies and councils up to £5,000 a day for leaving roadworks unmanned at evenings and weekends, this could make a massive difference to their ability to maintain the system.



### 06 AEROGEL

New materials are making fundamental inroads to the structure of our buildings, changing our expectations of what needs to be managed. Aerogel is a synthetic porous ultralight material derived from a gel, in which the liquid component of the gel has

been replaced with a gas. Aerogel can withstand very high temperatures, delivering 39 times more insulation than fibreglass. Aerogels are fantastic insulators because they limit two of the three methods of heat transfer – convection, conduction and radiation. Historically, it has been used for insulation in spacecraft

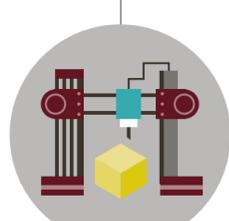
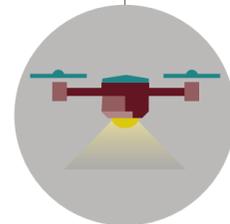
and spacesuits, and in building studs to manage heat transfer. Now Origin Windows, which has exclusivity with Aerogel, is to supply it in conjunction with its windows, providing major energy savings for the life of the home – in fact a single 10mm thickness of Aerogel increases insulation by up to 67 per cent.

### 07 DRONES

Increasingly, drones provide crucial surveying information, monitor project progress against more detailed digital designs and help create 3D models. In hard-to-reach places, such as the underside of a bridge, instead of paying expensive engineers to access the asset safely,

relatively inexpensive drones can be flown down to capture images for inspection immediately – often costing up to three times less than managing that process manually. Ariel inspection is another area in which drones are making their mark for surveying, site management and logistical planning. Kenny Ingram at IFS says: "Crossrail

is a great example of a company currently using drones as part of its Innovate18 project, which is focused on bringing in innovative processes and technology across its operations. Drones are in regular use across many of its sites and used for activities such as crane, tower and scaffolding inspections or site planning."



### 08 3D PRINTING AND DIGITAL OFF-SITE MANUFACTURING

Laser scanning and 3D printing are technologies that prove truly disruptive, where digital designs are broken down into components which are then manufactured by robots and 3D printers. The aim is to speed up processes and increase productivity and efficiency within

projects, while reducing manufacturing and labour costs. The possibilities of 3D printing for architecture are endless. Allowing architects and engineers to construct solid objects from digital models generates a huge potential cost-saving, allowing low-income homes to be quickly erected at scale and helping governments quickly address housing shortages or

provide temporary homes for refugees, for example. It reduces time, waste and cost, and can be used for anything from printing out components for a modular build or to print out a whole building. Combining it with BIM could prove transformative as much of the information necessary to create the end product will exist as a result of the design process.

# Adapting buildings to the changing weather

Ingenious solutions to the impact on buildings of climate change are redesigning the landscape – and changing the way we live and work

**CLIMATE RESILIENCE**  
ELISABETH BRAW

Rotterdam, the medieval Dutch delta city, has always been exposed to the whims of nature. But climate change has exacerbated the predicament of the city, which is already adjusting to rising sea levels and sudden downpours by building water plazas and underground parking garages that can be turned into water reservoirs.

And Rotterdam's architects are making sure that homes will remain standing when the next flood hits. Aqua Dock, an experimental project in the city's harbour, features floating buildings. "The biggest challenge in building on water is that you have to address the dynamic of the water," explains Jaap Peters, the city's lead engineer on the project. "When it's stormy and windy, you have a problem with waves. There's more movement in a floating house than in a skyscraper during a storm."

Knowing that residents won't want to get seasick, Mr Peters and his colleagues are working on ways for stabilising the homes and plan to have stable, comfortable buildings in place within the next two years. The City of Rotterdam, the Port of Rotterdam Authority and Rotterdam University are jointly managing Aqua Dock, which will also feature experimental energy generation as buildings submerged in water can tap into the regular grid. And Aqua Dock is just the first step as Rotterdam's goal is to build a floating city.

Its larger cousin Amsterdam has similar plans. Its IJburg neighbourhood already features several dozen floating homes, which will be joined by many more to form floating neighbourhoods, with jetties replacing walkways. That, to be sure, is prescient thinking, given that half of the Netherlands' territory is situated one metre or less above sea level.

While most cities don't have to worry about becoming completely submerged in water, the Dutch efforts are being studied closely by city planners, architects and construction professionals elsewhere. That's because the changing climate is making the ways we have built our living and working spaces insufficient. Buildings will have to withstand larger temperature shifts, more severe weather, more exposure to floods.

"The built environment has a long lifespan, many decades, so buildings that are being built and renovated now will have to withstand larger effects of climate change," says Esben Alslund-Lanthen, an analyst at Sustainia, a Copenhagen sustainability think-tank. "Architects and engineers are having to take into account not just hotter and colder temperatures, but heavier downpours, rising sea level and increasing examples of the urban heat island effect." Winds are also expected to become stronger as climate change continues.

Indeed, architects and builders elsewhere are trying out their own pioneering solutions. In Masdar City, the United Arab Emirates' model sustainable city, engineers have created a chimney-like vacuum that sucks out the hot air in homes and offices.

The American architect Ted Givens has designed a high-tech tornado-proof home. When a tornado or superstorm approaches, sensors activate the house's hydraulic arms and lower it into the ground. The roof and windows, meanwhile, are automatically sealed. "The goal of the project is to shift the way people look at natural disasters and too ultimately



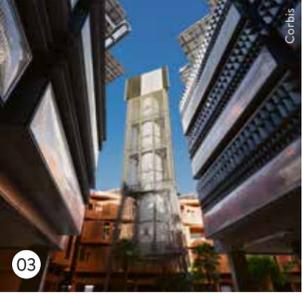
01

Waterwoningen George Kleinmetz



02

Christian Mlynck



03

Corbis

**01** Floating Houses project in the IJburg neighbourhood of Amsterdam

**02** Rundhaus, designed by architect and engineer Christian Mlynck

**03** Wind tower in Masdar City, Abu Dhabi, designed to bring cooling breezes down to ground level

design entire towns around the concept of disaster resistance," says Mr Givens.

Mr Alslund-Lanthen adds: "Cities are pushing for innovation. They're more exposed to climate change and their decision-making process is more nimble than that of federal governments."

Climate-resilience measures don't have to be as radical as the Dutch floating buildings, however. In fact, in order to be scalable, they need to be more modest. Stilts, in particular, are becoming a commonplace response to climate change. The flood-prone Swedish town of Kristianstad has put its new nature museum stands on stilts. In Cambodia, several new schools financed by the German government now also sit on stilts, elevating the buildings above the highest-measured water level.

A Thai school damaged by an earthquake has been replaced by an elegant one on stilts. And buildings in the new HafenCity neighbourhood in Hamburg, located at the German city's former docks, sit on pilings that elevate

them eight to nine metres above the ground.

Radley Horton, a climate scientist at New York's Columbia University, says: "There is also a trend towards passive survivability, whereby buildings can stay cool longer, should the power fail during a heat wave. Some measures may be as simple as ensuring that windows can be opened in the event of a power failure." Indeed, passive houses, which consume close to zero energy thanks to their sturdy frame, are now becoming a common sight in cities. This month, the world's largest passive house, a building featuring 370 apartments, was inaugurated in Heidelberg, Germany.

There's also a more basic strategy of rearranging building interiors. "Because many cities will be exposed to more frequent and extreme flooding, buildings are increasingly being designed to accommodate occasional flooding, with critical building equipment being sited on higher floors," says Dr Horton.

In countless cities, buildings now feature green roofs and walls where trees and bushes absorb heat and CO<sub>2</sub>. And in New York roofs on several buildings have been painted white. This inexpensive touch helps a building reflect 90 per cent of sunlight that hits it, thereby slashing the so-called heat island effect.

Rotterdam also boasts a city-funded climate-resilience retrofit project, where existing buildings are renovated to withstand a harsher climate without ending up looking like bunkers. "The largest challenge the construction world has today is how to deal with existing buildings," says an architect behind the city's Biobased Retrofit homes.

"We try to use as much recycled materials as possible and if that's not possible we use bio-based materials. But that's quite expensive." Bio-based materials include algae and organic agricultural residues.

That's the dilemma. While the Biobased Retrofit homes, featuring new a new outside layer that better insulates them from downpours and extreme temperatures, are strikingly elegant, even retrofits can be very costly.

"There are several potential obstacles to upscaling resilience from the building to the city scale," notes Dr Horton. "City building codes and the law can either hinder or support resiliency measures. It may also be more challenging to retrofit existing building stock, than to design with a *tabula rasa* [blank slate]."

As the New York City Department of Planning points out in its residential retrofit programme, launched following Superstorm Sandy, which flooded New York homes and businesses four years ago, retrofitting small masonry-based buildings, situated close

together as they often are in major Western cities, is difficult.

"The construction industry is reacting rather than changing or developing new strategies to deal with extreme climate and its role in exacerbating climate change," says David Cole, director of Building Trust International, which is focused on construction in the developing world. "There has been a lot of talk about reducing embodied energy in material selection and about zero-carbon buildings [passive houses]. Here we have seen insulation technologies that are commonplace in extreme cold regions of Japan or the US become part of designs for housing in the UK, but they remain a rarity and are really only being taken on by eco-conscious self-builders."

But growing awareness of the irreversible nature of climate change has also spawned some highly creative solutions that are neither expensive nor time consuming. They just require some mental adjustment.

In the German state of Saxony, architect and engineer Christian Mlynck has designed and built a round house that sits on a concrete foundation. The lower floor features a laundry room and a storage room that won't sustain much damage if flooded, while the living quarters are upstairs, divided like cake slices.

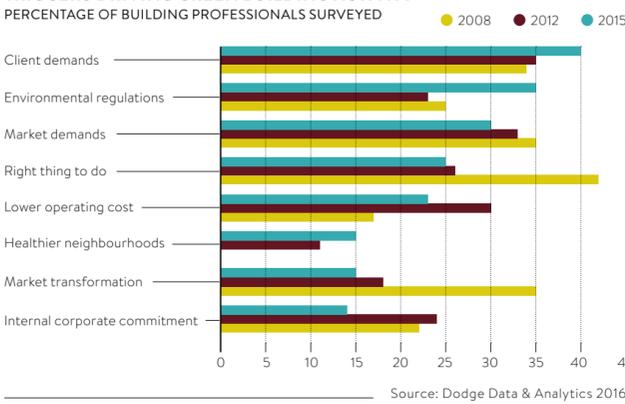
Thanks to the house's round shape, both wind and water largely pass it by rather than hitting it with full force. The sloping roof protrudes a couple of feet beyond the building, allowing it to act as a parasol during the summer, thus keeping the house cool and eliminating the need for air conditioning. It took Mr Mlynck only three months to build the house.

As far as Rotterdam engineer Mr Peters is concerned, climate-resilient architecture and construction are not that hard – it's just a matter of living with the elements rather than trying to shut them out.

Meanwhile, the lowly mushroom has resurfaced as a natural and, crucially, dependable, insulation material. Thanks to its fast growth, dense texture and ability to adjust to any shape, the mushroom can be used not just for packaging, but to build entire houses as well. Aided by mushrooms, in future we might grow our homes.

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## TRIGGERS DRIVING GREEN BUILDING ACTIVITY



# THE WAR FOR TALENT: GET INTO CONSTRUCTION

With the UK construction industry flourishing, there is growing competition for the best recruits



Ignore the official statistics that suggest construction activity in this country is slowing down – the industry is booming. Not only is this the message coming from Build UK members, who include the leading main and specialist contractors, but the trade figures prove it.

The latest report published by Build UK, in partnership with industry analysts Glenigan, confirms that 50 per cent of companies are operating at almost full capacity and see no signs of that slowing down. The biggest challenge today is recruiting the next generation of construction workers.

A powerhouse within the UK economy, the construction sector employs up to 10 per cent of the working population and will

need 46,000 new workers each year for the next five years. In the war for talent, every employer, whatever their business, obviously wants to recruit and retain good people. The beauty of construction is the rich mix of opportunities on offer, spanning more than 150 different professions with tens of thousands of apprenticeship places available.

It is not just traditional building skills that are in demand. Every company requires a back-office support network and front-of-house sales teams, offering huge flexibility to work full or part-time and the option of a warm office environment if the fresh air of a construction site holds no appeal. Operating in today's digital world calls for cutting-edge technical skills, both

to design and develop our built environment, but also to install and maintain it to the very latest standards.

As a result, everyone, whatever they are good at, can have both a job and a career for life.

As an industry, construction creates the built environment in which we all work, rest and play. Every day, it builds communities, growing the transport infrastructure and smart communications network, as well as delivering essential services, such as water and energy supplies.

Being part of a successful team is rewarding and having something to show for your day at work represents one of the big attractions of construction, says Build UK chief executive Suzannah Nichol.

"Not everyone can walk down the street and say 'I built that!' It's a fantastic feeling and I speak from experience," she says. "Joining the industry as a young engineer, I had no idea just how exciting life could be. My first job involved monitoring the stability of a beautiful historic façade in the heart of Westminster, while we demolished every other part of the building, inspecting complex scaffolding structures, setting out foundations for an enormous crane and drilling through seven concrete floors."

"Sponsored all the way by a contractor providing high-quality training along with a decent pay packet, I subsequently got into health and safety development, and visiting schools as a construction ambassador, then

more recently giving evidence in the House of Commons and discussing apprenticeships with the minister for skills in the shadow of Big Ben. Life in the construction industry is certainly varied."

Construction is a career with no limits. Whether you want to use your executive skills to manage multi-million-pound budgets, deliver the next high-speed railway, build a state-of-the-art football stadium or spend your days restoring heritage properties using the craft skills of a bygone age, there is a job for you.

Employers range from very large multinational companies operating in a high-level corporate environment to smaller and specialist contractors keen to develop their own



© Thomas Graham, Arup

**£125BN**  
industry value

**3.1M**  
people employed

skilled workforce. Recognising the need to hold on to that talent, the industry has its own pension and benefits scheme, with health and safety top of the agenda. With an average salary of more than £44,000, jobs in construction also offer people a realistic chance of settling down in their own home.

The passion and ambition within the industry to make a better world for everyone means construction is a great place to work, Ms Nichol concludes. "Anyone seeking a future career, a challenge or a change of direction is missing a trick if they don't take a look at what the construction industry has to offer. A can-do attitude along with a willingness to learn and a desire to do your best are the core skills required," she says.

"If nothing else, my career in the industry has taught me one thing: whatever you are into, get into construction – you won't regret it."

To get a taste for more go to <http://builduk.org/get-into-construction/> and during Open Doors Week, June 13-18, 2016, you can visit a live construction project run by a Build UK member; visit [www.opendoors.construction](http://www.opendoors.construction)

## CASE STUDY: BIOPHILIC DESIGN



The ubiquitous partitions that divide open-plan offices are rarely environmentally friendly, consuming energy during the manufacturing process, and are often unloved by office staff. But what if there was a way to make offices more attractive and healthier, while at the same time addressing climate change and even making workers happier?

There is. It's called the old-fashioned plant. Strictly speaking, it's called biophilic design. Stephen R. Kellert, an emeritus professor at Yale University and a pioneer in the field, characterises biophilic design as "an innovative way of designing the places where we live, work and learn".

He says: "We need nature in a deep and fundamental fashion, but we have often designed our cities and suburbs in ways that both degrade the environment and alienate us from nature."

Translated to the office environment, that means replacing the synthetic-material partitions with leafy plants and bushes. According to research by Dr Uwe Röther, of the Erfurt University of Applied Sciences in Germany, the low-tech solution increases employee productivity by 39.6 per cent and can increase worker satisfaction by 40.7 per cent – and lowers the energy bill along with CO<sub>2</sub> emissions.

Not surprisingly, a growing number of companies now offer biophilic design. Germany's Art Aqua, for example, sells greenery-covered partition walls, hedges and green walls suitable for interior use, moss arrangements and indoor water falls. As the company points out, the plants not only clean the air, but also help regulate the temperature and keep the air moist. They absorb dust.

Another benefit of plants is there are species conditioned to every environment. With temperatures growing more extreme, office plants will become increasingly useful. And in a rapidly urbanising world, city dwellers will enjoy their rare interaction with nature.

The sticking point is, of course, the cost. Though Art Aqua doesn't list its prices, its green walls can never beat the £100 or so that suppliers charge for a synthetic partition wall. Then again, the synthetic partition doesn't make the people around it happy, doesn't cleanse the air, doesn't humidify the room and doesn't contribute to climate change adaptation. As Google and the many companies that now employ biophilic design have discovered, going green indoors offers lasting benefits.

# Merging of the physical and virtual worlds

Digital technologies, including virtual reality, are revolutionising the way buildings are conceived, constructed and maintained

## DIGITAL EMMA CRATES

It's like the moment when people switched from fax to e-mail or from buying CDs to downloading music," says Andrew Pryke, managing director of BAM Design. "Construction is going through a step-change, but it's also a leap of faith. Companies will have to adapt or go out of business."

The sector is changing fast. Advancements in virtual reality, digital fabrication and the internet of things will continue to be major disruptors. But Mr Pryke is also referring to the impact of mobile devices on the way we live. Technology is driving behavioural change across populations. This has profound implications for the future design of buildings and cities, and the companies that build them.

"Our physical world is increasingly merging with the virtual world. How we, as human beings, understand and facilitate that is where the excitement lies," says Atkins director Anne Kemp.

Building Information Modelling (BIM) is providing an important platform for this built environment revolution. For every physical structure, a digital twin is created. When this virtual model intersects with other disciplines, such as data analytics, new possibilities for innovation proliferate. Thanks to the plunging price of technology in the form of low-cost sensors and affordable mobile devices, the pace of innovation is accelerating.

The effects are being felt as much on-site as in the office. Over the past six years, Bechtel has been collaborating with Silicon Valley developers to create more than 50

tablet-based apps. One example is an app that interacts with sensors embedded in wet concrete, providing accurate readings of the concrete cure rate.

"This reduces waiting around for workers and maximises our build time," says Stephen Smith, operations lead for Bechtel's virtual project delivery team.

The company is even trialling the use of sensors on workers and equipment to monitor productivity via its BIM model.

"We're tracking the movements of workers in real time, and then using analytics and big data to get an in-depth understanding of productivity rates," says Mr Smith, adding reassuringly: "But we're following the movements of the crowd, not individuals."

Until recently, industry conversation about digital construction has tended to focus on the benefits for project teams. But as construction typically accounts for just 10 per cent of whole-life cost, clients are now eyeing a greater prize – the value that an accurate data-rich BIM model can bring to an asset throughout its operation.

"Our facilities maintenance (FM) teams have been working from advanced BIM models on five buildings in Camden. Over the last two years, they've demonstrated a 50 per cent saving in call-out costs," says Mr Pryke.

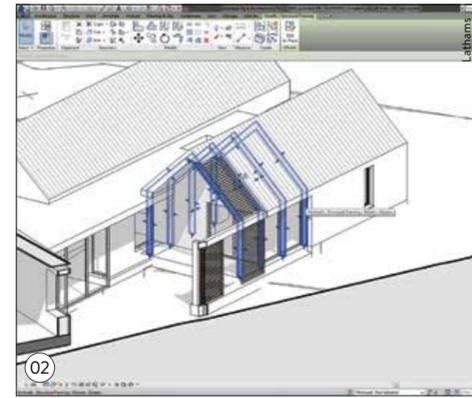
This is simply down to engineers accessing information before they visit a site. Instead of looking at paper drawings, or trying to remove panels or ceiling tiles to locate elements, they tap into a 3D model via a tablet. Stripping back virtual building layers, the engineers pinpoint precisely where objects, such as ventilation units, are located. Information on the service history and spare parts can be instantly downloaded.

Information on the service history and spare parts can be instantly downloaded.

“From the rise of steam, which led to railways, or electricity which brought the elevator and skyscrapers, technology has always changed the way cities work



01



02

01 Bechtel use apps that interact with sensors in wet concrete to provide readings of concrete cure rate

02 Architects firms such as Lathams use BIM to co-ordinate with engineers on a building design in a virtual environment

The strategy is enabling BAM Design's FM team to shave up to 30 minutes from every call-out. But this is just the beginning for Mr Pryke. He predicts that FM teams could soon be using 3D printers to download and print spare parts from BIM models on demand.

So, what happens when you scale up an advanced BIM model to cover a wider area? You have the beginnings of a smart city, according to Mr Pryke.

BAM Design is in the process of creating a digital model for a commercial district in London that encompasses fifty buildings and ten public spaces. The area contains a mix of old and new developments. Older structures are being gradually retrofitted with BIM through techniques such as laser scanning.

Mr Pryke believes that the model will bring benefits both to landlords and visitors. At client level, it provides a holistic overview of the property portfolio. The performance of buildings can be benchmarked and compared, leading to more sophisticated maintenance strategies.

He adds that analysing data from mobiles and sensors in the context of the digital model can also help a client reach a deeper understanding of the area's social and economic success. Property owners can investigate how visitors move through the streets,

tracking footfall and identifying obstructions to free movement.

Ultimately, Mr Pryke hopes that a simplified version of the BIM model could be accessible to the general public via a mobile app. This could guide visitors through the area, picking up alerts and suggestions from nearby shops and facilities via Bluetooth low-energy beacons. It could, he argues, be a powerful means of helping businesses connect with consumers and landlords strengthen their relationship with tenants.

Although light years away from a contractor's traditional activities, this illustrates how technology is helping the industry become less project centric and more outward looking, shifting focus to the long-term needs of the client and end-user.

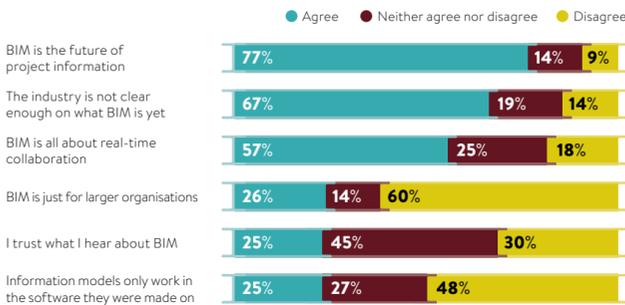
Using technology to help the flow of both people and vehicles around the built environment is also a major focus for Atkins.

"The way we're already using our phones to navigate around streets, the data coming on to our phone is not only informing us, but also influencing and controlling us. As a company we're thinking about what that means now," says Dr Kemp. "But we're not only identifying data that can help people move around their environments, we're also finding out how to do that in an intelligent, informed and safe way to keep people secure."

At a macro level, this involves modelling major transport arteries. Atkins is working on three smart motorway schemes for Highways England, undertaking design activities on the M6, M20 and M23.

Source: NBS 2015

## ATTITUDES TOWARDS BUILDING INFORMATION MODELLING



Source: NBS 2015

## COMMERCIAL FEATURE

# BRIDGING THE GAP TO GROWTH

Ever-increasing amounts of data call for an innovative approach to managing whole-project information

## NEWFORMA

The pressure is on. The UK is seeing unprecedented growth in the construction industry, coupled with an aggressive efficiency drive in the public sector. The 2016 BIM Level 2 mandate and Construction 2025 targets are forcing the pace of change, and the demands of the digital workplace are calling for enhanced connectivity and collaborative working.

As a result, the sector is witnessing an explosion in data and correspondence that, in turn, is exposing a gap between data generated and information of value. It introduces an element of risk that threatens quality and undermines productivity.

The problem lies in the highly fragmented nature of the traditional IT landscape employed to support construction projects, which throws up a whole host of information silos.

Paul Daynes, regional director for the UK and northern Europe at Newforma, explains: "From models and drawings, via contracts and specifications, to minutes and e-mails, you have information scattered across systems and platforms, variously on-premise, in the cloud and on mobile. File formats come in all shapes and sizes, and sharing is seldom easy to achieve with the appropriate levels of access and security. In short, the information is there, but its value is lost."

In response, Newforma has developed a radically different approach to managing whole-project information. Its philosophy is that successful project information management (PIM) must operate simultaneously on three different levels: the individual, for productivity via mobile apps; the project team,

“Successful project information management (PIM) must operate simultaneously on three different levels



for collaboration via the cloud; and the broader enterprise, for overall performance via framework analytics.

Newforma's unique paradigm is its indexing technology, which is non-invasive to company processes and workflows. It indexes information silos to build a more connected environment and optimise processes by which project information is captured, shared and managed.

In terms of the ability of PIM to deliver on its promises, one of the commonest measures of efficiency in a sector where completion deadlines are critical is speed.

On mega-projects where size matters, for example, speed arguably matters more. As the first building projected to reach a height of 1km, the new Jeddah Tower in Saudi Arabia is set to become the world's tallest building. Given its extensive project team, the mass of data, files and documentation is mountainous. Success relies on utilisation of technologies that foster collaboration and teamwork, enable faster decisions, and allow all team members to better realise their highest potential.

For leading global services provider Pinnacle Infotech, the benefits of using Newforma's award-winning Project Centre software on the tower to enable best use of BIM, speed delivery and reduce costs through collaborative efficiency are also proportionately huge. When there

are literally thousands of files to exchange, the advantage of transmittal times slashed by up to 90 per cent becomes cost critical.

Speed can also prove vital in meeting new standards and demonstrating compliance, so securing competitive advantage – as in the case of Newforma helping international architecture and engineering practice BDP become the first company in the UK to achieve BRE certification for BIM Level 2.

Being fast on your feet with agility in PIM can be crucial as well when working to demanding deadlines with changing requirements. For established architecture and building consultancy AHR, investment in Newforma systems that integrated Autodesk and Revit, as well as enabling BIM and features such as iPad apps to support personnel in the field, proved vital in closing-out a high-profile project for Blackpool Council, against the clock and an evolving regulatory backdrop.

"Done well, speed is a function of efficiency through PIM," concludes Mr Daynes. "By employing a lighter touch in a systemic manner, PIM bridges that gap between data and value. That's connectivity."

“From the rise of steam, which led to railways, or electricity which brought the elevator and skyscrapers, technology has always changed the way cities work; we're not thinking coherently enough about that as an industry," he says.

Mr Hill predicts that a range of trends, including face recognition software, driverless cars and mobile payment mechanisms, could lead to radical remodelling of spaces such as transport hubs.

"We could speculate that, over the next ten years, railway stations won't need ticket barriers, because the transaction would happen in a different way. This could transform their interior design, removing pinch-points. The movement of passengers would become much more fluid," he says.

He also predicts that digital design and fabrication tools could empower communities to become more involved with regeneration projects, creating flexible buildings that can be easily adapted according to need.

"All these trends are leading to a lighter, adaptable, fleet-of-foot building industry," Mr Hill concludes. "Digital designers will increasingly have a stewardship role, looking at what's working and what isn't, and constantly refining and adjusting what they do. It's a very different kind of engagement – much more sensitive, subtle and human centred."

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# Suppliers to the UK must be ethical employers

The UK construction industry must ensure its overseas supply chains comply with new legislation clamping down on slave labour in foreign sweatshops

**SUPPLY CHAINS**

JIM McCLELLAND

Sad to say, there is a lot of dirty money in modern slavery. Of the 35.8 million people estimated to be in modern slavery worldwide, some 21 million are thought to be the victims of forced labour operations, with the majority exploited by private-economy enterprises generating illegal profits in the region of \$150 billion a year. Even in 2016, slavery is a worldwide business.

The legislative response from the UK government has seen the introduction in England and Wales of the Modern Slavery Act (MSA), effective from October 2015 and requiring any business with a turnover greater than £36 million to make an annual declaration.

The first key implementation date looms large next week, when businesses with a year-end of March 31, 2016 or later become required to publish a statement prominently on their website within six months, detailing what they have been doing to combat modern slavery during their financial year, officially approved and signed by a director, member or partner.

For the UK construction industry, having the MSA come into law has had something of a galvanising effect on the engine of responsible business, says Dan Firth, sustainable procurement manager at Interserve Support Services and chairman of the Modern Slavery Special Interest Group at the Supply Chain Sustainability School.

"It's early days yet, but the Act has brought a focus to the discussion of supply chain ethics that wasn't there previously. Ethical supply has been high-profile in some supply chains – for example, retail food, clothes and electronics – and what the Act has done is to make it a more general issue."

In an industry described under its broadest definition as being comprised of up to 99.7 per cent of small and medium-sized enterprises, it is by no means just a matter of the £36-million-plus construction club

**MODERN SLAVERY ACT 2015**

Organisations operating in the UK generating annual revenues of £36 million or more will have to prepare a slavery and human trafficking statement each financial year.

This statement should include the following:

- Details of the company's structure, business and supply chains
- The company's own policies on slavery/human trafficking
- Breakdown of exposure to slavery/human trafficking, and steps taken to assess and manage that risk
- The company's effectiveness in ensuring that slavery/human trafficking isn't taking place across its business and supply chains
- How the company trains its staff about slavery/human trafficking

awareness will clearly rise," he says.

Both Mr Nicholson and Mr Firth fear a lack of resources for policing MSA policies will in practice undermine efforts and limit impact, with the low likelihood of businesses being caught for non-compliance inevitably leading to corners being cut.

While positive about MSA in principle, Professor Jacqueline Glass, chairwoman of architecture and sustainable construction at Loughborough University and leader of the Action Programme for Responsible Sourcing also has real concerns about what it will take to engage all construction.

"There's definitely been a huge increase in interest in these issues as a direct result of the MSA hitting the boardroom table," she says. "Don't get me wrong, it's a massive help, and will also propel businesses to invest in suitable training, certification and awareness programmes, but sadly I think, until we see a major non-compliance, then some parties just won't prick up their ears – and really, they are the ones I worry about."

Other prime supply chain sectors under the MSA spotlight, such as food and fashion, have already experienced catastrophic and public supply chain management failures, resulting in damage to reputation and even human tragedy, ranging from the market-cratering horsemeat scandal in Europe to the fatal Rana Plaza textile factory collapse in Bangladesh.

Accordingly, transparency and traceability are fast becoming collaborative-working watchwords for construction in today's market, and the MSA will only serve to shine the spotlight more brightly on labour practices and human rights. With data flooding the public domain, the length and complexity of supply chains will no longer offer any excuse for unethical or irresponsible corporate behaviour. On modern slavery, it's time to act.

coming on board, but their long and complex supply chains, too.

That MSA roll-out is still very much in its infancy, though, explains Ian Nicholson, managing director of ethical-sourcing consultancy Responsible Solutions.

"Last autumn, awareness in the supply chain was scarily low. I haven't yet seen any evidence that smaller companies are comprehensively aware. Most major contractors are still talking internally about how to comply and haven't yet engaged with their supply chain. Once they do,

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ICEhouse, designed by William McDonough + Partners, constructed for one week in Davos in January

# Permanence can still only be temporary

Designing buildings using good quality materials which can later be reused or recycled gives permanence a temporary nature

**REUSABLE MATERIALS**

STEPHEN COUSINS

Reuse, refurbish, remanufacture is a mantra often recited by disciples of the circular economy who seek to transform economic conditions so building materials retain their value for much longer than simply being disposed of as waste.

Designing for long-term value isn't something typically associated with temporary structures, but recent projects have shown the ephemeral approach can work if buildings incorporate easy-to-disassemble components and materials suitable for reuse or remanufacture.

With many existing buildings in the United States and Europe being torn down before they reach their 40th birthday, and China even demolishing high rises still under construction, the dismantle-and-rebuild approach could make economic and environmental sense if projects pursue appropriate models of finance and ownership.

Brummen Town Hall, in the Netherlands, was designed by architecture firm Rau to



The ephemeral approach can work if buildings incorporate easy-to-disassemble components and materials suitable for reuse or remanufacture

have a service life of 20 years, due to concerns over frequently shifting municipality borders. Rather than construct it using cheap materials, which would be likely to end up in landfill, it incorporates a variety of high-quality reusable materials, mostly prefabricated timber components, that will be dismantled and returned to their manufacturers at the end of the building's life.

The building was designed to be leased to the "owner" under a 20-year service contract. The systems were developed in collaboration with manufacturers to enable easy disassem-

ply in a condition that maximises their value after that period. For example, the structural timber posts were designed taller than required, in standard dimensions, to make them easier for the supplier to sell on.

Duncan Baker-Brown, director of BBM Sustainable Design, says: "This leasing model encourages corporate responsibility because the end-user, which may be the building owner, has to think about the life of the building after its end of use. A building that is only going to last for 20 years should be seen as a reserve and a future resource."

A circular economy aims for the cradle-to-cradle cycle of continual materials reuse and recycling to prevent negative effects on the natural environment. The Innovation for the Circular Economy house (ICEhouse), designed by William McDonough + Partners and displayed in Davos, Switzerland, as part of January's World Economic Forum, comprises just four materials that can be remanufactured into new products with no loss in material quality – an aluminium frame, polycarbonate walls and roofing, aerogel for insulation, and Nylon 6 for other elements.

"Remanufacturing should be seen as a priority over recycling, which loses all the value of the material," says Dave Cheshire, regional director of sustainability at consultancy Aecom. "Currently most materials either end up going to landfill or they are downcycled to a lower-value, lower-grade material. Metals are shredded and rarely reused or reclaimed, concrete is crushed to create lower-grade aggregate, and plasterboard, though in theory highly recyclable, is disposed of."

ICEhouse is based on principles developed at the groundbreaking Park 20|20 business park, located near Amsterdam's Schiphol Airport, where every building is being designed for partial or complete disassembly and functions as a "material bank" in which all components will eventually either be reused in another production process or sold on as a raw material.

The material bank concept is being piloted on the Bluewater Energy Services building and managed using Building Information Modelling (BIM) software. All the building's products are broken down into their constituent parts to identify which can be reused, refurbished or remanufactured, and also into their composite materials to identify recyclables such as metals, plastics and glass. Sophisticated software, developed by IBM, analyses the materials and their value over time and when the building is in need of repair or disassembly, they can be repurposed into their next form.

With the UK's built environment accounting for 60 per cent of materials consumption and one third of all waste arising, according to the Waste & Resources Action Programme, projects like these could be key to closing the loop on our own circular economy.

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# The only way is down when you cannot build up

Billionaires are building basements in Kensington and Chelsea, but going underground poses considerable challenges – not just cost

UNDERGROUND  
CELESTINE CHEONG

Grammy artist Jamiroquai's *Deep-er Underground* was apt as a soundtrack to the 90s movie *Godzilla*, in which a monster changes the face of many city buildings to then disappear underground. Roll forward 25 years and we too are going deeper underground.

Terms such as "iceberg homes" and "mega basements" are now commonplace as our interest in exploring and exploiting the realm below the topsoil continues while city designs keep changing.

There are quite a few reasons for wanting to go underground. Space is a blunt answer. In crowded and established cities, such as London, New York or Tokyo, there is not much room left on the surface.

Also there is a practical limit to how high buildings can be built. Less favourable outdoor climates are another factor. In places such as Eastern Europe and Canada winters can become so biting cold that a stable and insulated underground environment offers an attractive reason to want to dig deep.

Equally, in places where there is intensive heat from the sun and high humidity, and in heavily industrialised cities with air-quality issues, burrowing below ground could be a solution. Furthermore, underground frees up the capacity to build laterally, rather than just vertically.

An advocate of the use and planning of underground space is Han Admiraal, chairman of the International Tunnelling and

Underground Space Association's Committee on Underground Space. He believes the next 20 years will require more work than the past 200 years to cope with the challenges humanity is facing on a global scale.

"Underground space has a unique role to play in meeting these challenges. The expansion and resilience of the world's major cities will require planned and sophisticated use of all resources, including the valuable real estate of the underground," says Mr Admiraal.

One such proposal is the Earthscaper in Mexico City – a 75-storey, 300m-deep steel and glass inverted pyramid. Capped by a glass roof, the designs include a museum, retail, offices and residential space for up to 100,000 people.



A simple aim of relieving congestion and opening up surface space for alternative uses comes with a hefty price tag

The Earthscaper concept is the brainchild of local architects BNKR Arquitectura, and was originally devised as an entry for an architecture competition in attempt to increase the space available for living and working in the city's largest public square, which is bordered by the Metropolitan Cathedral, National Palace and Federal District Buildings.

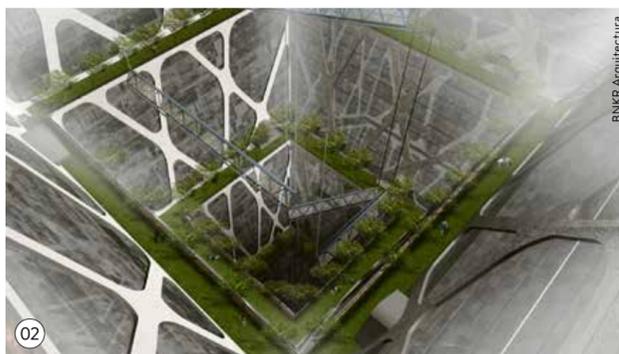
"New infrastructure, office, retail and living space are required in the city, but there are no empty plots available. Federal and local laws prohibit demolishing historic buildings and height regulations limit new structures to eight storeys," says BNKR Arquitectura chief executive Esteban Suarez. "The city's historic centre is in desperate need of a makeover, but we have nowhere to put it – this means the only way to go is down."



01

01 Artist's impression of Lowline in New York, the world's first underground park using solar technology to transform an unused trolley terminal

02 Earthscaper, designed by BNKR Arquitectura, is a proposed 75-storey inverted pyramid underground project in Mexico City



02

BNKR Arquitectura

There is good reason for building below Singapore. According to Singapore's Department of Statistics, a population of 5.53 million people share the island's mere 719 square kilometres of land. This makes it the third most densely populated place on Earth.

The Jurong Rock Caverns beneath Singapore's Jurong Island is South-East Asia's first subterranean oil storage facility. Built by Hyundai Engineering and Construction for JTC for S\$1.7 billion, the underground structure has five huge caverns 100 metres deep and 8 kilometres of tunnels, equivalent to nine storeys, to hoard hydrocarbons such as crude oil, condensate, naphtha and gas oil.

The nine storage galleries inside provide a volume of 1.47 million cubic metres, equivalent to the volume of 580 Olympic-sized swimming pools. This frees up to 60 hectares of usable land, or about 84 football fields, for industrial development above ground.

Drilling down into rock has also given rise to inventions. On the crowded Lower East Side of Manhattan in New York, the

Lowline project uses innovative solar technology to illuminate an historic and disused underground trolley terminal. Natural sunlight is transmitted on to a combination of hexagonal and triangular anodised aluminium panels that form a moveable canopy of lenses and reflectors. Sunlight can be directed where it is needed at any one time to support photosynthesis, enabling plants and trees to grow.

The one-acre project, once complete in 2020, will be the world's first underground park that attempts to add vibrant green space to the city's dense concrete jungle. Its Lowline Lab already has more than 3,000 healthy plants and dozens of unique varieties, including pineapples and other exotic fruit, spread across 1,000 square feet. The lab acts as an interactive science experiment and community backyard to host public programmes, street fairs, art exhibits, school groups, lectures and open science education courses about the botanical research being conducted.

Whether building underground is a one-stop solution to overcrowding remains un-

clear, however. The biggest barrier is cost, which involves the unknown, and this means increased risk. Even in Singapore, where land is at a premium, state developer JTC says the cost of building an underground science park for 4,200 workers would be 50 per cent more than an above-ground facility.

Building underground has also brought a fair share of critique. "When the Pollution Prevention Guidelines 3 were introduced, they effectively imposed a requirement for house builders to increase development densities in order to conserve the most finite of resources – development land," says Stephen Wielebski, senior technical consultant at the Home Builders Federation.

"The resultant increase in high-rise development was not the success many had perceived. Basement construction would fall into this same category given the number of technical issues that have to be overcome."

This means a simple aim of relieving congestion and opening up surface space for alternative uses comes with a hefty price tag. There is also the constant challenge of water ingress and the need to compete for space with other existing necessities, such as sewerage systems, electrical infrastructure, underground railways, subways and tunnels for roads.

"In the UK, the fiscal dynamics may make it an attractive proposition for 'iceberg homes' in London, but elsewhere the cost of construction and market responsiveness could easily see project viability compromised," says Mr Wielebski.

It would be wise to weigh up the cost of any underground venture in respect of social housing and ways of living, but we should not condemn going underground to a world of fantasy just yet. *Godzilla* is safe, for now.

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## CASE STUDY: JEWEL CHANGI AIRPORT



Hailed as the "terminal of the future", Singapore's Jewel Changi Airport development at the heart of Changi International Airport's Terminal One, was "borne out of a desire to increase the terminal's capacity", says spokeswoman Samantha Lee.

Given the practical and safety regulations associated with construction in and around airports, Jewel Changi Airport will feature a ten-storey multicomplex, offering retail, a 130-room hotel, attractions and facilities for airport operations underground. The S\$1.7-billion (£880-million) joint venture by Woh Hup and Obayashi Singapore is expected to open in early-2019.

In the middle of the project's steel and glass donut-shaped structure, the Rain Vortex, a 40-metre water feature, will be logged as the world's tallest indoor waterfall with 500,000 litres of water circulated via a storage tank and pump.

As part of its sustainable design, rainwater will also be allowed to flow through naturally. The downward air currents created by the waterfall will cool the internal environment. Photovoltaic panels will harness natural light into renewable energy, and at night the Rain Vortex will transform into a light and sound show.

Native trees, ferns and shrubs will feature in four different gateway gardens. These will have playgrounds and walking trails. Subway links will connect all the airport terminals and the Mass Rapid Transit train network.

The opening of Jewel Changi Airport in 2019 is expected to increase passenger handling capacity by 35 per cent from 17.7 million in 2013 to 24 million passengers a year. Designed by world-renowned architect Moshe Safdie, it is likely to further cement Changi Airport's status as Skytrax World's Best Airport.

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