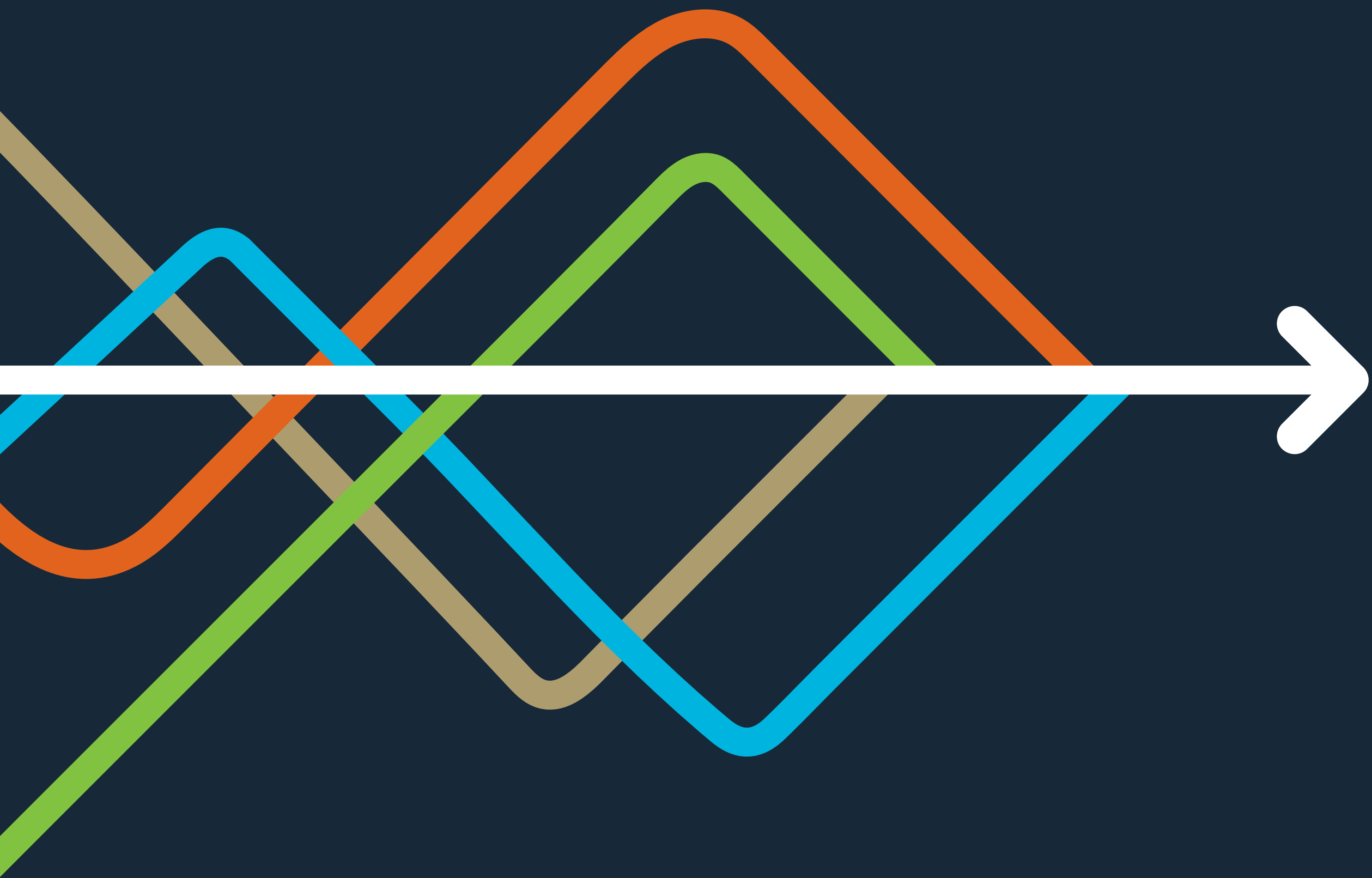
Horizons 2034
Report



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Looking to the future is difficult but pressing

Muyiwa Oki
RIBA President 2023–2025

It is difficult to get the headspace to consider what is ahead of us when our current concerns and energies are all focused on surviving in the present: obtaining and retaining work during an economic downturn and operating amid complex regulatory changes.

However, it is pressing that we do pay attention to what is coming down the tracks at us, so that we can be prepared. Whether it is for environmental challenges, fractured global economic conditions (impacted by climate crisis and geo-political rifts), population changes or technological innovation.

It is not, however, just a matter of being ready. If architects are to reassert their position in the design and construction industry and wider society, we need to assume agency and lead from the front. This is why a priority for me this year is Architecture Without Boundaries. As architects, we are educated to have a complex skillset that should enable us to punch above our weight. When working in practice, those skills and competencies are fully tested.

We have an important contribution to make to communities and wider society, not just as designers of individual buildings but as problem-solvers and thought-leaders.

An important piece of work that sits alongside horizon scanning is the 2024 RIBA Artificial Intelligence Report. Delivering the findings of the recent AI member survey, it reflects on the current and near-term realities of the application of AI in architecture. In the report, I call for a "critical yet optimistic mindset" to what is emerging as one of the most "disruptive tools of our time". When scanning the horizon for 2034 and looking at wider emerging trends, I also urge you to have a similar outlook, paying attention to both risks and opportunities.

Access to the horizons scans on **Architecture.com** is an exclusive member benefit for all chartered and student members; the scans will only become open access four months after publication.

The initiative represents the opportunity for you to engage with big-picture emerging trends and expert voices from across the world. Whether you are on the starting blocks of your career or an experienced professional, I urge you to invest a little bit of time reading the scans, carving out that essential thinking time to engage with the near future.

RIBA Horizons 2034: foresight and action

Adrian Malleson
Head of Economic Research and Analysis, RIBA

RIBA's foresight programme, Horizons 2034, looks ahead to the next decade and invites response.

It employs the established forecasting method of horizon scanning, in which subject matter experts develop 'scans' to identify and analyse emerging social, economic, environmental, and technical shifts, to ascertain what the future might look like.

So, in 16 scans, the programme uncovers the mega-trends shaping our society, the built environment, and the architectural profession, aiming to equip decision-makers with valuable foresight to make informed choices in a rapidly changing world.

The Environmental Challenge

The climate crisis demands radical change. This theme explores how the built environment, responsible for almost half of all global emissions, must recognise its accountability and become an agent of change.

How can architects address this urgent, generation-defining challenge?

The Economics of the Built Environment

Global economic systems and forces drive development. How money is spent directly affects social equality and individual life chances. The built environment is increasingly becoming the embodiment of buildings as financial mechanisms.

How are financial dynamics shaping our surroundings and how can architects respond?

Population Change

Demographic patterns vary widely worldwide. Some regions experience rapid growth, while others face ageing populations and contraction.

How can design professionals respond to urban-scale changes while fostering social cohesion for ethnically diverse and intergenerational communities?

Technological Innovation

The technological tools available to the profession are rapidly increasing in sophistication, scope, and ability. With the rise of AI, the prospect of autonomous tools is becoming real.

How will the role of the architect respond to rapid technological innovation?

View of the horizon west of Georgetown, Guyana. Agricultural housing lines irrigation and drainage canals, dividing plots of land into peculiarly narrow strips – as a wide as a house. Photo: Johnny Miller / Unequal Scenes, 2023

These themes are explored by a range of leading experts in the pages that follow.

To be clear, though, what follows is not the future predicted, nor is it a statement of RIBA policy. Instead, it is an initial exploration of those trends set to shape our future world. But, more than an exploration, the programme is also a call to action. By understanding these trends, we can actively shape our future world.

Already we can see huge changes coming, changes that will radically alter our lives and the environment in which we live them. Not all these changes are benign. While we still have time to act, the collective failure to address carbon emissions is set to be humanity's most expensive mistake at best, and an existential threat at worst.

But there are also huge opportunities: greater social cohesion, reduced inequality, successful urbanisation, increased global prosperity, and a safer, more efficient, construction industry, better meeting society's needs, transformed through technological innovation.

Indeed, there are few, if any, roles or professions in the construction sector better placed to effect change than architects. Following an intense and extensive education and qualification process and ongoing professional development, architecture straddles aesthetics, art, history, society, law, and technology. This breadth and depth of knowledge puts architects in a uniquely strong position to understand and respond to future challenges.

So, architects are not mere bystanders on history's field of play, awaiting the change to come. Instead, they can be, are, and increasingly will be, premier agents of change, literally shaping the built environment to meet the needs of communities, delivering a sustainable future, and securing the profession's place.

While we still have time to act, the collective failure to address carbon emissions is set to be humanity's most expensive mistake at best, and an existential threat at worst.

Reflections on the Themes

Michèle Woodger
Architecture journalist

Michèle Woodger reports on some concluding reflections on RIBA Horizons 2034. Key programme contributors discussed the intersection between the programme themes in a global context - with an eye to future opportunities for architects.

In the words of RIBA Past President Sunand Prasad, the RIBA Horizons 2034 program has yielded "an amazingly rich set of reflections, information and analysis". And yet, as the final instalment of this foresight-gathering exercise demonstrated, many questions remain unanswered, including: "What does it all mean for the built environment and specifically for the practice of architecture?"

The session brought together theme editors Alice Moncaster, Astrid Haas and Phil Bernstein, RIBA Past President Sunand Prasad, plus RIBA's Head of Economic Research Adrian Malleson and David Light of Autodesk to round off the four themes of environment, economics, technology and population. And, as Prasad commented, "the intersection of these themes is where the exciting conversations and opportunities are".

This animated concluding session explored this interconnectedness, highlighting, in Malleson's words, "where we can position ourselves for future success, and how we can shape the future".

Global discrepancy

A point reiterated throughout the discussion was the discrepancy between global north and south. In the north, population growth is predicted to remain almost static to 2050. Across the south, however, populations are increasing rapidly, with that of Africa set to double in that time. The world already reached the 8 billion mark in 2022, but, said Haas, "the poorest 50% of the world owns only 1% of it".

There is also an enormous difference in carbon emissions, with Africa responsible for "a fraction" of Europe's. Importantly, said Moncaster, "across Europe we already have pretty much all the buildings we need, but energy use per capita is very high". To lower these emissions, we should be "radically reducing our embodied carbon by minimising new build…and reducing operational carbon in our existing buildings through appropriate retrofits" she summarised. "If I were setting up a practice in the global north right now I would be focusing on renovation and restoration" agreed Bernstein.

Conversely, in the global south, new build is drastically needed. "Cities, particularly in emerging economies, are going to have to accommodate nearly one billion more people" said Haas, "and that built environment is not yet there – it needs to be constructed – so there is a major opportunity".

Fundamentally, this construction must respect local context for the population to thrive, as Moncaster elaborated: "Africa already suffers from little resilience, poverty and exposure to harsh climates… understanding regional differences [via the lived experiences of communities] is essential for ensuring a just transition."

Growth and cities

"Across history and across the globe, people have been moving to cities in search of opportunity" said Haas. When they function well, cities are able to mitigate the downsides of density and unleash the benefits of productivity and innovation. "But we are not getting it right", she said. Real estate is "financialised", remote ownership facilitated, the poor neglected, and the world left facing a housing crisis.

Bernstein elaborated on the role of the architect in this economic picture. "What we do as architects is convert big piles of money into buildings," he said. "We are at the front end of a very complex chain of global financial structures that are super interested in built assets right now. And we are going to continue to do it … until there is some top-line, policy-level change that affects the flow of capital markets." Moncaster shares this view: "Without a much stronger control or regulation… there won't be anything to push us towards making the right choices".

What's needed is a paradigm shift. Is there space for such a thing? asked Prasad. Could we even begin to measure growth spiritually rather than economically, such as through 'Gross National Happiness'? "GDP growth is not a sufficient condition" agreed Haas. "We may be moving the numbers one way but that that doesn't mean we are distributing the outcomes, in fact we are going further and further away from that". But such shifts take generations, beyond the scope of the ten-year horizon. "How we can distribute the outcomes of GDP growth to benefit the majority…that's where the conversation should go."

But is there nothing we can do to improve the state of our cities meanwhile? In terms of biodiversity, for instance, while increased urbanism is damaging ecosystems via different mechanisms, blue green infrastructure and other urban greening strategies help mitigate loss and build climate resistance. "We need green solutions to be incorporated into building projects as standard [and] avoiding green gentrification", Moncaster said. Indeed, she argued, climate change may well "force a paradigm shift" upon us very soon.

Technology, employment and education

And what of technology? "There is the tendency to think that technological tools are magic and will solve our problems", Bernstein argued. But the future lies not in 'cool new gadgets' but in strategically harnessing technologies, mindful of ethics, equity and risk.

Perhaps the biggest disruptor is AI, which has the potential to revolutionise efficiency, but at devastating environmental cost. Tech generally also risks supplanting jobs, including jeopardising the manual labour that emerging economies currently rely on.

Bernstein, Light and Haas approached this debate from different perspectives. "Roles shift significantly as technology opens up, creating new services and propositions", said Light. "It will need a significant mindset shift, but I do believe [architects] should see these technological solutions as an opportunity".

Haas, on the other hand, reiterated the importance of construction labour for sub-Saharan economies. "The professions that are emerging [from technological change] require a high skill set," she argued. "What I am speaking about is a billion people in 25 years moving to cities looking for jobs …[these new roles] are not going to satisfy … this vast number of people".

But AI may help break down the siloes contributing to our current problems. In the future, speculated Prasad, we will see that "where interdisciplinarity became the dominant theme in how we work, AI was there to help us navigate it with extraordinary processing power and capacity to integrate vastly different fields of knowledge". Collaboration will be key to delivering an equitable future built environment. "Maybe we can't design out poverty," said Moncaster, "[But perhaps we can] use technology to do the grunt work to give us time to think".

"I really believe in the power of education," she continued. "Not just teaching facts that people can regurgitate [but in the] opportunity to come together and discuss things with very different people, and to develop our understanding of what the problems are from a much wider perspective than our own."

Sharing knowledge can indeed help rebalance opportunities. "The number of built environment professionals per capita in sub-Saharan Africa is low, we are having to import our design thinking," Haas said. "Being able to upskill professionals whose lived experience is in the environment they are trying to change, is a first critical step".

Design in perspective

So, "What is the capacity of design?" Prasad asked the panellists to conclude.

"I am split" admits Moncaster. "Architecture as a profession has a certain arrogant sense of itself, that design can provide the solution to problems. However, there is something about an architecture education that … does push people to think more widely and encourage people to look from different perspectives." This outlook surely places architects in a unique position.

"In emerging economies, it is estimated that two thirds of the built environment is yet to be built…In this two thirds there is the need to be creative," said Haas. "Seek to work with communities and individuals from radically different backgrounds. Ask 'Do I value this voice? Do I value this opinion? Why is this opinion different from mine?'" In so doing, opportunities will be unleashed.

"We are coming to a moment now where there are huge collaborative opportunities" urged Bernstein. "Experiment in a collaborative way and see if this thesis about the free-flow of information really has legs".

The Future of Design and Make

Nicolas Mangon
Vice President, AEC Industry Strategy, Autodesk

Through Horizons 2034, RIBA set out to collaborate with experts from across the industry to understand significant global themes on how we build and live in the future.

We see strong synergies with our own path here at Autodesk. We recently released the 2024 edition of our annual State of Design & Make report after interviewing 5,399 industry leaders, futurists, and experts. The report identifies the most pressing issues shaping today's businesses to help leaders make informed, strategic decisions about how to prioritise and invest in the future.

Key themes that emerged were business resilience, the upskilling of talent and sustainability. While cost control has come up as a new challenge, confidence is growing and leaders feel their companies are more resilient. The data also show increased trust and optimism in AI and digital transformation, especially as the industries that create buildings and infrastructure are aiming to become more efficient and cost-effective.

In fact, the next 25 years will see a breathtaking pace of technological change. According to the report, firms are preparing by adopting digital solutions at a faster pace than ever before. For example, 27% of those surveyed increased their investment in technology to deliver improved project outcomes over the past three years.

But limiting factors remain. 35% of respondents stated that cost was a barrier to digital transformation and felt that the time needed to invest in new tools and ways of working was holding them back.

The industry needs a better way of working that simplifies adoption and workflows, saving time and money. While Building Information Modelling revolutionised AECO (architecture, engineering, construction and operations) practices by allowing organisations to centre their workflows with a model-based approach, BIM technologies have historically been limited in their ability to enable trusted collaboration and connectivity across project phases and stakeholders. In large part this is because data have been locked in proprietary files, hindering transparency, data-sharing, and interoperability in ways that create additional value.

Today's BIM environment is hampered by fragmented technological processes, with the average AECO professional toggling between at least four design software applications daily. These technologies are often complex, overburdening users with details and offering little in the way of automation or decision support. They are also frequently incompatible, forcing AECO organisations to rely on document-based collaboration. Rather than working from a shared data repository, engineers, designers, and other stakeholders resort to emailing documents back and forth, limiting the ability of teams to merge their best ideas and work together in real time.

The shift towards open, integrated cloud platforms and the adoption of granular data for efficient and precise information exchange represent fundamental changes in the industry's operational model, facilitating the advanced utilization of AI and enhancing collaboration, productivity, and sustainability in the AECO industry. Photo: Zoonar GmbH / Alamy Stock Photo

To overcome these limitations, the industry's technology providers are **embracing interoperability** through open, integrated cloud platforms. The **Autodesk Construction Cloud** also supports open standards and APIs, which are an important path to a future where a fluent exchange of information brings about the next generation of BIM.

But that future also depends on how that information is structured. Exchanging big files isn't the best way: the goal is to break these exchanges into more precise elements. An IFC file contains tens of thousands, if not hundreds of thousands, of components. The currency is shifting from these large discrete files to more granular data. If an architect sends an 850 MB file to an engineer, it often contains superfluous information that isn't relevant to the engineer's scope of work. Sharing granular data means contributors can send a set of curated information or make updates to specific parts of a design.

Software technology called data models enable common data environments to parse granular data. For example, Autodesk Construction Cloud's common data environment, **Autodesk Docs**, uses an AEC data model to differentiate between design elements without the need for additional parsing of metadata.

What can granular data do? The possibilities are almost endless. Granular data on a platform enables simplified workflows. It will enable frictionless connectivity; secure access at any time, from anywhere; real-time and on-demand project insights; better, informed decision-making; and effortless collaboration. It's already enabling a vibrant third-party ecosystem of apps and services, as well as powerful generative co-creation using AI.

Productivity gains are a promising effect of AI, and business leaders are pushing their teams to pilot use cases in hopes of converting opportunities early. One benefit of this urgency is improved sustainability. AI has risen to the top spot of technologies that leaders are using to make their businesses better equipped to meet the challenges posed by climate change, population growth and economics.

Combining human intuition and expertise with AI's computational capabilities allows us to expand the realm of possibilities and can bring us closer to better informed and more creative solutions. For example, AI-platforms such as Autodesk Forma enable architects today to integrate AI capabilities in their design process, simplifying everything from exploration of design concepts to evaluating environmental qualities surrounding a building site. And this is just the beginning.

It is clear that the AECO industry is ready for a better, faster, more decisive way of working, one that harnesses the power of AI to automate repetitive tasks, augment human design, and analyse data to uncover critical insights to make businesses and the built environment more resilient for the future. As the RIBA Horizons 2034 programme looks ten years into the future, it's clear that we face a great deal of change and uncertainty. The world needs human ingenuity more than ever – and it needs the data to do it.

At Autodesk, we believe that technology will always be one of society's most powerful catalysts for progress, and that progress requires collaboration and partnership. So, let's change how the world gets designed and made, together.

The Environmental Challenge

Introduction

Alice Moncaster is Professor of Sustainable Construction at the University of the West of England, following academic posts at the Open University and the University of Cambridge, and degrees from Cambridge (BA and MA), Bristol (MSc) and UEA (PhD).

She seeks through her research and writing to challenge the status quo in the construction sector, thereby achieving a radical transition towards environmental sustainability and resilience to climate change.

She works with national and international partners across disciplines and retains a close link with practitioners and industry.

The only possible answer to the climate crisis is to recognise our global responsibility, even as the political mood swings towards nationalisation.

Radical change is needed to meet the urgency of the climate crisis. The scans in this theme will explore how the built environment is accountable for almost half of all global emissions and how the design and construction industry has a pressing need to recognise its responsibility.

The environmental challenge facing us is both vast and urgent. Use of energy and materials is increasing globally, greenhouse gas emissions are going up rather than down, the devastating impacts of climate change are already being suffered from sub-Saharan Africa to the poles, and the crisis in global biodiversity is unprecedented.

Vested interests, lack of understanding, and inertia are compounding the problems. As Latour asks in Down to Earth: "How can we not feel inwardly undone by the anxiety of not knowing how to respond?" **[1]**

Architects and built environment professionals have a particular responsibility. As highlighted in the International Energy Agency and United Nations Environment Programme Global Status Report 2022, greenhouse gas emissions arising from heating, cooling and lighting our buildings are responsible for 27% of global emissions. **[2]** Constructing and maintaining those buildings emits an additional 10%, with construction of infrastructure responsible for another 10%. Our built environment, then, is responsible for almost half of all global emissions – and, by implication, so are its architects.

At the same time, urbanisation, more extreme weather, growing populations and increasing migration are exerting an ever-greater pressure on our cities. The need for resilient buildings to shelter us all in comfort and security from the heat and storms to come is only going to grow.

The only possible answer to the climate crisis is to recognise our global responsibility, even as the political mood swings towards nationalisation. How should architects respond professionally to both this responsibility and this demand, in the next ten years and beyond?

The current system of education and skills, manufacturers and supply chains, procurement and finance, and developers and design firms, is so unwieldy that it is no surprise that the construction industry is seen as one of the slowest to change. And yet change is happening. An understanding of the importance of improving energy efficiency is now widespread and enshrined in regulations across much of the world. The measurement and gradual reduction of embodied carbon in building materials is finally starting to catch up, with national regulations just introduced in the Scandinavian countries and spreading.

But professional training and practices still tend to reflect old siloes based on rigid divisions of knowledge and labour. They still respond to a conceptual framework which sees buildings and infrastructure as technologies made up of individual parts, rather than integrated socio-technical systems. This has too often produced battles rather than consensus: arguments over whether operational or embodied carbon is the most important, over heavy-weight versus lightweight structures, over demolition versus retention, and over densification versus low-rise.

Radical change – indeed revolution – is needed, and this is what RIBA Horizons 2034 is challenging us to achieve.

The four Horizons 2034 topics are overlapping and inter-connected. Degradation of the environment is unfairly experienced at both global and local scales, with economic systems increasingly protecting the rich at the expense of the poor and vulnerable. Population growth and migration add additional pressures. Technological innovation is often held out as the holy grail, and yet repeatedly fails to reduce carbon emissions, often instead producing unintended negative consequences.

Within The Environmental Challenge theme, we are considering **'mitigation'**, **'adaptation'**, **'biodiversity'**, and the role of **'engagement and activism'.**

Climate change mitigation is the most advanced area, focusing on the reduction of carbon emissions and driving the net zero transition. Climate change is already here and its effects are increasing, and so architects also need to simultaneously adapt the existing built environment to help society to cope with heat waves, storms, flooding and drought. Biodiversity and protecting the variety of life on Earth in all its forms is also crucial in ameliorating the impact of global warming on ecosystems and preventing local environmental degradation. However, driving change at a policy and an individual level requires engagement and activism in a cycle of continuous debate and lobbying. These areas are intrinsically linked.

So, this is how architects must respond. They must rethink the boundaries of their responsibilities and start a revolution. Revolution is needed all along the supply chain, to produce near-to-zero carbon products and buildings.

But revolution is also needed at the point at which projects are first imagined, at the point at which planning is approved or denied, throughout the design professions and the construction industry and within regional and national governments.

Building professionals must reconsider their role, not as great designers of new objects to be admired and consumed, but as servants of global communities who need more from their built environment than ever before.

And rather than working in siloes, they need to learn about and practice maths, art, humanity and understanding – and above all humility.

Change is needed in the ways that decisions are made, in the arguments that are openly had, those that are hidden, and those that are never discussed.

Every step of our approach to the built environment must be deconstructed, in order to reassemble it as one that is fit for the future, that minimises our impact as a species on the climate and on Earth's ecosystems, and that provides us with a built environment capable of sustaining our future on the planet.

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[1] Bruno Latour (2018). Down to Earth: Politics in the New Climatic Regime (Catherine Porter, Trans.). Polity Press

[2] Global Alliance for Buildings and Construction (9 November 2022). 2022 Global Status Report for Buildings and Construction. United Nations Environment Programme https://www.unep.org/resources/publication/2022-global-status-report-buildings-and-construction

Satellite image of the Earth at night, with the continent of Asia in view. Photo: NASA / NOAA / SCIENCE PHOTO LIBRARY

Mitigating carbon emissions: global challenge and regional priorities

Abimbola Windapo is a Professor at the Department of Construction Economics and Management, and the Deputy Dean of Postgraduate Studies, Faculty of Engineering and the Built Environment, University of Cape Town. She has more than 35 years of experience in practice, teaching and research in the construction industry. She is a C2-rated researcher with the National Research Foundation (NRF) of South Africa, a Professional Construction Project Manager, and a Mentor registered with the South African Council for the Project and Construction Management Professions (SACPCMP). She is Registered with the Council of Registered Builders of Nigeria (CORBON).

Alice Moncaster (as previous biography)

Abimbola Windapo and Alice Moncaster discuss climate change mitigation where focusing on carbon emissions reduction and driving the net zero transition is pressing. The next decade is our last chance if we are to ensure a liveable planet for future generations.

The Sixth IPCC report makes clearer than ever before the urgency of mitigating anthropogenic greenhouse gas emissions to reduce our impact on the global climate and avoid the worst predictions. [1]

The decade from 2011 to 2020 was the warmest on record – 1.1°C above pre-industrial figures – and there are indications that the current decadal average is rapidly approaching the 1.5°C limit defined in the Paris Agreement. **[2,3]**

This 'decadal average' approach also gives a useful timeline for understanding the impacts of greenhouse gas emissions. All greenhouse gases – and carbon dioxide in particular – last in the atmosphere for many decades. The cumulative effect of their build-up has long-term consequences for our climate and planetary systems, including unprecedented biodiversity loss and sea level rise from melting ice caps. Also, the cumulative effect of repeated periods of extreme heat, drought and heavy rainfall creates localised disasters. The world is already seeing a growing incidence of heatwaves and wildfires, devastating floods and crop losses. As the IPCC says, this means that there is "a rapidly closing window of opportunity to secure a liveable and sustainable future for all".

The next decade is critical for the radical reduction of emissions to limit these impacts. Over 140 countries have already signed up to net-zero targets. However, the UN reports that current commitments "fall far short of what is required". The most recent UN Emissions Gap Report suggests that at the current rate of progress we will be emitting 9% more greenhouse gases by 2030 than we are today, rather than 45% less, which is the figure that is necessary to meet our targets. **[4]**

Across all industrial sectors there is now a critical need to reduce energy consumption, phase out fossil fuels, use more sustainable materials, and decarbonise energy supply, manufacturing and transportation.

The importance of construction and the built environment

Within this wider picture, professionals working in the design and construction of the built environment have a particularly important role to play.

The operation and construction of buildings are together responsible for around 37% of global energy-related emissions. **[5]** This is made up of 27% from the energy used in heating, lighting and cooling existing buildings, and 10% from the construction of new buildings each year. With a further 10% emitted from the building associated with infrastructure, the construction sector as a whole has a responsibility for almost half of all global energy-related emissions.

While climate change is a global issue, it is essential to understand the very significant disparities between global regions, and this is particularly the case for the built environment.

Europe has an old building stock, with about a third of buildings over 50 years old. New buildings add less than 1% to the total building stock each year. The UK's building stock is one of the oldest, with the average age of domestic buildings being around 70 years old. Europe's population is currently growing very slowly and is predicted to shrink back to current levels in 2050. **[6]** The average greenhouse gas footprint of a European citizen is just under 8 tonnes carbon dioxide equivalent, reflecting the relative wealth of the average European. **[7]** However, Europe is experiencing twice the average climate warming since the 1980s, a much faster rate than in other global regions. **[8]**

Other regions of the world have very different characteristics. A particular contrast is Africa. The continent is experiencing exceptionally rapid population growth, expected to increase from 1.4 billion to 2.5 billion by 2050 according to the World Green Building Council. Much of this new population is predicted to live in cities, and rapid urbanisation is already happening with the continent building at a vast rate. **[9]**

The current average carbon footprint of an African is much lower than that of a European, at around 1 tonne. However, in contrast to Europe there are huge disparities between different African countries. The carbon footprint in Libya is around 11 tonnes per person, and 7 tonnes in South Africa, while that in the poorest countries such as Somalia is under 0.05 tonnes.

For much of the existing population in poorer countries, there is little access to clean energy, clean water, and adequate housing or transport infrastructure. While warming is happening more slowly in Africa than in Europe, poverty means that there is far less resilience to climate change. Drought in East Africa and flooding in West Africa over the last few years have already led to crop failures, severe food insecurity and famine. These issues mean that, without significant investment, this region is expected to experience some of the worst impacts from climate change.

Meanwhile, rapid and sustainable new construction will be essential for the continent's growing population. Ensuring that this development happens with the lowest possible carbon impacts will require significant financial support from richer regions. Without it, the likely consequence will be increased use of local fossil fuels, and significantly increased, rather than decreased, carbon emissions.

Mitigation strategies in the built environment

In Europe, strategies for reducing energy use in buildings and for implementing renewable technologies have been at the forefront of mitigation efforts in the built environment for more than two decades. The Energy Performance of Buildings Directive (EPBD) has pushed regulation towards increasing operational energy efficiency since 2002.

Despite this progress, however, challenges persist. Energy efficiency improvements in new buildings have not significantly reduced total energy consumption in the building sector because a focus on efficiency per square metre ignores the final energy demand. The age of the building stock also means that around 80% of the buildings that will exist in 2050 have already been built, and there has been little focus on reducing energy use in this existing building stock. Also, until very recently there have been no regulatory instruments to reduce or even measure embodied carbon.

These multiple gaps have justified – indeed incentivised – the destruction of buildings in the name of reducing carbon emissions, while the reality has been an increase in emissions. The alternative to demolition in the majority of cases is retrofit, which 'costs' only half the carbon emissions of new build – but without regulations requiring the measurement of embodied as well as operational carbon, there has been no incentive to retrofit.

The revised cast of the EPBD, which is due to come into force in summer 2024, will at last address both the energy use of existing buildings and the embodied carbon of new buildings, but it is likely to be several years before it is ratified across Europe.

The picture in Africa is different. In South Africa, the key standards and regulations applicable to mitigating carbon emissions in the built environment are aligned with international standards. **[10]** However, in other African countries, which are grappling with poverty and currently have a very low per capita energy usage, regulatory approaches need to prioritise a just transition. This means greening the economy in a way that is as fair and inclusive as possible to everyone concerned, creating decent work opportunities and leaving no one behind.

At the same time, there is a need to minimise embodied carbon emissions from the huge construction programme that is underway, while making sure that the new buildings are resilient and comfortable for future climates with minimum energy use. This is an unprecedented challenge.

Anticipated developments in carbon emission mitigation measures

Significant advancements in carbon emission mitigation measures are likely to shape the future built environment as they become more prevalent and are gradually mandated for building design and construction.

These advancements are in three areas: low-carbon energy technologies; innovations in construction materials; and new approaches based on the concept of the circular economy.

Minimising carbon emissions through urban design is also increasingly of interest to building and urban designers, including such measures as using trees and greenery to shade buildings and reduce energy requirements, and reducing carbon emissions (and pollution) from transport by designing neighbourhoods for walking and cycling.

Building technologies

A significant driving force for change is rapidly developing building technology. For example, operational energy efficiency requirements have led to increased levels of insulation (high-specification windows, for example) and increased levels of airtightness. Innovative energy performance-based design approaches such as Passivhaus and, for existing homes, EnerPHit, are becoming increasingly popular across Europe. However, there are risks of maladaptation, particularly for older, solid-walled and timber structures where breathability is essential for the fabric and poorly detailed or installed retrofit measures can cause damp problems and deterioration.

Meanwhile heat networks are common in the Netherlands and Norway, and interest in the technology from other countries is growing. Innovations in renewable energy or using waste heat for such networks will make them increasingly carbon efficient.

In parallel with decarbonising national electricity networks, interest in building-level renewables is also spreading. The technologies include air-source and ground-source heat pumps and roof-mounted or integrated PV, all still increasing in efficiency with continuing research and development.

New approaches to energy storage are also happening at the building level, with increasingly efficient battery technology and innovations in combined electric vehicle and energy storage systems.

Energy management systems are also increasingly sophisticated, even for domestic buildings where smart controls for heating, lighting and white goods have been introduced to save energy and, therefore, carbon.

While some of these technologies are being installed in social rented housing and in non-residential buildings, many are still beyond the financial reach of most homeowners in Europe, let alone in countries with lower GDP. It isn't yet clear, therefore, whether these building-scale technologies will help to reduce emissions to the required extent, or simply remain high-tech toys for the relatively well-off.

Construction materials

Construction materials are also changing because of more stringent industry standards, the development of environmental product declarations, and the promise of regulation to reduce embodied carbon.

The development of bio-based materials, such as timber, bamboo, straw and hemp is currently underfunded, although increasing support from European funding programmes is encouraging innovation in these materials and standards, which could transform the choice of construction materials.

However, manufacturers and suppliers of bio-based materials are currently struggling to compete with the established and well-funded steel and concrete manufacturers, both of which claim to be on the road to decarbonisation.

The limitations of these claims are more or less acknowledged. For example, the steel roadmap accepts that its target of 80% to 95% carbon emissions reduction by 2050 relies on an uncertain set of future conditions. **[11]** These conditions include significant investment in technology, the complete decarbonisation of energy – which must then be available at commercially viable rates – and the easy availability of iron ore. Reaching its target is also predicated on a globally integrated, highly regulated market to avoid undercutting. In this scenario, the steel industry admits it would use seven times more energy than it does today including in both low-carbon electricity from the grid, and the production of green hydrogen.

The concrete roadmap is more bullish, although as with steel, its authors point out the need for funding, including from the public purse, to support the technical transformation needed. **[12]** A substantial proportion of the proposed decarbonisation of concrete again comes from outside the industry, including decarbonised energy and transport and a significant reliance on carbon capture and storage (arguably nothing to do with carbon reduction).

Both the steel and the concrete roadmaps indicate, but don't spell out, the high cost of decarbonising currently mainstream, high-carbon construction materials. This suggests that the future consumer is likely to have to pay many times the current price. By the end of the coming decade, 2034, these sectors may well have invested in new technologies and be using lower carbon energy sources. However, these are likely to entail higher prices, while the reduction of carbon achieved is far from clear.

Innovative energy performance-based design approaches such as Passivhaus and, for existing homes, EnerPHit, are becoming increasingly popular across Europe.

Circular economy

The principles of the circular economy are also increasingly being considered in construction.

The European Parliament defines the circular economy as "a model of production and consumption, which involves sharing, leasing, reusing, repairing, refurbishing and recycling existing materials and products as long as possible". **[13]** However, the construction sector has predominantly focused just on materials' end of life, and developing new ways to re-purpose and recycle waste back into the construction supply chain. While this is useful in tackling the high levels of construction waste, there is little evidence that it has a major impact on the carbon emissions of raw material in the majority of cases. (The exception is steel scrap, which is already almost 100% recycled.)

Applying circular economy principles to extending the life of buildings is currently much less discussed, despite far greater potential carbon savings. However, the European Commission's Renovation Wave strategy, alongside the moves towards whole life carbon accounting, means that retrofitting rather than demolishing existing buildings is likely to become more important. **[14]** Arguments for reducing whole life carbon are already pushing decisions towards retrofit rather than demolition, as seen in the recent high-profile case of the M&S building on Oxford Street, London. **[15]**

Implication of the adoption of carbon emissions mitigation

With the urgency of responding to the climate crisis increasing over the coming decade, mitigating carbon emissions will be critical. The extent of carbon emissions from the built environment sector, second only to the energy sector, means that architects and other built environment professionals have both the responsibility and the opportunity to contribute significantly to reducing global warming.

In Europe therefore, while innovative technologies and strategies will undoubtedly start to become more mainstream for the rich, the most significant changes over the next decade are more likely to be in the materials used in new buildings. If embodied carbon reductions are regulated and enforced, the most likely way to achieve this is by using intrinsically lower carbon materials. This implies significant changes to building design, supply chains and related skills.

A much stronger focus on retrofit, meanwhile, is likely to accelerate the development and mainstreaming of innovative approaches to energy reduction, building conservation and re-use. As national energy supplies are decarbonised, though, it will be important to ensure that high carbon-cost retrofits aren't emitting more carbon in the short term than they will save in the long term.

In rapidly developing countries in Africa, construction will need to continue at a huge pace as there just isn't the infrastructure needed to support the current or future population. Whether this can be the carbon-minimal development that is needed to keep global warming to 1.5 degrees will depend very much on the financial and technical support made available. The risk of further environmental degradation across the continent is also a considerable challenge, and the use of local sustainably sourced materials will be fundamental.

Impacts and roles

The impacts of such substantial changes in practices will be widespread. Low-carbon buildings could play a critical role in supporting urbanisation and population growth. As an added bonus, they offer the possibility of improved health through cleaner and more comfortable living environments, and improved quality of life.

The new green economy also offers the potential to create jobs, grow the local economy, reduce energy costs for individuals and increase property values. Low-carbon and bio-based materials will support the conservation and sustainable management of global resources and habitats.

For architects and other building designers, considerations of whole life carbon should offer a platform for innovation, creativity, and collaboration. They should seize the challenge, developing a profound understanding of, and expertise in, sustainable low-energy design principles and carbon modelling. Architects will also need to be influential actors in promoting sustainability to clients and across the built environment. Professional organisations such as the RIBA will play a key leadership role by advocating for whole life carbon reduction, providing members and clients with the necessary resources and support, and continuing to lobby Governments to implement carbon-mitigating building policies and standards.

Governments clearly have a critical role to play. They must formulate appropriate policies and regulations. They must also put into place stringent monitoring and control measures for construction output to make sure that hoped-for carbon reductions are achieved. The empirical data collected this way will also yield evidence of what works and inform future policies and strategic decisions. Governments and international groups also have a fundamental responsibility to create financial incentives for green buildings and low-carbon materials. Critically, this extends to agreeing financial support for technical and material innovations, particularly in the Global South.

The disparity in contexts across global regions, such as those discussed here between Europe and Africa, also necessitates that mitigation strategies are tailored to their local context. Europe's mature urban landscape and slow population growth starkly contrasts with Africa's rapid urbanisation and population expansion. Understanding these regional differences is essential for ensuring a just transition that grants fair access to mitigation benefits. The Global North, historically responsible for the vast majority of greenhouse gas emissions, must also accept some responsibility in supporting the low-carbon development of the Global South.

Efforts to address the impending climate crisis over the next ten years must be concerted and ambitious, its solutions global but regionally contextual. The built environment sector is primed for transformation, with potential ripple effects likely to reshape society, the economy, and the architectural profession.

Our sector's drive for action and the changes implemented over the next decade have the potential to shape a resilient and sustainable future for all. We must seize the opportunity and accept the responsibility.

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Aerial view of flooded houses in Halych, Ukraine. Photo: iStock|Bilanol

Climate adaptation: how can design science help the transition?

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She leads the Cambridge Sustainable Design Group and works on built environment intervention-led health and energy inequalities in the warming climate, harnessing data-driven design for precision prevention.

She was awarded the prestigious EPSRC Women Ambassador in Engineering award (2023), the Exceptional Woman of Excellence accolade by the Women Economic Forum (2019), and a notable felicitation by the Ministry of Health, Government of India (2022).

Ronita Bardhan looks at the next 10 years, when sustainable design will no longer be just about carbon emissions reduction and shifting to net zero. The onset of climate change will require adaptation of the existing built environment to ensure it is resilient to increasingly adverse weather conditions.

Climate change is currently under way. We will increasingly feel its effects over the next 10 years as extremes of weather affect our buildings and infrastructure.

There's a growing concern that, without immediate and deep efforts to slow climate change, global temperatures will surpass the critical 1.5°C threshold above pre-industrial levels by 2027. **[1]**

Simultaneously, the world is becoming more urbanised, with major urban areas becoming extremely vulnerable to the hazards of climate change. This situation has intensified the need to depart from traditional business-as-usual strategies in urban areas in favour of more sustainable development.

In general, actions to address climate change broadly adopt a two-pronged approach: mitigation and adaptation. As Abimbola Windapo and Alice Moncaster show in their **horizon scan,** mitigation strategies slow climate change by reducing carbon emissions. Adaptation strategies, on the other hand, accept that climate change is already under way and respond by bolstering our capacity to cope. Adaptations, in their most basic definition, permit "adjusting to the actual or anticipated climate and its effects." **[2]**

An approach centred on people, places, and practices is founded on the tenet that species adapt to changing environments. This allows them to minimise or avoid harm while evolving under stress. According to the Intergovernmental Panel on Climate Change (IPCC), it will be difficult to avert the effects of climate change even with "the most stringent mitigation efforts". **[3]** Consequently, climate adaptation becomes indispensable and unavoidable.

Climate adaptation in the field of building science and design is not new. The earliest builders improved their buildings in response to varying extremes of the local climate to maintain a stable indoor environment. Over time, they integrated technological advances and adjusted design parameters to, for example, enhance airtightness, weather resistance and insulation. New materials like cement and concrete were incorporated to make more enduring shelters to accommodate the expanding human population.

Had it not been for the challenge of carbon emission reduction, the building design industry would have persisted along the same trajectory of innovation in materials and technologies.

Partly because of these first-generation building design innovations (such as introducing materials like cement and concrete), the construction sector contributes approximately 40% of worldwide greenhouse gas emissions.

Apart from buildings' increased carbon emissions, studies also suggest that they fail to foster good health. According to recent estimations, current building design practices contribute to approximately one-fifth of chronic diseases. **[4]** While buildings need to mitigate their greenhouse gas impact, they also need to adapt not just to inevitable changes in the climate but also for the health of their occupants.

Designer's dilemma – challenges in climate adaptation?

Adapting to climate change is a complex challenge that necessitates preparing for multi-dimensional severe weather phenomena, including intense fluctuations in temperature and precipitation, rising sea levels, flooding, prolonged droughts, and intense winds.

Since climate scientists assert with "very high confidence" that the planet is facing a 1.5°C rise in temperature, even the most optimistic will likely agree that we need robust adaptive measures to counter its negative effects. [3] Such a rise in temperature will present unique challenges to humanity, infrastructure, economies, and natural systems, all of which will deviate from what is currently considered normal.

Nonetheless, there is still uncertainty about the rate of climate change, and how soon its negative effects will kick in. This uncertainty is a dilemma for building design scientists. Presently, the practice of architectural design is advancing to meet the demands of a changing climate, which includes departing from traditional building materials and construction practices to embrace climate resilience. Yet, without precise predictions of when these changes will occur, achieving the Goldilocks design that ensures effective adaptation is a formidable task.

Also, while climate change affects the entire planet, its impacts are unevenly felt, with the people of the Global South experiencing more severe consequences due to widespread poverty. Adaptive building technologies such as mechanical cooling systems are often not designed for local climatic differences and may not be universally applicable.

Most design norms are derived from empirical studies conducted mainly in the Western context, leading to adaptive design parameters that cater to those specific environmental and societal contexts. Yet, despite facing more acute climate vulnerabilities, the developing world often adopts these same design standards without modifying them to suit their own unique environments. **[5]**

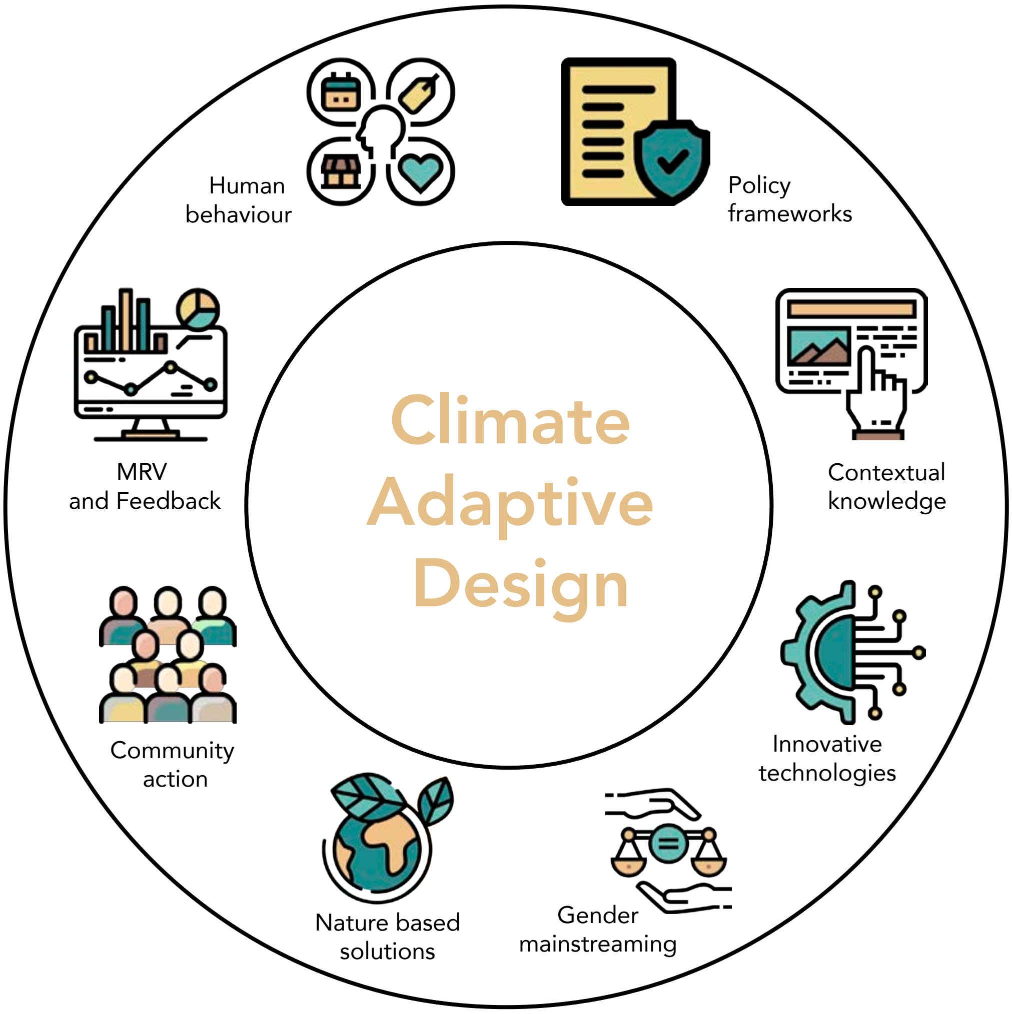
The challenges in moving beyond these misunderstandings are multifold. They include a dearth of comprehensive information. For example, there is a significant lack of data on human adaptive thresholds that consider historical climate exposure, social behaviours and cultural norms. This gap means that current standards may not effectively meet the needs of diverse populations facing varied climate impacts.

There is a pressing need to gather more inclusive data and develop accessible adaptable design parameters that recognise and address the specific vulnerabilities of different regions, especially those most affected by climate change.

Foundations for climate adaptation through design

Architectural design science is grounded in the principle of constructing environments that foster a sense of physical and mental well-being while ensuring sustainability. Due to climate change, buildings now have the dual function of reducing carbon emissions while simultaneously enhancing the health, well-being, and productivity of occupants by protecting them from the extremities of future climate by maintaining a 'good' indoor environment. Realising the health potential of adaptive design strategies is still at an early stage, yet there is empirical evidence that they can improve indoor air quality and the thermal environment, which can affect human behaviour and impact health outcomes.

Approaches to climate adaptive designs can be defined as fitting within eight foundation principles, which between them delineate specific and practicable ways to enhance the resilience of the built environment to climate change.



Foundational principles of Climate Adaptive Design.
Credit: Original drawing by Ronita Bardhan. Redrawn by Marie Doinne, RIBA

Contextual knowledge

One of the daunting challenges for the science of designing for climate adaptation concerns how to include local knowledge. The only way to ensure that buildings are resilient to specific local weather patterns and cultural practices is if their design harnesses accurate contextual knowledge.

This is about understanding unique region-specific data on historical climate exposure, stress-coping mechanisms, thermal history and socio-cultural dynamics to design and construct buildings that not only respond to the local climate's idiosyncrasies but also resonate with the community's way of life.

By incorporating indigenous materials and traditional construction techniques alongside modern technology, designs built with contextual knowledge ensure sustainability and comfort. At the same time, they foster a harmonious relationship between the built environment and the natural ecosystem.

Tailored approaches like these enhance resilience, diminish environmental impact, and uphold the local community's cultural traditions.

We can capture contextual knowledge by using methods from the social sciences and humanities, including narrative surveys, focus-group discussions, and key informant interviews. These methods inform designs by using grounded data that reduce uncertainty about climate change risks. **[6]**

Innovative technologies

Innovative technologies harness data-driven methods, smart materials, and bioclimatic principles to create built environments that respond dynamically to changing environmental conditions. Utilising advancements such as weather-responsive facades, green and energy-efficient methods, and AI-driven climate control systems, innovative technologies help designers to optimise comfort, reduce energy consumption and adapt to the current and future impacts of climate change.

However, the implementation of this technology is often hindered by uneven access, limitations in widespread application, and asymmetry in communities' preparedness to integrate new technologies, particularly in resource-constrained settings. As a result, useful technologies may not be suitable for adoption, especially if they are very sophisticated.

Transformative gender mainstreaming

Climate change has an uneven impact on different genders, often exacerbating existing gender inequalities. Women are disproportionately impacted by climate change. For example, pregnant or elderly women are more prone to dehydration and can suffer more from extreme heatwave days. This leads to – and from – their continued marginalisation and underrepresentation in accessing and co-designing effective adaptive strategies.

The disparity in how women are affected by climate change is frequently determined by their designated roles and unequal power dynamics arising from customs and societal norms, all influenced by historical, cultural, and social factors. This results in maladaptation. **[7]**

Incorporating climate-resilient designs that take into account gender-specific roles within a community can help to break the link between poverty and the dual pressures of health and energy costs.

This is particularly relevant in low-income areas where women's decisions to use active cooling solutions indoors are often influenced more by social norms and the cultural expectation to be the family's stabilising force, rather than by a direct need to manage thermal comfort. Unfortunately, these ingrained behavioural patterns, deeply rooted in social customs, are frequently overlooked when developing strategies for climate-adaptive designs.

Data on the gendered differences in climate change impacts and processes of adaptation are currently scarce but crucial for successful climate adaptation.

Unlike rigid, engineered solutions, NBS can grow, self-repair, and adjust to changing conditions, which makes them more resilient to climate change.

Nature-based solutions

Nature-based solutions (NBS) in architecture promise to reduce the whole life carbon of buildings while also offering various multi-scalar ecological regeneration benefits.

For example, using green roofs can lower the temperature of buildings and their surroundings, a useful adaptive strategy in areas where extremes of heat are rising. (Green roofs also reduce operational carbon by lessening the need for air conditioning and mitigating the urban heat island effects.)

Another advantage of NBS is that they present the opportunity to utilise local knowledge, which allows ethical factors to influence climate adaptive designs.

NBS can encompass design approaches that imitate natural processes, such as biophilic design, ecosystem-based arbortecture, **[8]** and design for disassembly, frequently using natural materials such as timber, clay, and bamboo.

NBS systems are inherently adaptive. Unlike rigid, engineered solutions, NBS can grow, self-repair, and adjust to changing conditions, which makes them more resilient to climate change. Also, they are easily accessible to people and disrupt daily lives minimally, allowing them to gain community acceptance naturally. Being natural ecosystems, NBS remain effective over the long term, and their acceptance by local communities ensures their continued care, protection, and longevity. In short, they are long-lasting sustainable systems. (Coincidentally, some NBS also allow buildings to work as material banks and carbon sinks, **[9]** which are both useful mitigation strategies.)

Although there is currently a move towards using multiple NBS, a significant constraint is that they require extensive interdisciplinary knowledge and comprehension of natural materials and ecosystems. Effectively utilising NBS in this way will necessitate expansive collaboration between people in the fields of natural sciences, engineering, and design.

Monitoring, reporting, verification and feedback

Reliable data on the effectiveness of designs' adaptive potential is crucial for their successful implementation. We can only know how successful they are with extensive monitoring, reporting and validation through post-occupancy evaluations and other forms of research.

The feedback can be used to inform and improve models and simulations and develop data-driven design heuristics to ensure design consistency, which will help designers to verify that their designs will be effective.

To evaluate the tangible advantages of adaptive designs, it will be necessary to develop new metrics and tools that can accurately assess the economic, social, and environmental benefits and reliably correlate them with particular climate adaptive design strategies.

Influencing human behaviour

Design interventions can have an impact on human behaviour. To influence behaviour reliably to support the effectiveness of adaptive measures, we must comprehend the behavioural dynamics of inhabitation and resource utilisation that could hinder climate adaptation strategies.

The literature on how designs interact with their occupants to enhance good climate adaptive behaviours is scarce. Although still evolving, the fields of salutogenic design potentially hold useful insights.

Community action

Community action (through climate action groups, for example) is probably the most effective way for individuals and communities to have their voices heard. Listening to them can help to identify viable strategies for adapting to climate change, and by engaging with relevant groups, designers are more likely to devise successful strategies.

To ensure that the community's perceptions, sentiments, and needs are properly represented, design processes should incorporate co-creation and participatory design approaches. Groups within the local community with relevant information thus have the opportunity to become catalysts for positive change. In short, the approach ensures that people are central to both the design process and the resulting products.

Emerging methods like computational social science have the potential to capture and process the community information required, especially in early design stages. **[10]**

When designers recommend adaptive design measures, they encounter barriers from local approval bodies.

Policy frameworks

Policy support is necessary for climate adaptive designs to work. Presently, many building design regulations and policy guidance (and the codes they refer to) fail to account adequately for the upcoming effects of climate change. When designers recommend adaptive design measures, they encounter barriers from local approval bodies.

Effective adaptation requires an in-depth understanding of possible risks in the context of evolving community needs. As a public good, developing and monitoring this regionally specific understanding is a government responsibility. It can be used to inform policy frameworks to either nudge or, if the risks are serious enough and public interest strong enough, regulate building design practice towards outcomes that are properly resilient to local climate change risks.

Adaptation for a better future

Design science offers a multifaceted toolkit for climate adaptation, crucial for the reconfiguration of our built environments to better withstand impending climate change.

The essence of sustainable development lies in a dual approach: reducing emissions through innovative design while bolstering our built environment's resilience to potentially damaging climate change.

Eight foundational principles underpin architectural design that harmonises with environmental exigencies, integrates community knowledge, leverages technology, and aligns with gender and policy frameworks. This holistic approach aims to protect our built environment and the people most at risk from climate change.

Overcoming entrenched conventions, bridging data gaps, and democratising access to these solutions remain significant challenges. Yet, the promise of climate adaptive design – rooted in rigorous data, inclusivity, and community engagement – paves the way towards sustainable living and a climate-resilient built environment.

As we navigate the unpredictability of climate effects and consider the practice of architecture over the next 10 years, it's critical to embrace and champion design breakthroughs that embody climate resilience. Although the risks posed by climate change can appear catastrophic, such change can also bring opportunities. Adopting climate adaptive design strategies is one such opportunity, with the power to propel humanity forward.

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Graffiti of a tree on a building in La Rochelle, France, framed by real leaves. Photo: © Steprphotos | Dreamstime.com

Biodiversity: why architecture must get to the roots of the nature crisis

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Her research focuses on environmental governance and the politics of climate change, energy, nature and sustainable cities. She currently convenes the Horizon Europe NATURESCAPES project (2023 to 2027). She has undertaken commissioned research for the UK Government, European Commission, NGOs, UN-Habitat, the OECD and the World Bank.

In 2023 was appointed to the Scientific Council of the European Research Council and as international honorary fellow of the American Academy of Arts and Sciences.

Harriet Bulkeley highlights how the protection of life on Earth is crucial for mitigating the impact of global warming on ecosystems. Biodiversity is most often tackled in the context of natural landscapes. As rural species decline in the coming decade, the significance of urban habitats for nature must be realised.

As the crisis of the loss of biodiversity intensifies globally, cities are increasingly seen as important havens for nature.

This might seem counterintuitive. After all, the global urban population is set to reach four billion by 2030. Temperatures in cities are predicted to rise faster than anywhere else. Urban expansion will potentially lead directly to the destruction of 290,000 km^2 of natural habitat. **[1]** And yet, as the dual crisis of nature and climate change unfolds, so too has the long-standing divide between town and country, nature and civility that permeated Modernist thinking been replaced by a recognition of the increasingly hybrid and entangled forms that nature and urbanisation take. **[2]**

Cities are now at the forefront of concerns about what it means to live with and respond to the crisis of biodiversity. The prominence of cities is in reports signposting the significance of urban habitats for nature as rural species decline. **[3]** It is in the second series of David Attenborough's much loved Planet Earth documentary, which featured an episode on urban wildlife.

More importantly, cities' prominence is in the Kunming–Montreal Global Biodiversity Framework. **[4]** This new plan agreed by national governments at the 'Nature COP' in December 2022 aims to conserve and restore nature while enabling society to benefit. The Framework includes a target to "significantly increase the area and quality and connectivity of, access to, and benefits from green and blue space" in urban areas.

By recognising cities' critical role in responding to the biodiversity crisis, the Framework opens up new opportunities, responsibilities and challenges for the profession over the next ten years.

Cities – part of the problem or part of the solution?

The increasing prominence given to cities in the global response to the biodiversity crisis has primarily been driven by concerns over the threat that urban expansion poses for nature. **[5]** The 2019 IPBES Global Assessment Report demonstrated that we are losing nature at an unprecedented rate, with potentially up to a million species at risk from extinction. It identified the expansion of urban land use as one of the most significant drivers of biodiversity loss alongside the conversion of land for agriculture, climate change, invasive species and pollution. **[6]**

Less commonly recognised are the significant ways in which cities indirectly contribute to biodiversity loss. **[7]** For example, as key centres of consumption and production, urban areas –including suburbs – contribute significantly to the greenhouse gas emissions that lead to climate change and are important sources of plastic and nutrient pollution. Also, built development in cities is driving the extraction of resources such as sand and aggregate used for concrete, which is destroying ecosystems around the world. **[8]** The concentration of institutions, organisations and individuals that inhabit cities means that they are also vital in shaping societal values and in fostering a growing disconnection with nature, which the IPBES Global Assessment considers to be one of the key root causes of the biodiversity crisis.

Yet this is far from a one-way relationship. There is growing evidence that nature matters for cities. Urban areas benefit from a range of what are termed ecosystem services. **[9]** These are the means by which nature contributes to society by, for example, protecting coasts, cooling hot streets with shade, and slowing the flow of water to reduce flood damage – as well as providing opportunities for awe, wonder, spirituality, health and well-being.

The loss of nature and of the benefits it provides for society is likely to undermine the resilience of urban communities, infrastructure and the built environment. Faced with these growing pressures, cities are now seeking solutions that can allow them to work with and for nature.

Of course, the history of the Modernist city is replete with examples of efforts to control nature towards urban ends. From large parks to waterways, urban planning and infrastructure development have served as a means through which nature has been brought into the city for particular ends. **[10]**

However, there has been a shift in thinking over the past few decades. The new perspective is that the urban arena is a means to address wider global challenges of sustainability. While this approach to urban sustainability can be traced back at least to the Brundtland Report of the early 1980s, the focus on nature as playing a vital role in such solutions is more recent. **[11]**

An early iteration of the importance of harnessing nature towards urban sustainability can be found in the concept of ecosystem-based adaptation, introduced by the United Nations Framework Convention on Climate Change (UNFCCC) in 2008. This approach includes conservation, restoration and the management of ecosystems intended to reduce climate impacts and increase societal resilience. Significantly, it was adopted by the World Bank as an alternative to mainstream adaptation measures based on technical solutions and grey infrastructure. **[12]**

Most recently, the more expansive concept of nature-based solutions (NBS) has been used as an umbrella term to capture a range of interventions that work with and for nature towards sustainability goals. Here, the emphasis is on the potential for such interventions to address multiple sustainability challenges simultaneously.

The European Commission, an early advocate and key stakeholder in this approach, suggests that NBS can "result in multiple co-benefits for health, the economy, society and the environment, and thus they can represent more efficient and cost-effective solutions than more traditional approaches" for sustainability. **[13]**

Towards nature-based solutions

As the importance of finding solutions to both the climate crisis and the loss of biodiversity has grown, NBS offer a glimmer of hope that it is possible to address the loss by working with nature, for nature. **[14]**

Globally, investment in nature-based carbon offsetting in the land and forestry sectors increased twenty-fold between 2016 and 2021 to reach a value of over 1.3bn USD. **[15]** At the same time, the international climate and biodiversity COPs have been dominated by multiple examples of the possibilities that NBS present.

Even so, the financial investment and political capital being directed towards urban NBS remains relatively small, with estimates suggesting that just 0.3% of overall spending on urban infrastructure globally is being directed towards NBS. **[16]**

Within this arena, architects and built environment professionals have played a crucial role in showcasing the possibilities that cities hold. There have been a number of iconic projects, from the Bosco Verticale in Milan **[17]** to the Khoo Teck Puat Hospital, Yishun, Singapore, **[18]** the Rolls-Royce plant in the UK, **[19]** and One Sydney Park in Sydney, Australia. **[20]** These are all examples where architects and designers have worked with NBS to enhance the quality of the built environment, using strategies that include green roofs, walls and structures, sustainable drainage and therapeutic gardens.

As well as producing attractive assets, these strategies also generate benefits such as improved thermal efficiency, flood protection, enhanced biodiversity and supporting the health and well-being of occupants.

Making just urban nature futures

Despite these important advances in how the sector is engaging with the challenges of urban sustainability and the opportunities that NBS provide, three critical challenges remain.

Rethinking models of risk and value

The first and most obvious challenge is that, across the built environment, NBS remain the exception rather than the rule. The iconic examples provided above – and often repeated in the popular industry press – are well known because of their rarity.

Structural conditions and institutional norms across the urban development sector create significant barriers for the uptake and mainstreaming of NBS. **[21]** For example, the rate of return on investment required, the ways in which risk is calculated, tacit knowledge and professional training have all been built upon concrete foundations – literally.

Bringing nature in – with its cyclical temporalities, uncertain futures, often unruly aesthetics and complexities that require alternative expertise – disrupts these stable ways of working. It requires new forms of calculating risk, value and futures.

As such, NBS are currently most often used only when they conform closely to existing models (for example, the use of simple green roofs as a form of insulation) or where existing approaches have reached their limit point – for example, where predictions of flooding frequency and magnitude mean that concrete solutions can neither fit nor be afforded within a particular scheme.

In this context, experimentation has become the norm, and is a crucial means through which current ways of thinking and doing urban development are established. **[22]**

But making progress will require architects not only to adopt the new but also to question the old. In the context of the twin crises of climate and nature, architects need to confront current standard ways of assessing risk, investment and value if the kinds of experimentation seen at the moment with NBS are to gain more traction. **[23]**

As the IPBES Global Assessment has shown, land use conversion through urbanisation is a significant threat to biodiversity.

Designing for system integration

The second challenge is that, as things stand, there is a danger that how the architecture and built environment professions are engaging with NBS amounts to little more than a green gloss that conceals the significant ways in which urbanisation is contributing to the biodiversity crises.

The practice of incorporating NBS one building or one masterplanned development at a time, albeit set within its immediate context, tends to isolate fragments of urban development from their wider potential impact. As the IPBES Global Assessment has shown, land use conversion through urbanisation is a significant threat to biodiversity.

And while this may be obvious at the urban fringe, within cities it is much less so. Areas that appear as scraps of unwanted space, brownfields or wastelands can, in fact, be important areas for biodiversity not only in themselves but as part of the patchwork of loosely interconnected spaces across cities that provide for nature. **[24]**

Creating meaningful NBS will involve moving built environment professionals' – including architects' – perspective beyond the direct envelope of singular developments to consider how different sites and interventions can contribute to a multiplicity of urban sustainability goals because of how they interweave with existing spaces, flows and connections. **[25]**

At the same time, efforts to generate NBS must not be undertaken in isolation from the contribution that urban development might make to the root causes of biodiversity decline globally. **[26]**

While the material footprint of the built environment is increasingly under scrutiny for its contribution to climate change, its biodiversity impact also needs to be considered. The profession must scrutinise the biodiversity impact of supply chains for critical materials such as sand, concrete, steel and wood much more closely.

Likewise, there are significant opportunities to build more circular economies around the development of NBS by attending to how, where and by whom the very stuff of nature being incorporated is itself created.

For example, in Hyderabad, India, **[27]** the city's programme to radically increase the extent of the tree canopy has been supported by the development of urban plant nurseries. In the Netherlands, UK and Ireland, More Trees Now **[28]** works with local volunteers to find unwanted tree saplings and make them available for planting.

To progress NBS that are truly sustainable, architects and built environment professionals will need to enter into new system-wide partnerships to sustain ambitions to bring nature into urban development.

Planning for fairness and justice

The third, and perhaps most critical, challenge concerns the (unintended) consequences that urban NBS can have for social and environmental justice.

Access to urban nature and the benefits it provides is already highly uneven within and between cities. **[29]** There is now also growing evidence that interventions designed to address urban sustainability challenges, including climate change and biodiversity – including those that work specifically with NBS – can sustain and exacerbate these inequalities by contributing to green gentrification. **[30]** Introducing nature into an urban area inflates its land values and property prices, with the result that its pre-existing communities may be displaced and those on low incomes are effectively excluded.

Similarly, when NBS are designed with dominant western tropes of what 'good' nature entails, the benefits and values that diverse groups hold for nature, including those of indigenous peoples and local communities or black and minority ethnic groups, can be excluded.

The provision of urban NBS is not just about realising multiple benefits but also ensuring that the process is inclusive and just. This requires careful consideration of who is involved and at which stage in the design process.

Too often, nature is an afterthought to the main business of urban development. Giving it due consideration requires that decisions about how and why to incorporate NBS, and for whom, must be made much earlier in the practice of building and urban design.

Likewise, processes of gentrification and exclusion are exacerbated when the goal of incorporating nature is to increase profit through land sales and to create privatised benefits for owners and residents.

No matter how high the walls that enclose it, nature is always at least in part a public good – cooling the city, retaining water, harbouring biodiversity and so forth. The critical challenge for architects and built environment professionals here is how to work with more fluid boundaries between the public and private realms. Doing so will make it more likely that developments benefit the investor and, at the same time, help to fully realise the contributions that nature can make for urban communities.

Urban nature, transformed?

As the world approaches the second anniversary of the 2022 Montreal-Kunming Global Biodiversity Agreement – with a new round of talks to be held in Cali, Colombia in November 2024 – all eyes are turning to whether it is now possible to move from agreement to action on and for nature.

Yet it is clear that simply more of the same kind of action will not be good enough.

For architects, taking the crisis of nature seriously requires a fundamental rethinking of how we live alongside and with nature every day. From our back gardens and balconies, to the scraps of wasteland and the edges of urban sprawl, the first and crucial step is to let nature in.

Moving towards transformative change for cities and nature will also require built environment professionals to reconceive what constitutes value, where the boundaries of their responsibilities lie, and what it means to create a flourishing city for all.

As humankind faces the environmental challenges ahead, transforming cities with and for nature might just be one of its last and best hopes.

The provision of urban NBS is not just about realising multiple benefits but also ensuring that the process is inclusive and just.

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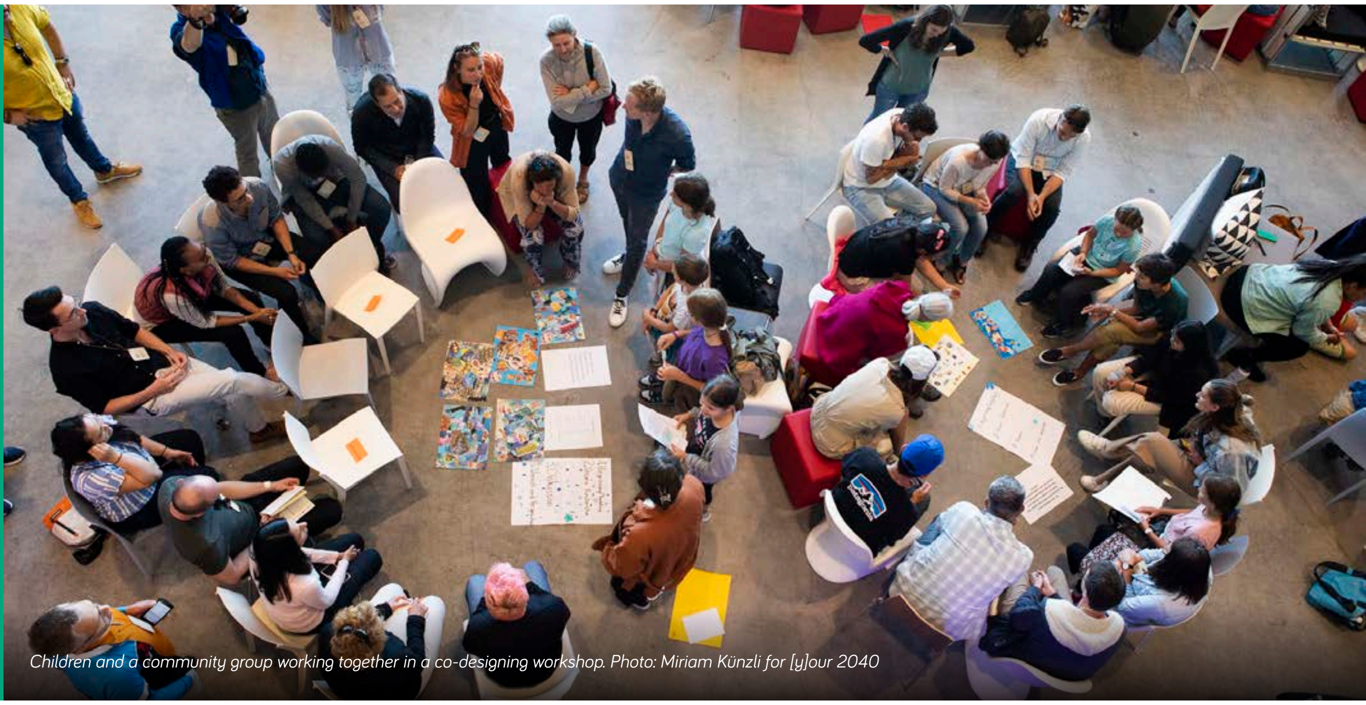

Children and a community group working together in a co-designing workshop. Photo: Miriam Künzli for [y]our 2040

Engagement and activism: choosing to matter [1]

Chris Luebkeman is known as a bridge builder. He enjoys connecting and inspiring people around the globe, generating ideas with action, and curating content across time to ensure a habitable and thriving future for us all. He has worked in foresight for almost 30 years, 20 years at Arup in various leadership roles and now leading the Strategic Foresight Hub at the ETH Zurich. He created Foresight at Arup and is Founder and CEO of [y]our 2040.

Jonelle Simunich is a futurist, designer and entrepreneur focused on creating collaborative urban futures and aspirational narratives for change. Trained as an architect, city planner and innovation strategist, she focuses on life in and around cities to transition us towards positive outcomes for people, place and planet. She is COO and Co-Founder of [y]our 2040.

Chris Luebkeman and Jonelle Simunich discuss how combatting climate change and its impacts requires engagement and activism. Only by taking individual and collective action, raising awareness and developing professional knowledge and expertise, can a universal commitment be made to a sustainable future.

Change is constant. We cannot stop it. We can observe all its variations and nuances. We can describe how fast it is, and whether we like or dislike it. We can have an attitude towards it and what we then wish to do about it. It affects everything, at all scales. When it affects the climate, its impact is multi-scalar too, impacting every living thing on the planet.

We read about the entire spectrum of action for change, from radical individual protest to collective governmental action. At times, this action seems to be a bit too much; at others it can seem unwieldy and slow.

What is clear is that we all have professional and personal choices to make. When these choices align, they can add up to massively influential movements. To improve things for the better, we must consider how and where we can influence and implement change. It is the doing of something – taking action – that makes a lasting difference.

Indeed, activism is of such importance to the UN's 'Decade of Action' **[2]** to find sustainable solutions to all the world's biggest challenges that it has its own UN Sustainable Development Goal – SDG 13. Its objective is to "take urgent action to combat climate change and its impacts". **[3]** The goal describes how we each have a responsibility to act now, to raise awareness, to build knowledge and capacity, to strengthen resilience and adaptive capacity, and to integrate climate change measures into national policies, strategies, and planning.

For architects, activism means engaging in civil and democratic society, as individuals and as members of communities and businesses, to effect the change only the profession can make. For example, it falls to architects to build knowledge among clients, contractors, and the community, so that client briefs and agreed design choices are founded on a shared commitment to a sustainable future.

In this context, the architectural profession stands at a critical juncture: will we transform how we work, engage and collaborate? The role of not just architects but engineers and planners too in shaping our built environment becomes increasingly important the longer the climate crisis deepens. These professionals can be radical activists or passionate persuaders working to influence client decisions, government policies and industry standards. Embracing a forward-thinking mindset and anticipating emerging trends are essential for responding effectively to the challenges and opportunities that lie ahead.

How built environment professionals choose to respond to today's environmental challenges, and how they approach, engage and act as activists for the built environment and society will have a lasting impact. It is up to them to collaborate, partner and connect across disciplines, industries and communities to leave a positive legacy for the future.

Before then, these professionals need a clear roadmap to set them on the right track. What does an equitable and just world look like? What pressing social and environmental issues can be addressed by architecture and design? How can professionals use their voices to advocate for social justice and environmental sustainability? What role must they play to promote equality in design? How can they engage actively with their communities? How can they collaborate better with other disciplines and organisations to amplify their impact? What partnerships are necessary across organisations to expedite better outcomes?

These are some of the questions professionals must ask themselves in the next 10 years. The answers will help them to find and design plausible, pragmatic and positive solutions to put the world on a (r)evolutionary path to a regenerative future. Only that way will they be able to look into the eyes of the next generations and say, 'I did everything in my power to leave the world a better place for you.'

An interconnected world

Despite an ever-shifting external environment, the fundamental human aspirations that drive architectural design remain constant. The desire for community, healthy living spaces, access to safe food and clean water, and the ability to form meaningful connections with others is deeply ingrained in our collective consciousness. These aspirations are the bedrock of civilization, and so they must be at the heart of every built environment endeavour.

The world is increasingly interconnected. It is more important than ever that built environment professionals adopt a 'glocal' – i.e. both local and global – approach to architecture. They must strike a balance between understanding and addressing local needs and recognising the far-reaching, global consequences of their actions. For example, specifying certain construction materials in one region can lead to the extraction of resources on the opposite side of the world, with the potential to disrupt those distant ecosystems and communities. Architects can embrace a holistic perspective, ensuring that their designs contribute to a sustainable and equitable future for us all.

Visionaries

Architects occupy a unique position as visionaries and shapers of the built environment. They have the opportunity – and responsibility – to educate themselves about the complex political, environmental, social, and technological challenges facing society. Beyond simply designing for the present, they must design for the future, ensuring that their creations are sustainable, equitable, and resilient for, if not centuries, then decades to come.

Only by deciding to actively engage can they influence social norms, government policy, commercial organisations and industry bodies. The power of visionary design to influence thought and action is profound. For that to happen, there must be trust. As Covey and Merrill say:

"There is one thing that is common to every individual, relationship, team, family, organisation, nation, economy, and civilization throughout the world – one thing which, if removed, will destroy the most powerful government, the most successful business, the most thriving economy, the most influential leadership, the greatest friendship, the strongest character, the deepest love. On the other hand, if developed and leveraged, that one thing has the potential to create unparalleled success and prosperity in every dimension of life. Yet, it is the least understood, most neglected, and most underestimated possibility of our time. That one thing is trust." **[4]**

Architects must focus on building, re-building, expanding their role as trusted, honest, forward-focused brokers for a better world. It is time.

Collective efforts

Designers cannot know everything; yet they can engage and consult to ensure more holistic and collaborative outcomes. They could more actively engage the wider community in the architectural process. This community, which includes stakeholders, clients, and the public, have insights and perspectives that, collectively, are invaluable to ensure that buildings and public spaces respond to local needs, aspirations, and cultural contexts. By fostering collaboration in this way, architects are more likely to create environments that truly reflect the communities they serve.

Societal and cultural forces have a major impact on the climate and health of the planet. Some are specifically within the purview of built environment professionals, who can design and provide frameworks for positive action. These frameworks, which include active mobility, sponge cities, 15-minute neighborhoods, recycling, regenerative or circular 'everything', and the desire for more access to nature, have fundamentally shifted the design of urban environments. The quest for healthier lifestyles in many places has meant that bike lanes have been carved out, and shared bikes and bike parking are becoming the norm in neighbourhoods that are densely populated enough. The desire for open space has driven a global movement for creating parklets and for re-integrating the streetscape for daily human life.

What these examples have in common is that they are often driven by local activists who, by campaigning to change planning codes, ultimately improve communities. They are just a small sample of the endless possibilities ahead. The key here is for designers, clients and inhabitants to embrace new attitudes and mindsets to consider new ideas and win-win solutions for people, nature and the whole planet.

The goal of a horizon scan is to help individuals, groups or organisations to anticipate potential challenges, and opportunities, so that they can consider strategies and actions to prepare for the future.

Addressing change

Addressing global challenges is designers' highest calling. To tackle it successfully, they must recognise human needs, expectations, hopes and desires. A framework for how these needs are met can be articulated by Maslow's hierarchy of needs. Maslow suggested that needs are hierarchical, visualising them as a pyramid where categories of need build upon each other. From the base upwards, the needs are: physiological, safety, love and belonging, esteem and, finally, self-actualisation. To navigate successfully to a sustainable future, architects must acknowledge this hierarchy when working out how to improve outcomes. A critical tool in doing so is horizon scanning.

A horizon scan is a systematic approach for identifying and monitoring emerging trends, issues, and developments that could have a significant future impact on a particular industry, organisation, or domain. The goal of a horizon scan is to help individuals, groups or organisations to anticipate potential challenges, and opportunities, so that they can consider strategies and actions to prepare for the future. The process can be based on keywords, concepts, and free text. It can be highly scientific or personal and opinion-based. In the end, the goal is to challenge a group's understanding of what is driving change so that they can act to influence its direction.

Engagement and activism in the built environment have their roots in the movements of the 1960s and 1970s, primarily in North America and Europe. It was a time of mass awakening with social and political upheaval. The groundbreaking movements that were established resulted in new norms for equality, justice and environmentalism mirroring much of what is happening today. The slogan at the time was 'think globally: act locally'.

Today, the impacts of the global climate crisis are impinging locally on the everyday lives of ordinary citizens. They can see all too clearly how irrelevant geopolitical boundaries are when it comes to the carrying capacity of our planet.

Ecosystems do not have borders. To regenerate ecosystems requires an understanding of systems and a reconsideration of the topologies of borders. This will require an active engagement with the drivers of change of, and for, the systems that we humans depend on for our built environment and urbanised civilisation.

If we wish to leave a habitable earth for future generations, we must band together, rethink our systems, and redesign our built environments for the world we want. Activist-architects can connect with practitioners from other countries and cities to co-create a new manual for what 'good architecture' and 'regenerative urbanism' look like. It is the opportunity of a generation.

Trends

This horizon scan highlights some of the key trends shaping the future of architecture. They may not seem cutting edge, but their application and implementation have the potential to effect profound change. We must work hard to implement them to their full potential.

Sustainable building certification

Certification to rigorous sustainability standards is a strong, evidence-based way to address future environmental challenges. There are many relevant schemes around the world. For example, BREEAM **[5],** LEED **[6],** CASBEE **[7]** and Green Star **[8]** focus on minimising the environmental impact of buildings, while WELL focuses on buildings' impact on human health and well-being **[9].** A less well-known energy efficiency scheme is Minergie, a Swiss energy efficiency standard that aims to achieve a very low energy consumption for heating and cooling. Buildings that meet it typically consume less than 100 kWh/m² per year of primary energy for heating and cooling. **[10]**

Prioritising these certifications helps architects to respond to concerns about climate change and sustainability, promoting resource efficiency and ensuring that buildings minimise their environmental impact.

Environmentally considerate solutions

There are a plethora of principles, concepts and tools that help architects to arrive at environmentally considerate solutions, including net-zero resource utilisation, circular economy principles, ecological footprinting, and biophilic and regenerative design. Focusing on one, or several, of these approaches would have a monumental impact. It would improve our built and natural world with cleaner air and lower energy usage, and bring flora and fauna deeper into human habitats.

Glocal knowledge sharing

Glocal knowledge sharing is essential to increase the exchange of ideas across industries and regions. It allows the co-creation of improved outcomes and expedites the collective learning process. Understanding excellence in global practice and applying it sensitively to the local context will foster appropriate innovation and encourage a considered evolution to a more sustainable future.

Retrofitting

Retrofitting the existing built environment offers the opportunity to rethink and improve the sustainability and resilience of existing structures in the face of carbon budgets, sand shortages and the reality of a resource-constrained future. Retrofit offers both novel challenges and opportunities for creative solutions. It is a chance for architects to innovate, enhance and fundamentally redesign all the elements of the built environment for future well-being.

Partnering

Partnering through meaningful collaboration has proven again and again to result in innovative solutions to gnarly challenges. Indeed, pursuing unusual partnerships is central to SDG 17, the objective of which is to "strengthen the means of implementation and revitalise the Global Partnership for Sustainable Development". **[11]** Establishing and developing partnerships is essential for co-creating better outcomes.

Where to start

How can built environment professionals manifest the spirit of thinking globally and acting locally? How can they better engage and make a positive difference given their personal and professional situations? How can they ensure that they consider current trends and drivers affecting the future of design and construction?

Professionals can and, indeed, must be active at many different levels. For example, they can get involved in local politics or in public office, or they can advocate for better outcomes in global, regional, national or local forums. There are many opportunities to make positive change by working with organisations with relevant missions. A small representation of them include the International Union of Architects, **[12]** the International Federation for Housing and Planning, **[13]** the Urban Land Institute, **[14]** the European Council of Spatial Planners **[15]** and the European Regional Science Association. **[16]** Joining committees or projects that are focused on the future of the built environment is a great way to contribute.

There are other organisations whose focus is on improving the overall design of the built environment. Many have research programs as well as engagement platforms where interested parties can be active. For example, the #BuildingLife advocacy project of the World Green Building Council aims to "galvanise climate action through national and regional decarbonisation roadmaps, which will tackle the whole-life environmental impacts of the building and construction sector". **[17]** The International WELL Building Institute is focused on "creating and certifying spaces that advance human health and well-being", certifying practitioners to improve places and spaces for human habitation.

Alternatively, you could look to C40, the membership organisation of city mayors. Although it is more difficult to participate directly, architects could encourage their local city to look to the C40 programming for aspects to emulate.

The most important thing is for each and every built environment professional to participate in some meaningful way.

Go broader, embrace glocal

As Harriet Bulkeley's **biodiversity scan** shows, embracing glocalism also means considering the natural environments that surround our urban centres by applying regenerative design principles. Expanding systemic understanding this way will require a mindset shift so that design decisions consider both the built and natural environments holistically and at a variety of scales.

Architects must account for the way that these systems intersect when creating a single built object or structure. This urban regeneration, which we define as renewal, restoration, and growth after a period of decline or damage which balances the needs of people, place, and planet in harmony with nature, is an opportunity to create lively and resilient environments that improve the quality of life for both people and the planet. Regeneration is a comprehensive approach focusing on making sustainable, net-positive, enjoyable, and considerate places both for now and the future.

Architects can practice regenerative design and systems thinking by embracing continued and active learning, challenging existing methods and practices, and being intentional in their approach.

Clients can incorporate regenerative design and systems thinking in their requests for proposals and push the design community to articulate the value which this brings. Clients may acknowledge their responsibility to be a willing partner in the quest for creating places and spaces for generations to come. This includes staying informed about sustainable design principles, incorporating ecological expertise into projects, and seeking innovative solutions that contribute positively to the built environment, society and natural ecosystems.

By adopting an intentional mindset and continuously questioning and refining ways of working, the built environment sector can contribute to regenerative design that promotes the environmental and social well-being of all living things.

Choose to matter

The next 10 years matter. They are an urgent opportunity for all built environment professionals to be activists and advocates in their communities, towns, cities, counties, countries and global regions. Each has many choices to make every day. As designers and decision-makers, their daily actions shape the narratives of many people's lives. Recognising the privilege and responsibility inherent in the role, they have the unique opportunity, if not the ethical obligation, to make intentional choices that transcend their immediate impact and to take into account the needs of future generations. Efforts such as [y]our2040 have been established to work towards achieving this vision. **[18]**

The scale of our contributions is secondary to our commitment to design with purpose. Just as a well-designed structure is not a product of happenstance but of deliberate choice, so too is life and the world shaped by mindful decisions. It is up to architects to determine how they can, and will, contribute to the future of their profession by being active and engaged actors in the environmental challenges ahead.

As the author Michael Josephson put it, "Living a life that matters does not happen by accident. It's not a matter of circumstance but of choice." **[19]** Let each of us choose to act: our collective future depends upon it.

Regeneration is a comprehensive approach focusing on making sustainable, net-positive, enjoyable, and considerate places both for now and the future.

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Economics of the Built Environment

Introduction

Astrid R.N. Haas is an independent urban economist working across research and practice, supporting cities in Africa, the Middle East and Asia with questions of strategy related to financing and funding. She also has appointments as Adjunct Professor at the School of Cities, University of Toronto, Research Associate at both ODI and the African Centre for Cities at the University of Cape Town, and Extraordinary Lecturer at the African Tax Institute at the University of Pretoria. Her previous engagements include working as an urban economist with the African Development Bank and as Policy Director at the International Growth Centre. She holds an MSc in Public Financial Management from SOAS, University of London and an MA in International Economics and International Development from Johns Hopkins University.

In the 1990s, through policy transfer, governments globally jumped on the political and economic privatisation bandwagon.

What are the global economic systems and forces that will continue to drive the development of the built environment? How will the way money is spent on new and existing buildings by the public and private sector impact on social equality and the life chances of individuals?

In the day-to-day practice of architecture, thinking about economics is most often restricted to the financing of projects: are the economic conditions right for clients to get the funding they need for well-designed projects?

The second theme in RIBA Horizons 2034 programme, 'The Economics of the Built Environment', invites a deeper consideration of the global economic system and architects' part in it.

How is wealth created, owned, distributed and spent, and by whom? Who has the wealth now, and how did they get it? What are they using it for? What effects does the way that money is spent have on those with very little of it? Who gets to commission buildings, and for what purpose? Is the urban form, and the buildings within it, as much an expression of economic forces as it is an expression of design and client choice?

Looking deeper still, are economic forces themselves a manifestation of ideology? During the 1980s, Ronald Reagan and Margaret Thatcher turned the tide on the public sector spending of the postwar years with a zealous enthusiasm for privatisation and new public management, which took a private sector approach to delivering public services. In the 1990s, through policy transfer, governments globally jumped on the political and economic privatisation bandwagon. This has had a profound and lasting impact on the way that governments worldwide delivered many policies – including, for example, housing policy.

So, might client requirements and their resolution in design be helpfully understood not only as expressions of aesthetics and creativity but also as the results of economic and ideological imperatives, sometimes unseen and unacknowledged? And can these considerations inform architects' future choice of how to practice, including what buildings to design, for whom, and where?

The Economics of the Built Environment theme breaks down into four topics: **'interconnectedness and specialisation'**, **'emerging economies'**, **'inequality'**, and **'financialisation of the built environment'.** These topics are, together, likely to drive changes in the economics of the built environment over the next decade to 2034.

Powerful economic drivers

Since the establishment of ancient civilisations, cities have been synonymous with economic, cultural and human prosperity. Whether cities in the future are to remain productive, liveable and sustainable will ultimately be determined, in large part, by the shape of the built environment.

To date, across history and around the world, there is abundant evidence that urbanisation is one of the most powerful driving forces to shift entire generations from poverty to prosperity. **[1]** The power of cities lies in their density and in a built environment that drives interconnectedness and specialisation. For the private sector, this means that firms are closer to a wide and diverse pool of labour, critical for productivity. It also ensures that firms are well networked, allowing them to specialise because they can rely on other firms around them for other specialised inputs into production. Cities also ensure that firms are close to markets – locally, nationally, regionally, and globally – by developing infrastructure that provides avenues for trade. The same density that drives productivity in the private sector also brings people closer together, so spurring new ideas and innovation.

These drivers of economic growth are the same ones that Adam Smith described in his seminal work, 'The Wealth of Nations', first published in 1776. This is why economists emphasise that cities can become key engines for growth. This should be encouraging for many emerging economies, which are currently some of the most rapidly urbanising places in the world. For example, due to high population growth, the number of people living in African cities is set to triple between 2024 and 2050. This has huge implications for the built environment in these places: based on current projections, the urban footprint of Africa is set to expand by more than three times in the same period. **[2]**

As much of East Asia's urbanisation trajectory has shown, the expansion of the built environment needs to be carefully managed. Where this does not happen, urbanisation results in sprawling, disconnected urban spaces characterised by unmanageable density in the form of congestion, insecurity of tenure and the proliferation of informal settlements. Cities that do not invest enough in infrastructure fail to attract businesses and the rapidly growing youth population – i.e., those under 35 years – struggle to find employment, ultimately driving the growth of informal work. Even China's built environment, which has experienced one of the highest rates of expansion in the world, is experiencing an economic slowdown as its population ages and urbanisation slows, leaving broader questions about how to make urbanisation-led growth sustainable.

UN Sustainable Development Goal 11 codifies the global aspiration to "make cities and human settlements inclusive, safe, resilient and sustainable". **[3]** Its first target is to "ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums by 2030". Distressingly, it is one of the few targets that has gone backwards. **[4]** Across the world, the urban environment is failing its inhabitants. UN-Habitat and the Office of the High Commissioner for Human Rights define adequate housing by seven criteria: security of tenure; availability of services, materials, facilities, and infrastructure; affordability; habitability; accessibility; location; and cultural adequacy. **[5]** Ensuring a sufficient supply of affordable housing, a key determinant of liveability and productivity, has become a central challenge for built environment professionals.

How housing is produced and where it is located is a substantial driver of inequality. **[6]** In high-income housing markets, developers are highly incentivised to respond to the demand from their clients to ensure that housing is of good quality and well-located. However, poorer, more vulnerable communities are more tied to what they can afford, often having to forgo most of the other measures of adequacy. For example, many social housing projects are being built further and further from city centres, and thus are far from economic opportunities.

Inequality has been exacerbated by the financialisation of urban land and housing markets since the 1980s. Pioneered in the UK and the US and created by the globalisation and the associated liberalisation of capital markets **[7]**, financialisation is resulting in the current global affordable housing crisis, as experienced in Europe, the UK, the US, and many other parts of the world. Accelerated by technological innovations, banks and other large lending institutions have not only entered but now dominate finance in the built environment – including in housing. **[8]** Land and housing have both substantially appreciated in value over the past decades, becoming the preferred form of collateral. As a result, housing no longer functions just as a home but also as an asset that provides a store of value. As finance-stimulated demand rapidly increases, so too does price, particularly for well-located properties.

A future-focused, intersectoral response

Continuing business as usual is not an option. Not only will it fail to serve our communities, especially the poor and most vulnerable, but it will also fail to address the climate crisis. Currently, cities are responsible for over 70% of emissions globally, and with so many needing to be built to meet projected population growth, continuing at this rate is unsustainable.

The built environment professions must innovate urgently to match the dynamism and pace of change in cities. The approaches adopted must be tailored to their context. What works in regions with ageing populations, such as Europe, are likely to be different compared to what works in regions with a much younger workforce, such as in Africa and Asia. Other changes will also need to be accounted for. In the US, for example, built environment professionals must acknowledge the impact of working from home. **[9]**

Importantly, none of this innovation can be done in isolation. We need an intersectoral response by architects and planners, working closely with economists, engineers, sociologists, and others, to come up with solutions that unlock the potential of the built environment globally. Doing so successfully will have positive repercussions not only for current populations but for many generations to come.

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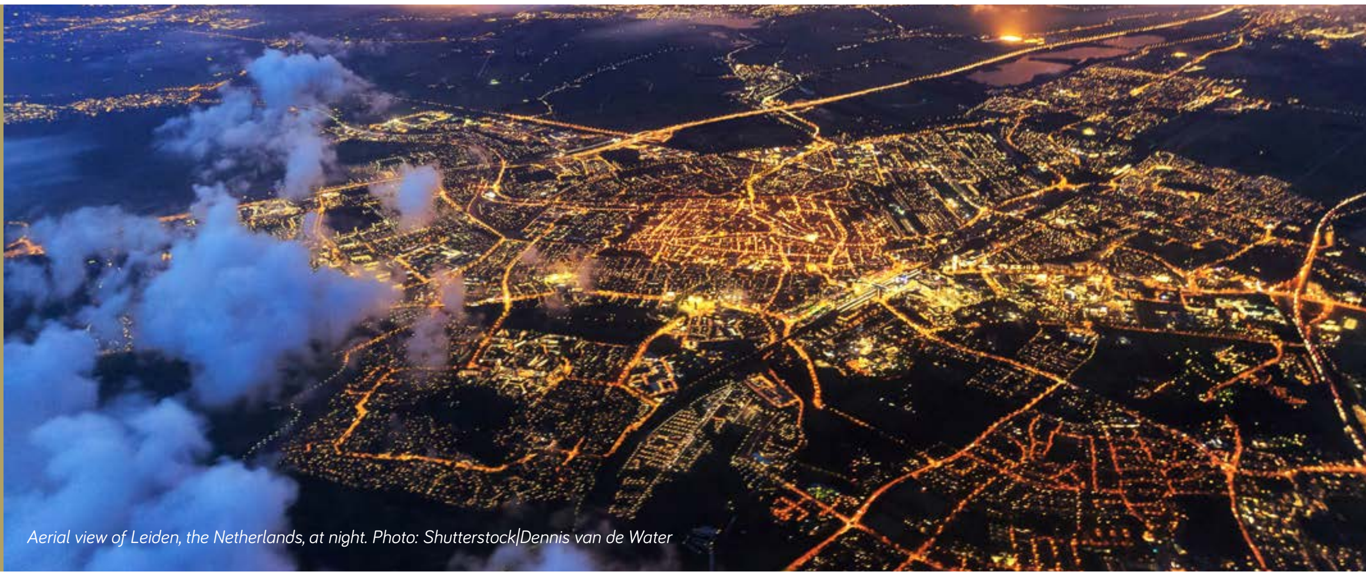

Aerial view of Leiden, the Netherlands, at night. Photo: Shutterstock|Dennis van de Water

Interconnectedness and specialisation: the economic geography of the built environment

Anthony J. Venables CBE is senior research fellow at the Department of Economics, University of Oxford and visiting professor at the Centre for Economic Performance, London School of Economics. He is a Fellow of the British Academy, the Econometric Society, and the Regional Science Association. Former positions include chief economist at the UK Department for International Development, professor at the University of Oxford and the London School of Economics, and research manager at the World Bank. He has published extensively in the areas of international trade, spatial economics, natural resources, and economic development.

Anthony J. Venables highlights the significance of economic geography and the clustering of populations in cities and towns, where people live, work, study, and choose to spend their leisure time. How are these urban and economic forces changing and how might they further shift over time? What could be the consequence for the built environment?

The built environment is composed of structures where people live and work. Economic forces combine with historical, cultural and institutional factors to determine the location of these structures and the forms they take, and to shape the economic geography of countries, regions, cities and towns. This chapter outlines these forces, reflects on how they have changed and might continue to do so, and speculates on the implications of such changes for the built environment.

Economic geography is shaped by the trade-off between the benefits and the costs of proximity. Benefits arise from social interaction and the fact that, to be productive, people in most lines of work need to be close to other people. A thriving market needs lots of buyers and sellers: businesses want to be close to customers and suppliers, and workers want to be close to employers. There are benefits from economic scale and spatial density. These can be achieved within a particular organisation, such as large factories, hospitals, universities or theatres. And they can arise between separate businesses, where clustering in close proximity creates high productivity through various synergies (agglomeration economies). Activities such as research and development (R&D), finance, and creative sectors cluster to benefit from these synergies.

Pulling in the other direction are the costs of proximity, above all the facts that space is limited and that travel (to bring people into close proximity) costs time and money. Floor-space can be added by building tall, but this too is expensive. To these costs can be added those of congestion, pollution, and anti-social behaviour.

These two forces are mediated through two mechanisms: the market, in particular that for land and built structures, and good governance. Markets can support efficient outcomes; for example, rents are high in city centres, ensuring that land is occupied by those who most value economic density. But markets alone do not secure good spatial outcomes. Effective governance is essential to provide infrastructure and to shape cities in ways that support urban productivity.

The remainder of this scan looks at recent, and possible future, developments that change the balance between these economic forces. What are their implications for how space is used, urban areas are shaped, and buildings get constructed?

Technical change in manufacturing, together with competition from emerging market economies, drove the shift from manufacturing to services, a change that hit many traditional manufacturing areas hard.

The structure of employment: what people do

Economic development has been accompanied by massive change in the structure of employment and the built environment. The shift from agriculture to manufacturing and services drove urbanisation. Technical change in manufacturing, together with competition from emerging market economies, drove the shift from manufacturing to services, a change that hit many traditional manufacturing areas hard. At the same time, some places developed high productivity centres of service- and knowledge-intensive activities, particularly clusters of finance, business services, and high-tech, which transformed their urban centres.

These transformations will continue. In developing economies, the urbanisation process is far from complete, and may be hastened by climate change. (See, for example, Abimbola Windapo and Alice Moncaster's horizon scan about **mitigating carbon emissions.**) China's urban population increased by around 700 million over the last 50 years, and Africa's is predicted to increase by that much – an amount similar to the total urban population of the EU and North America – over the next 25 years.

However, the nature of urban employment in developing countries is changing, with discussion of 'premature deindustrialisation'. The model of large factories (often export-oriented) around which many East Asian cities have grown is now being questioned. Some countries are looking to international trade in services (e.g. call centres or routine data processing) to fill the gap, but there are doubts about the employment creation potential of these activities.

In high income countries, there are likely to be changes in the structure of service employment, with faster growth in personal services (which are spatially dispersed) than in business and financial services (which have a propensity to cluster in central areas). Several forces will be at work. One is the demographics of an ageing population, requiring an ever-larger share of the labour force to be involved in personal and health-related services. Another is the development of AI, raising productivity in some service sectors, probably including finance and business services.

It remains unclear how the development of AI will play out, but several observations are possible. One is that AI is likely to be labour-augmenting, rather than labour-displacing: it will improve the performance of workers, rather than substitute for them. Another is that these effects may cut in very rapidly. It took 40 years or so for production techniques to fully adjust to electricity, and the productivity effects of ICT have been slow coming through. But generative AI is catching on fast. For example, ChatGPT reached 100 million users in 60 days and firms are achieving double-digit productivity gains within a few months of commencing use. **[1]** There will be changes in the structure (for example, the skills mix) of workers employed in many sectors, and this is likely to affect the physical form of their workspaces.

A tram passing through Manchester city centre. Photo: Shutterstock|SAKhanPhotography

Connectivity and transport

Improvements in transport and connectivity have double-edged effects. They reduce the costs of economic proximity (by bringing down the time and monetary costs of commuting, for example), thereby enabling cluster formation and the emergence and growth of cities. At the same time they can reduce the benefits of proximity; why should businesses cluster together if they can interact easily over long distances?

To break this down, consider first the costs of transporting people and goods. Technological improvements reduced these costs through the 19th and much of the 20th centuries, enabling trade, international specialisation, and urbanisation. Transport technologies and their costs are now changing relatively slowly, and only one quantitatively important feature stands out: the age of the motor vehicle is not over. Electric vehicles (and possibly autonomous vehicles) are likely to reduce motoring costs, particularly given the small chance that governments will develop effective tax instruments to replace fuel duties.

The costs of transporting ideas and knowledge fell dramatically with the ICT revolution from the 1980s on. This led to a literature about the 'death of distance' **[2]** and the idea that activity would deconcentrate as workers – in some sectors, at least – no longer needed face-to-face contact. Smaller towns and provincial centres would prosper, while cities such as London (where the population had been falling) would become unnecessary.

In fact, the reverse happened, due largely to the growing importance of knowledge-intensive sectors (business services, creative sectors, R&D). These require the benefits of face-to-face interaction: high frequency communication, the transfer of tacit knowledge, and ability to read body language and develop trust. The growth of these sectors was concentrated in relatively few places, which experienced increases in density and land prices. As noted above, as these places boomed so other places (in which structural change had removed traditional manufacturing activities) lagged behind or experienced absolute decline – a problem that was particularly pronounced in the UK and parts of the US.

Distance has not died over the last half-century, but what of the future? Further development of ICT, coupled with the effects of the pandemic, have increased working from home (WFH). This may increase productivity in some activities (those that were screen-based in any case) but cannot replace the in-person contact required in knowledge-intensive skills and might hinder the development of new employees' skills. Nevertheless, a substantial fraction of the workforce is likely to reduce in-work days to three or four per week.

What impact does this have on the economic geography of work and residence? First, as is already apparent, there are changes in the type and quantity of office space required by firms, with increased emphasis on high-quality space and collaboration facilities, and less on routine open-plan space. Uncertainty about future space needs may lead to increased demand for temporary workspace.

A bigger question concerns the attractiveness of large urban clusters relative to dispersed activity. Economic reasoning suggests, perhaps counter-intuitively, that WFH will strengthen large clusters. The benefits of in-person work interaction remain unchanged, but their cost has gone down (commuting just three days a week, not five). This is essentially a reduction in commuting costs, which has the effect of growing the travel-to-work-area from which city firms can draw workers. While employers may need less floor-space, there is no incentive for them to move out of a central area or existing cluster to dispersed locations. On the contrary, running a central operation has become cheaper for both workers and employers.

Fifteen minute cities?

A radical view of the future of cities is the idea of organising urban space so that most people can reach most of the places they want to visit in 15 minutes' walking or cycling. **[3]** The approach combines density with decentralisation through a polycentric urban structure.

What are the prospects of this reshaping cities? The attraction (to the young and the old) of living in dense areas close to amenities, coupled with climate change concerns, are pulling in this direction. WFH might pull in the opposite direction – less frequent but longer commutes and demand for more space at home.

It seems clear that most people will continue to work, some days at least, outside their 15-minute area. Many places of employment (large factories, hospitals, universities, sports stadia, for example) are 'lumpy' – i.e., require scale – and offices will increasingly function as places to bring people together, not as separate fragmented units.

Efficient land-use and city governance

The technological and structural forces that shape the benefits and costs of proximity are usually slow to change. Equally important, and potentially faster moving, are the policies and regulations that shape the built environment. They can harness the benefits and mitigate the costs of proximity.

Failure to manage the costs or achieve the benefits of urban centres is seen most starkly in some developing economies. Unplanned urban growth has led to sprawl, informal settlement, and failure to achieve high productivity. This failure stems from three causes. First is the high cost of providing current services and new infrastructure in fast growing cities. Second are the difficulties in enforcing land rights. Last is the limited capacity of local government to design, implement and enforce policy.

It is unclear how cities of this type will evolve, particularly given possible future patterns of employment. China has provided high-density housing of reasonable quality, based on strong government, a remarkably high savings rate, and at the cost of speculative over-building. This experience offers some useful lessons, notably the importance of land value capture in financing development. But translating this model to other environments is problematic; where tried in Africa it has proved over-expensive and ill-adapted to local needs. New models of mixed-use medium-rise development and new technologies of low-cost building are badly needed.

The UK offers examples of inefficiencies in land-use and spatial policy, some of which could, conceivably, be changed within a relatively short time horizon. Many UK cities have poor intra-urban transport compared to cities of a similar size in other advanced economies. **[4]** This inhibits the development of integrated urban labour markets and is one of the reasons for the poor productivity performance of these cities. Effective levelling-up policy needs to provide the concentrated development push in the UK's lagging cities that is so far lacking, as well as the inter-urban connectivity to support it.

Development is impeded by slow and cumbersome planning procedures, and land-use plans are often outdated. Building costs are high **[5]** and quality often low, due in part to unsatisfactory procurement and contracting processes. Shortages in the overall housing stock are well documented and, perhaps as importantly, land taxation is not conducive to either efficient or equitable use of housing. Property taxation is based on outdated land values and the taxation of housing transactions (stamp duty) impedes the mobility required to ensure best use of the existing housing stock.

These issues are part of the UK's record of chronic under-investment by both the public and private sectors. Investment as a whole in the UK runs at around 17% of GDP, compared to a range of 21 to 25% of GDP in comparator countries. **[6]** A return to economic growth requires raising this investment rate, with much of the spending going to infrastructure, housing, and other built structures. From the UK perspective, the most impactful changes that can be imagined over the next decade are those to do with policy measures to raise investment and remove obstacles to the supply of new built structures, as well as supporting the efficient use of existing ones.

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A busy street market in Lagos, Nigeria. Photo: iStock|peeterv

Emerging economies: how architects can contribute to sustainable urban futures in fast-changing contexts

Giulio Verdini has a PhD in Urban and Regional Development. He is Reader at the School of Architecture and Cities of the University of Westminster, leading the MA course in International Planning and Sustainable Development. He is also Visiting Professor at Mohammed VI Polytechnic University in Morocco. He has held academic positions at the Xi'an Jiaotong–Liverpool University in Suzhou in China and consulted for UNESCO, UN Tourism (formerly UNWTO), Union for the Mediterranean, Cities Alliance, and The King's Foundation.

Giulio Verdini outlines how emerging economies in Africa will drive urban growth in forthcoming decades. How might urban transformation provide opportunities for lifting populations out of poverty? Where might the barriers lie? How might architects and urban planners positively contribute?

The urban population in emerging economies will grow significantly in the coming decade, with the African continent predicted to see the fastest increase. This growth has the potential to stimulate prosperity and to lift people out of poverty, as it did in China a decade ago.

However, strategies used in the past might not work today. New and forward-looking ideas are needed to reduce social inequality and create sustainable pathways to urban development, all without aggravating the global environmental and climate crisis. This is a call for built environment professionals to transform their practice so that the cities of the future are reconciled with nature and generate opportunities for all.

The purpose of this horizon scan is therefore to explore not just the potential costs of and bottlenecks to this great urban transformation, but also its opportunities, and how architects and urban planners can positively shape it.

Two caveats need to be added.

First, the current global context is complex and uncertain. Multiple socio-economic, environmental, institutional, and especially urban crises – which are particularly acute in fast-changing countries – are becoming “causally entangled in ways that significantly degrade humanity’s prospects”. **[1]** Architects must wake up to the impact of these forces, upgrade their competence to respond to them, and adjust their design solutions accordingly.

Second, this uncertainty coincides with what has been called ‘the end of illusions’. The illusions were that, after decades of relatively stable global economic growth leading up to the 21st century, it was thought possible to improve the world’s economic health. As it turned out, though, globalisation was not beneficial for all. Economic interdependency between countries did not always reinforce multilateralism and common understandings. By integrating into this global system, emerging economies did not necessarily embark on economic growth through modernisation, opening up to market opportunities, and democratising their processes. **[2]**

This shattering of old certainties has given rise to new questions. Which solutions should be implemented to enhance the quality of cities and their economic functioning? What forms of international collaboration should be envisioned? And what should be the profession’s ethical response to the changing transnational context?

Trade-offs for a built environment in emerging countries facing multiple crises

Since the world has surpassed eight billion inhabitants in 2022, it is worth noting that more than a quarter of this total has been added almost entirely in emerging economies over the last 25 years. What’s more, the global population is predicted to rise by an additional 1.6 billion by 2050, more than 90% of which will be in emerging countries. While Asia led demographic growth over the past 25 years, Africa is expected to take over for the next 25 years. **[3]**

The proportion of the world’s population living in cities is due to increase everywhere, concentrating in larger cities. By 2030, a projected 28% of people will live in cities with over 1 million people, and nine of the 10 projected mega-cities, i.e., with populations of over 10 million people, will be located in the emerging world. **[4]**

In the second half of the 20th century, the astonishing development of East Asia was primarily attributed to the role of the state in steering growth. In the case of China, development was the result of stimulating market-oriented mechanisms for industrial development while at the same time strictly controlling domestic mass migrations and large-scale land development processes. **[5]** The fact that today China is showing signs of demographic and economic slowdown, while African cities are predicted to grow hugely, is generating a new discourse about the African miracle. **[6]**

Whether Africa will be able to replicate the Asian trajectory and manage its massive urbanisation effectively is, however, open for discussion – not least by Anthony Venables in his horizon scan about **interconnectedness.** Africa still has problems associated with urban sprawl, lack of infrastructure and large-scale informal settlements, meaning that so-called agglomeration economies, i.e., the benefits that accrue when firms and people come together, may not lead to shared prosperity. **[7]**

Back in 2014, the World Bank praised China for its socially considerate urban development model, which had prevented the formation of slums, and for its unprecedented investment in infrastructure. However, they warned against the rising environmental and health costs of such a model, and the potential future shortcomings of its entrepreneurial governance for municipal finance and real estate development. **[8]**

Understanding such critical trade-offs sheds light on the narrow margin for realising the economic potential of the built environment in a sustainable way. For example, forecasts for the economic performance of the global construction sector are promising. The sector is predicted to reach 13.5% of global GDP by 2030, with almost 60% growth in emerging markets alone. **[9]** However, currently the sector is responsible for around 21% of global greenhouse gas emissions. If this continues at the same pace, the economic good will be at the expense of the environment. **[10]**

To reap the global construction’s economic benefits sustainably, the sector must decarbonise and, critically, retrofit the existing housing stock. This is especially true in hot climatic regions where there is an increasing demand for cooling and, because so much housing is in informal settlements, a low resilience to climate change. How much of this housing stock will be in fast-growing cities and whether it will be accompanied by appropriate urban planning policies is unclear.

This gives a picture of the massive challenges ahead. The emergence of multiple overlapping issues, such as mitigation versus adaptation and economic development versus public health, requires strong political visions and tough choices.

Aerial view of Shenzhen: since 1980, it has been one of the fastest growing cities in China. Photo: iStock|CHUNYIP WONG

Competence of architects and planners in and for emerging countries: the need to do 'something more'

Architects' and urban planners' competence to tackle these challenges needs to be enhanced. There is also a critical shortage of these professionals in emerging countries, especially in areas where the challenges pose the greatest risks. **[11]**

Of course, problems will not be resolved simply by adding suitably competent architects and planners. There is the feeling that, as in the early 20th-century debate about the evolution of the architecture profession, 'something more' is needed. **[12]** Complex urban problems need holistic design thinking, integration of knowledge, and anticipatory approaches. City designers will have to navigate the challenges of operating in different and, in some cases, weak institutional environments, and under unpredictable conditions. They will be expected not just to design buildings and cities, but also to manage multi-stakeholder and multi-scalar processes, collaborating to enable long-lasting transformations. **[13]**

Architects' and urban planners' educational curricula should be updated, too. They will need to be equipped with suitably context-based understandings of places and the skills to deal with culturally sensitive issues. At the same time, they need to rise to the professional challenges of digitisation and AI. The legacies of cities, including their inhabitants' traditions and indigenous knowledge, will need to be reassessed, possibly reused, but not erased, in ambitious, innovative urban futures.

What a sustainable city should look like: signs of change

The latest UN-HABITAT report on the future of cities describes an optimistic scenario of "collaborative, well-coordinated and effective multi-lateral interventions", and calls for major efforts to localise global agendas to improve people's lives. It recognises, however, that the goal of eradicating poverty by 2030 is unlikely, and the objective of reducing the number of people living in inadequate housing is still far from reach.

The key to moving from business-as-usual practices, which are dangerously unsustainable, towards more ambitious urban futures lies in the capacity to envision long-term action in the face of multiple crises – which have become the norm in many countries. These include the difficult and unequal global recovery in the wake of the COVID-19 pandemic, the climate emergency, and the tensions caused by wars and conflicts. **[14]**

In times of crisis, it is worth turning to the lessons of history – its pathways and trends, ruptures and experiments – and interpreting them for meaningful foresight. Identifying even small signs of past innovative change is essential in that it stimulates creative imagination and alternatives.

By comparing Asian urban development, and China's in particular, with that of current emerging economies, one might conclude that dirigisme and resource control are the keys to success. However, this may be no longer viable, or desirable, given the side-effects of such a model. There's a danger, however, of throwing the baby out with the bathwater. Chinese municipal Governments' experiments included some interesting approaches. For example, they devised strategies for collaborative urban micro-regeneration, flood-resilient built environments (sponge cities), and, more recently, a massive revitalisation of the countryside. **[15]**

A few emerging countries have attempted, not always successfully, to shift their development away from a model based on manufacturing and cheap labour to one based on a more advanced knowledge-based economy. The idea is to avoid the so-called 'middle income trap'. **[16]** This has resulted in increasing investment in high-quality urban space and rural restructuring, new infrastructure, including for higher education, and new service industries such as finance, retail and tourism.

At the same time, people have experimented with more radical and equity-oriented ways to transform their cities. For example, they have linked urban development to the constitution of new urban commons, circular economies, the re-naturing of cities, and the democratisation of urban processes. **[17]** Taking these aspects together, a more fine-tuned understanding of emerging countries as potentially extraordinary laboratories of innovation may emerge.

Future built environment professionals in a complex world

Built environment professionals' involvement could be game-changing in shaping cities' long-term sustainability. As well as having more of them where they are needed and ensuring that their skillsets are properly upgraded, these built environment professionals will need to position themselves effectively in a changing geo-political context.

We have seen the end of illusions. Countries may act against the internationalist spirit that broadly characterises the architecture and planning professions, **[18]** thus creating barriers to collaboration. While potentially problematic, this is also a spur to reflect critically on how to overcome these barriers by avoiding the mistakes of the past. The complex interdependency of global economies and their common urban challenges requires that built environment professionals operate beyond national boundaries.

Examples like China and the Gulf countries show that virtuous processes of urban development can generate international professional opportunities and new educational ventures. In turn, this can stimulate the formation of a more mature professional class locally.

The solution is not that simple, however. Emerging countries that lack urban infrastructure and skilled professionals may not be able to develop in the absence of processes of economic opening up. Even where the same modernisation process has been tried, it has, in some cases, been contested, generating abstract urban formations, scarcely related to the everyday life of people. Behind a supposedly progressive Westernisation, development assistance, which is generally unilateral, may have resulted in extractive architectural and urban outcomes – in other words, purely for profit, with little regard for social or environmental benefits.

To be credible, new multilateral collaborations need to be built on a different basis. They must be more responsive to the diversity of local contexts and designed to enable regenerative processes. They must forge more mature and equal partnerships between countries in the Global North and the Global South.

Models of development reimagined

The range of models for managing the built environment and stimulating the economic potential of emerging countries have generally only partially responded to the complexity of problems on the ground. Given the imperative to limit global warming, the world can hardly afford another wave of massive urbanisation without decoupling its environmental harm and without fostering more transformative and inclusive processes.

To create sustainable, resilient cities, fresh models of development are needed. What they will look like it is hard to foresee but built environment professionals will contribute constructively to it. To do so, they need a new set of skills. They must be able to respond effectively to the complex challenge of how agglomeration economies are achieved in emerging countries. They must consider the challenge's multiple scales, dimensions, unaccounted costs and trade-offs, anticipating possible solutions. And they must develop the awareness needed to open up a frank, honest and mutually beneficial dialogue between people and places all over the world.

Emerging countries that lack urban infrastructure and skilled professionals may not be able to develop in the absence of processes of economic opening up.

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A cluster of homes in a township in South Africa. Photo: iStock|Grant Duncan-Smith

Inequality: planning and design for a more equitable world

Taibat Lawanson is Professor of Urban Management and Governance at the University of Lagos, Nigeria where she leads the Pro-Poor Development Research Cluster and serves as co-director at the Centre for Housing and Sustainable Development. Her research focuses on the interface of social complexities, urban realities and the pursuit of spatial justice in Africa.

Professor Lawanson is a member of the board of directors of the Lagos Studies Association and the steering committee of Future Earth's Urban Knowledge Action Network. She is a fellow of the Nigerian Institute of Town Planners and an alumna of the Rockefeller Foundation Bellagio Centre.

Taibat Lawanson describes the persistent impact of inequality globally – the unequal distribution of resources and opportunities among members of a society, standing in the way of socio-economic development. How might the vision and actions of built environment practitioners, aspiring to a more equal world, provide a catalyst for spatial justice?

Over the last few decades, the tackling of poverty internationally has transformed millions of lives. [1] Despite this, we still live in an unequal world. The stark reality is that the poorest half of the world's people have just 2% of the total wealth whereas the richest 10% have 76%. [2] This is a critical issue for the next decade to 2034.

Inequality happens when resources and opportunities are unequally distributed among members of a society. Inequality can be unjust where it is based on characteristics such as race, religion, sex and citizenship status. It can also unjustly arise from the unearned income passively derived from wealth or capital. **[3]**

Unfortunately, the problem is persistent and stands in the way of socio-economic development. This was acknowledged by the UN, whose global commitment to reducing inequality within and among countries is articulated in SDG 10. **[4]**

A gated community with sports facilities outside Guayaquil City, Ecuador. Photo: Alamy Stock Photo|Michael Müller

Studies on inequality are often related to issues of economic globalisation, international migration, and neoliberal government policies, relying almost exclusively on national income data. However, merely addressing poverty alleviation is treating the symptom rather than the root cause, which arises from unjust structural systems of wealth accumulation and power and has multifaceted economic, social, environmental, and political dimensions.

Of course, moves to improve inequality in the built environment need to be done sustainably, without breaching limits for carbon emissions. This is because inequality of wealth between countries is directly linked to inequality of emissions. Currently, the wealthiest 1% emit more carbon than the bottom 50%. As emerging countries develop and their peoples are lifted out of poverty, their emissions will increase. To compensate, wealthy countries, whose own economic advantages were at enormous carbon cost, have an ethical responsibility to reduce their emissions while redistributing their wealth to parts of the world in greatest need.

At its most basic level, inequality manifests spatially in residential segregation and neighbourhood development. A critical factor in effecting beneficial change, therefore, is to rethink the built environment – its development, governance, funding, and affordability. As Soja put it: "If the geographic space formed by the social process is not socially just or fair to all, the space formed in this way affects the society and lives of individuals in unjust ways." **[5]**

Inequality has a postcode

Inequality in the built environment arises from the location of economic and service facilities. Simply put, where a person lives to a large extent determines the quality and level of access they have to public resources, including education, health and public spaces. This pattern is perpetuated when people in a particular social class enjoy all the opportunities and benefits, leading to spatial injustice.

The so-called platform economy has accentuated this divide. Those selling short-term rentals – Airbnb, for example – reinforce existing spatial patterns of inequality and segregation. In neighbourhoods occupied by privileged people, this exacerbates uneven development. It also increases disparities in areas with a locational advantage by blurring traditional boundaries between residential and tourist areas in the city. **[6]**

Political choices about the built environment can have lasting positive and negative impacts on inequality. For example, in South Africa, the built environment is still dominated by the impact of apartheid planning policies that continue to entrench racial and economic segregation. On a more positive note, South Africa's mixed-income public housing policy deliberately and directly seeks to counter existing spatial and social segregation across the country. **[7]** This positive bent is a direct result of participatory decision-making that prioritises planning with rather than for the people.

Planning and anti-planning

Socio-spatial inequality can also be exacerbated through land use regulations. For example, land use zoning can be a way to hoard opportunities. A study of Dublin found that, while land-use regulations can be sensible and fair, they can make it easier for a small subgroup within the community to seize all the economic benefits. **[8]** This, of course, limits the wider community's diversity and social mobility.

On a larger scale, recent waves of gentrification and the proliferation of gated communities, elite enclaves, new cities and special economic zones have all exacerbated socio-spatial inequalities in large cities. From London to New York, Mexico to Lagos, this form of elite capture, which is often accompanied by extensive land grabs and forcible displacement of local communities, attempts to produce aspirational visions of a utopian city where only the rich belong. **[9]**

These grandiose visions, driven usually by the vested interests of the political and economic elite, are given material expression through the professional expertise of architects, urban designers, urban planners and other built environment professionals. This reinforces the stereotype that those who envision the built environment have a disregard for the practicalities of everyday life. **[10]** It also calls into question city-making processes and their governance, with all their implications for the future of human settlements.

The immediate and longer-term impact of these decision-making trends is that they promote the design and planning of socially unjust spaces. Real estate investment by the rich often results in an architecture of fear in middle- and high-income neighbourhoods and a growing public discontent in lower income ones.

In London, for example, development is almost entirely in the interests of capital investment rather than creating social value, with empty housing units priced out of the reach of those who need housing most. **[11]** In a city where people wait months or years for a home and have to compete hard when one becomes available, this inequity – unsurprisingly – breeds a sense of conflict. The effect is compounded by the relative neglect of the infrastructure supporting residential and commercial spaces patronised by mostly lower income households.

Planning and design for a more equitable world

The future of cities and indeed all human settlements rests on the vision and actions of built environment practitioners. In transiting to a more equal world, how can we catalyse spatial justice?

The first thing to recognise is that the social and environmental implications of design decisions are equally as important as ones to do with aesthetics and functionality, and that to ignore them risks unintended consequences. As custodians of the built environment, it therefore behoves architects, planners and built environment professionals to prioritise these considerations early during conceptualisation stages of projects. Also, curricula for architecture and planning education, and how they are taught, must treat social awareness as equally important as those disciplines' other skillsets. (A good example of this is Architecture for Social Purpose, a mandatory topic in RIBA's core CPD curriculum.)

Future-proofing human settlements also requires embracing full participatory consultation. This means going beyond mere tokenism to engage with the communities impacted throughout the project lifespan. This has been shown to have multiple benefits, including increasing the likelihood that developments will be fit-for-purpose, be sustainable in the long-term and enjoy full community support.

The good news is that many built environment professionals are already at the forefront of promoting such socially just spaces. Examples abound of architects, urban planners and urban design teams engaging in the conceptualisation, design and implementation of equitable urban and climate resilience strategies and action plans. There are many tactics. For example, they have developed urban regeneration plans and programmes predicated on expanding land tenure and access for vulnerable groups. They have championed the provision of mixed-income, low-cost social housing and advocated against environmental despoilation and direct interventions in natural and built environment heritage conservation.

However, it is not yet nearly enough. What is required is the scaling up and expansion of such efforts beyond current levels. As building professionals looking to the future of cities and other human settlements, it is important that social and spatial justice is enshrined in their ethos. RIBA Code of Professional Conduct, for instance, requires that: "In performing professional services Members should promote stronger communities and improve equality, diversity and inclusion in the built environment." **[12]** It is only by paying attention to this ethical dimension that professionals can truly contribute in a tangible manner to a more equal world.

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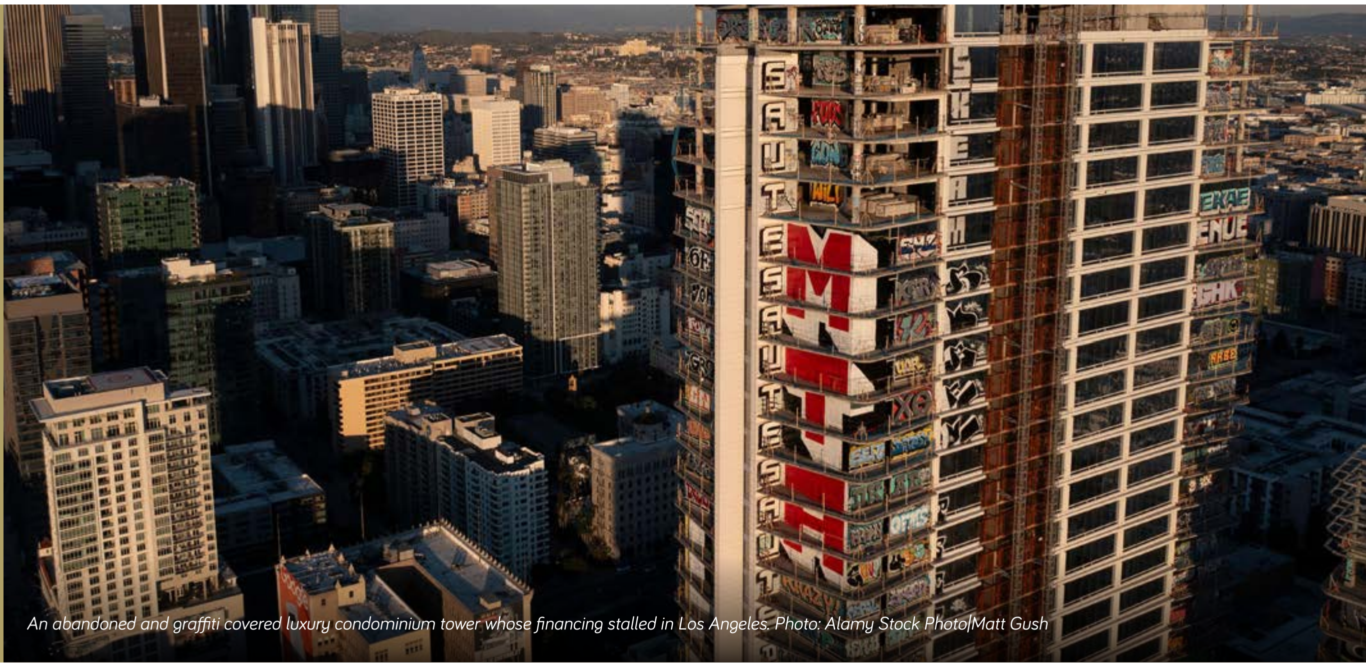


An abandoned and graffiti covered luxury condominium tower whose financing stalled in Los Angeles. Photo: Alamy Stock Photo/Matt Gush

Financialisation: buildings and architecture at the centre of global financial systems

Matthew Soules is Associate Professor of Architecture at the University of British Columbia's School of Architecture and Landscape Architecture, and founder of Matthew Soules Architecture. He has been visiting faculty at the Southern California Institute of Architecture and visiting associate professor at the Harvard University Graduate School of Design. His most recent book is 'Icebergs, Zombies and the Ultra-Thin: Architecture and Capitalism in the Twenty-First Century' (Princeton Architectural Press, 2021). He is co-founder of Architects Against Housing Alienation (AAHA), an activist collective that represented Canada at the 2023 Venice Biennale of Architecture.

Matthew Soules explains how built property now sits at the very heart of complex, global financial systems. This situation will only be compounded in the decade to come with the expanding scope and scale of property technology and the housing crisis. How might a sharper awareness among design and construction professionals of buildings' role in financialisation deliver a more just and beautiful built environment?

A defining challenge for the architectural profession in the 21st century is how to position itself in relation to financialisation. While buildings have always been to some degree 'financial' – physical embodiments of wealth necessarily connected to economic systems – it is a relatively recent transformation that has embedded them squarely at the centre of vast and complex financial systems. It is not a stretch to say that buildings are now not only dialectically informed by and informative of finance, but an integral and primary medium of finance itself.

In the forthcoming decade to 2034, emerging trajectories of financialisation, such as the expanding scope and scale of property technology and the entrenchment of the spatial politics of crisis, will pose significant implications for buildings. A sharper awareness of buildings' role in relation to financialisation has the potential to empower architects, professional membership institutes, and the wider public. Understanding how financialisation works reveals opportunities and constraints for how to create a more just and beautiful built environment.

The FIRE economy

While finance is integral to capitalism, its prominence has risen and fallen over time. At the time of writing, 2024, it is very prominent. Indeed, there is near-consensus of an unprecedented rise in finance's scope and scale since approximately 1980.

American sociologist Greta R. Krippner defines financialisation as "a pattern of accumulation in which profits accrue primarily through financial channels rather than through trade and commodity production. 'Financial' here refers to activities relating to the provision (or transfers) of liquid capital in expectation of future interest, dividends, or capital gains." **[1]** Real estate occupies a central position in financialisation. The extent of its symbiotic integration has even spawned its own term: 'FIRE economy', where FIRE stands for 'finance, insurance, and real estate'.

The extent of this economic ecology can be measured in a myriad of ways. In most euro area countries, bank mortgage loan portfolios exceed 200% of the core capital of banks. **[2]** Americans have over $12 trillion USD in mortgages, accounting for 70% of consumer debt. **[3]** US commercial banks alone hold approximately 5.5 trillion USD in real estate loans, a 22-fold increase in constant dollars since 1980. **[4]** Multinational insurance companies are among the world's largest real estate investors. Buildings and their subdivided increments are integrated into a vast and interconnected financial network like never before.

Buildings increasingly function as physical sites to store wealth speculatively. From mega-basements in Aspen to hyper-tall and thin condominium towers in Dubai, buildings are mutating, literally changing shape and scale to soak up capital.

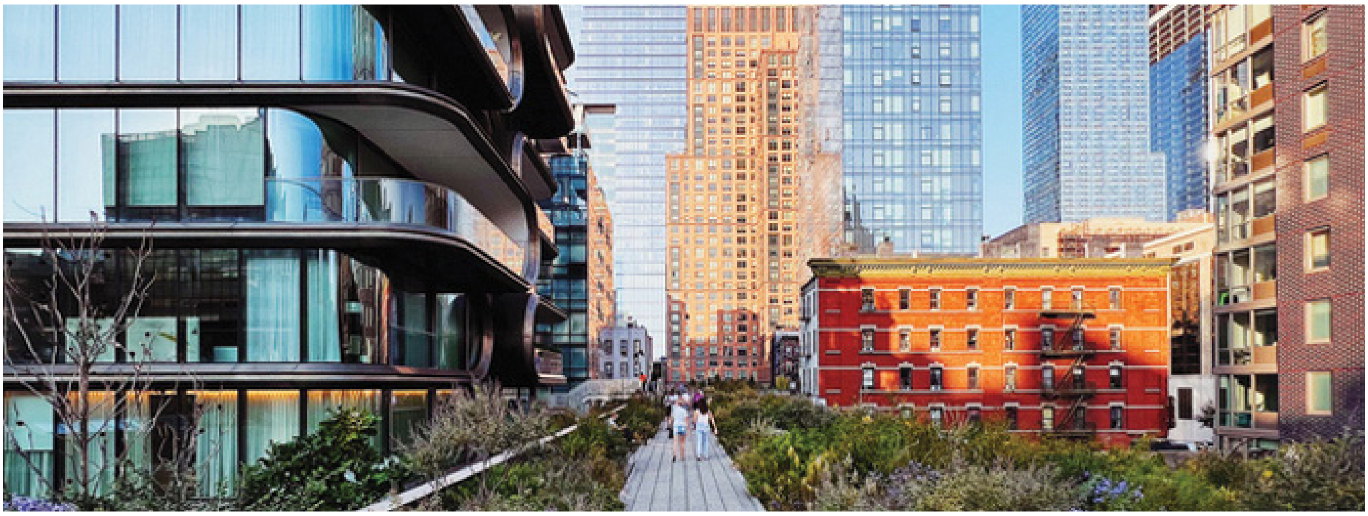
The giant pool of money and asset architecture and urbanism

An important driver of financialisation is the 'giant pool of money', i.e. the aggregated and growing amount of worldwide capital savings that are held in a variety of forms such as pension funds, mutual funds, or insurance funds. In a process that David Harvey describes as the "perpetual need to find profitable terrains for capital-surplus production and absorption", the built environment has provided a primary site of the giant pool's absorption. In so doing, it has changed to suit the logic of financialisation. **[5]**

The resulting finance capitalist architecture and urbanism is inherently unstable and creates spaces in perpetual crisis. This is seen in the increasing unaffordability of housing in most major cities and the large swings between various forms of growth and decay that pulsate across cities, regions, and continents. Buildings increasingly function as physical sites to store wealth speculatively. From mega-basements in Aspen to hyper-tall and thin condominium towers in Dubai, buildings are mutating, literally changing shape and scale to soak up capital.

Perhaps most significantly, financialisation challenges real estate's position as the quintessential illiquid asset. The slow friction wrapped up in the saying "all real estate is local" has been ground away. Today, real estate is a smooth, radically expanded market of maximum liquidity where large amounts of self-similar architectural assets are exchanged with relative ease.

Transforming buildings and their subdivided increments into more liquid assets necessitated shifts in finance, law, business, technology, and physical form. Inherently more liquid financial instruments were invented and tethered to built space, including mortgage-backed securities (MBS) and shares in Real Estate Investment Trusts (REITs). Condominium laws that emerged in the 1960s and gained widespread popularity in the 1990s, facilitated for the very first time in many jurisdictions the direct ownership of housing units separated from the ground. Owning a condominium unit high in the sky literally removed it from the messy unpredictability of the public ground plane. International real estate brokerage firms that first emerged in the mid-1970s, and radically expanded in scope and scale in the 21st century, helped individuals and entities to purchase real estate in far-flung locations. All of this was supercharged with the rise of so-called proptech (property technology), a subset of financial technology devoted to real estate, that started in the 2000s and continues to gain momentum.



View featuring high-end apartments along the High Line towards the towers of Hudson Yards, New York. Photo: Getty Images| Alexander Spatar

The forms of finance

At the beginning of the 21st century, architect Rem Koolhaas wrote: "In the free market, architecture = real estate." **[6]** While buildings have acquired heightened liquidity through new financial instruments, laws, and business practices, their physical form and function are also at play. There are four primary design strategies for making built assets more liquid: 1) simplifying space, 2) maximising the number of assets, 3) facilitating remote ownership, and 4) adding superficial complexity to compensate for the negative consequences of the first three strategies.

Common tactics to simplify spaces include deploying design characteristics that minimise the possibility of meaningful social interaction. The unpredictable and unique nature of the human life that unfolds in and around buildings is time-consuming to account for as an investor, and so makes buildings less liquid. Reducing the chances of social interaction standardises space and converts it into something more abstract and easily exchangeable. Maximising the number of assets means repeating standardised units in large numbers. Facilitating remote ownership centres on adjusting the siting, massing and organisation of buildings to reduce maintenance demands and security concerns and thus the need to be on hand to deal with problems as they arise.

Units that comprise the entire floor of ultra-thin towers; vast horizontal expanses of tightly spaced and almost identical single-family homes; residential towers severed from the public realm because they sit atop private podium landscapes: these are all avatars of architectural assets optimised for liquidity.

Paradoxically, while applying the first three strategies heightens built assets' liquidity, it also damages their appeal. The diminishing 'real' in 'real estate' threatens to undermine its very capacity as a unique asset class. To resolve this inherent tension and compensate for what has been lost, designers invent conditions that merely seem complex. The obsession with views, recreational leisure space, complex surface geometries, and manufactured natures in the guise of sustainability are all manifestations of this compensatory complexity.

The strategies apply to many different segments and geographies of financialisation: they are as prevalent for middle-class housing in ex-urban Spain as they are for luxury flats in central Beijing.

Variegated, localised, and global [7]

Even though the forms and logic of financialisation are global, they differ from neighbourhood to neighbourhood, city to city, and country to country. Financial instruments such as REIT and MBS may not have a direct presence in low-income countries, but the buildings produced in these contexts can often be equally financialised.

For example, housing micro-finance has dramatically expanded in the Global South where it is now deeply enmeshed with informal architecture and urbanism. **[8]** In Latin America, it is common for large construction material companies to provide self-builders with consumer loans, allowing transnational finance to flow through low-income spaces. **[9]** Proptech in the form of new mobile apps is expanding the micro-financing of housing across Africa. **[10]** And sometimes financialisation connects the architecture of high-income and low-income countries in surprisingly direct and perverse fashions. Take, for example, Bjarke Ingels Group's Vancouver condominium tower that included the world's first "one-for-one" home gifting program, in which each condominium purchase funded the creation of a housing unit in a "slum" in Phnom Penh. **[11]**

Ongoing financialisation, instability, and emerging implications

In the aftermath of the 2007 to 2008 global financial crisis, which started in real estate, there were numerous policy changes meant to mitigate the risks of a repeat. However, financialisation itself has continued apace, and during the pandemic, it accelerated.

All manner of risk remains. What was once the world's largest real estate company, Evergrande, was ordered to liquidate in early 2024 amid the ongoing real estate crisis in China. At the same time, regional banks in the US were experiencing real estate-related losses, fueling worries of a new financial crisis.

It's anyone's guess what will happen, but financialisation's continued march and associated instabilities are certain. Two likely trajectories that pose significant implications for architecture are, first, the expanding scope and scale of proptech and second, the entrenchment of the spatial politics of crisis.

Expanding scope and scale of proptech

The expanding scope and scale of proptech is likely to accelerate financialisation in the coming years. Digital twins of built space, which are designed to facilitate smart buildings and city planning, operations, and maintenance, is also being used to streamline real estate transactions.

During the pandemic, virtual home tours became commonplace, and this practice will likely become widespread and more varied. Virtual home staging is already touted as a way for sellers to save money and time, and generative AI is poised to become fully synthesised with the effort. At the same time, crowdfunding real estate platforms (such as Fundrise) that allow real estate investment for as little as 10 US dollars are gaining momentum.

While it will be full of fits and starts, dead ends, and failed ventures, the convergence of digital twinning, generative AI, and digital real estate investment platforms will almost certainly expand the limits and character of financialisation in the built environment.

The spatial politics of crisis

The prevalent opinion in public discourse around the world is that housing is in a state of crisis marked by widespread unaffordability, too little space per person, precarity, and homelessness. While almost everyone agrees that housing is not faring well, the reasons for the crisis are hotly contested. To what degree is it a result of financialisation? To what degree is it the result of an undersupply?

The scope and scale of this highly politicised crisis have no easy answers or quick remedies. However, it seems certain that financialisation is involved to an important degree, and that built environment professionals will be operating within the crisis for the foreseeable future. The implications for architectural practice are significant.

Implication 1: digital twin feedback

When the use of digital twins becomes widespread in the buying and selling of housing, a peculiar phenomenon occurs: digital twin feedback.

This is how it works. Certain spatial characteristics are easier than others to represent in a digital twin that is navigated on a mobile or desktop application. And indeed, certain characteristics become paramount to the liquidity of the architectural asset within this medium. Because these virtual characteristics are easier to represent, they become ubiquitous, with the result that they begin to infect the real world.

Kate Wagner, architecture critic for 'The Nation' and creator of the 'McMansion Hell' blog, has written about the omnipresence of the colour 'greige' – gray-beige – in actual residential interiors. She brilliantly describes this as a byproduct of the "reorganisation of the real estate industry away from traditional vectors – television and magazines – toward the Internet" and the way that "neutral gray colors are integral to [the] new post-digital kind of unreality' of virtual staging. **[12]** The point here is that greige is so important in the housing market's digital marketplace that it entrenches the colour in physical, built space. It might even be possible to say that greige is the colour of financialisation.

Online real estate platforms and all manner of mortgage lenders now use Automated Valuation Models (AVMs) for the valuation of real estate. In fact, AVMs are one of the most widespread existing uses of artificial intelligence, and their use is spreading globally. **[13]** As a 2023 report from the Brookings Institute states, AVMs "are among the most established, ubiquitous, complex, and impactful algorithmic systems in the United States." **[14]** With providers like CoreLogic UK and Hometrack/Zoopla, the UK appears to be the most active European country using AVMs.

As these systems become more central to the valuation of buildings, a major challenge for architects is the limitation in what AVMs can 'see'. The systems are most accurate when working with generic architectural space. They don't possess the means to value design elements beyond basic real estate metrics of things like proximity to schools, size, and number of bathrooms.

In the near future, it is likely that these systems will be able to assess digital twins, allowing them to 'see' more aspects of architectural design and thereby factor them into valuations. There is a tremendous possibility that this will result in greater simplification and standardisation of buildings in the service of greater liquidity. Proportions, spatial relationships, circulation, window placement, will all be algorithmically maximised to perform optimally for machine vision algorithms. The omnipresence of greige is only the beginning of this digital twin feedback loop.

Implication 2: alternative forms of practice, from activism to the developer-architect

As financialisation continues, the potential for meaningful and spatially just architecture within the dominant economic paradigm will be further constrained. This is likely to result in more architects searching for alternative modes of practice, ones that extend beyond the most common and well-understood bounds of the profession.

The intensity of the spatial politics of crisis, which is driven at least in part by financialisation, may see more architects involved directly in activism, operating overtly to challenge the political economy of the built environment. Witness the rise of The Architecture Lobby as a case in point. (To see how activism works, see Chris Luebkeman and Jonelle Simunich's **Engagement and Activism horizon scan.**)

At the same time, project delivery models that operate outside the common strictures of the private market are already flourishing and may see increased growth on the horizon. A renewed interest in such things as housing co-ops, co-housing, co-living, and community land trusts all open avenues for architecture that is resilient to the limitations imposed by financialisation.

Architects may increasingly become actively involved in the financial context of their projects, designing creative and critical forms of finance that operate synthetically with physical form. John Portman, perhaps the most renowned developer–architect, said back in 1976 (just as financialisation was taking shape) that he had learned "to think of real estate architecturally." **[15]** German Baugruppen, Catalan housing co-ops, and developer–architects like Melbourne's Nightingale Housing can all be understood as contemporary and relevant manifestations of thinking about real estate architecturally.

Implication 3: affordability versus design

Housing crises and the intensity of the political discourse around them is generating a patchwork of new policies at all levels of government (local, regional and national) that will continue to evolve into the foreseeable future. This results in a dynamic and diverse terrain for architects to navigate.

Perhaps somewhat paradoxically, some of the new measures aimed at addressing affordability will accelerate financialisation and housing alienation. This all stems from the widespread argument that today's housing crises are primarily the result of low supply.

A harbinger of what may be in store occurred in late 2023 when the Canadian government announced plans to introduce a catalogue of government-sanctioned and "pre-approved" housing plans to "unclog the housing pipeline." **[16]** Shortly after its announcement, Allan Teramura, past president of the Royal Architectural Institute of Canada, called it out as a misconception. He wrote: "The … concerning implication of this initiative is that somehow the time spent on the design of housing is a major impediment to lowering its cost. This is a fallacy … The housing industry is already based on a model of the absolute minimum of time spent on design." **[17]**

Fighting the negative impacts of financialisation: activist architects and critical finance

For the foreseeable future up to and beyond 2034, financialisation will be central to the built environment sector. It will continue to inform everything from the design of floor plans to the political environment within which architects operate.

Practitioners, professional institutes, and non-governmental organisations can respond with activism to blunt its impact, or by promoting new modes of practice that involve adaptive collaboration with critical and creative financial consultants. Either way, they will be well-served to self-consciously position themselves in relation to its ongoing constraint of architectural potential and its de-socialising consequences.

The intensity of the spatial politics of crisis, which is driven at least in part by financialisation, may see more architects involved directly in activism, operating overtly to challenge the political economy of the built environment.

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Population Change

Introduction

Jane Falkingham is Professor of Demography and International Social Policy at the University of Southampton. She is Director of the ESRC Centre for Population Change whose remit is to better understand the drivers and consequences of demographic changes.

A wide variation of demographic patterns is emerging internationally, with rapid growth continuing in some regions, ageing and contraction elsewhere, coupled with wide-scale movement. How can design professionals simultaneously respond to the level of change at the urban scale, while supporting social cohesion for diverse and intergenerational communities?

According to the United Nations, on 15 November 2022 the world's eight billionth citizen was born in the Dominican Republic. [1] The UN described it as "a milestone in human history" – the culmination of an era where dramatic improvements in diet, sanitation, education and income have led to better health, resulting in an acceleration in the size of the global population.

It took all of human history for the world to reach its first billion at the dawn of the 19th century. The pace of change then quickened as the Industrial Revolution spurred on economic growth and social change, with the landmark of the second billion reached in 1930. Since then, the time between successive billions has shortened, with the result that, within the lifetime of someone born in the early 1970s, the world's population has doubled from four billon to today's eight billion.

It is widely accepted that the global population cannot continue to grow at such a pace. Most demographers believe that the world's population will stabilise at around 10.4 billion at the start of the next century, ending three centuries of population growth. **[2]**

So where might we be in 10 years' time in 2034? Population growth is already slowing as families adjust their behaviours, with parents choosing to have fewer children. Fewer births mean that the world's population is changing in shape, moving from the classic 'population pyramid' – with lots of children at the bottom and few older people at the top – to a 'population rectangle' where there will be similar numbers of people at each age. In short, this means that we have an ageing population.

Population growth is already slowing as families adjust their behaviours, with parents choosing to have fewer children.

The Population Change theme for RIBA Horizons 2034 considers four challenges.

The first is how architects should respond to **changing demographics**. How do we design for tomorrow's population, with more single person households, smaller families and more generations alive simultaneously? How do we ensure that our (smart) homes can age with us, enabling us to continue to age in place and remain living in the community? And how can cities be designed to support an ageing society?

Not all parts of the globe have gone through this demographic transition at the same time or pace, meaning that the spatial distribution of the global population has changed and will continue to do so. Europe and North America are projected to reach their peak population this decade, and indeed some countries within these regions are already experiencing population decline. In contrast, the population of sub-Saharan Africa is still growing and is expected to almost double by 2050, surpassing two billion inhabitants.

Urbanisation is the second population challenge. The diversity in population growth, allied with stark differences in economic and social life chances between countries and areas within countries, means that more people than ever are on the move.

Today, four and a half billion of the world's eight billion citizens live in urban areas and this is likely to increase by a further two and a half billion by 2050. **[3]** Rural to urban migration has seen the emergence of megacities – that is, cities with over 10 million inhabitants – in China, India, Latin America and parts of sub-Saharan Africa, with all the challenges this creates for the built environment and the supply of services.

As well as moving from rural to urban settings, more people than ever are moving across international borders and so **migration and displacement** is our third population challenge.

According to the UN, the number of persons living outside their country of birth or citizenship reached 281 million in 2020. **[4]** Today, international migration helps to maintain the population size and labour force in countries where the birth rate is low, adding to the cultural diversity of villages, towns and cities across Europe.

However, skilled economic migrants are just part of the picture. The past decade has witnessed a marked rise in the number of people displaced because of armed conflict and famine, with mass movements of refugees and asylum seekers. How should architects respond to these movements?

The final population challenge – the increasingly **diverse population** – brings together aspects from all three previous challenges. The built environment professions need to respond to the increasingly diverse makeup of our communities, creating places that meet the needs of different age groups and communities while promoting social cohesion.

Looking forwards

Population change over the next decade will provide exciting opportunities for designers, while presenting some resourcing challenges, meeting a skills gap.

With cities in the Global South expanding rapidly, often in unplanned ways, the need for design professionals to drive equitable and sustainable development has never been higher. In many low- and middle-income countries, developing collaborative ways to advance, retain and enlarge the pool of those much-needed professionals is a priority.

Moreover, the UN population projections used here assume that the IPCC target to limit average global warming to 1.5°C above pre-industrial levels will be met by the end of this century, which may be optimistic. Should we fail to adequately address the climate challenge, global displacement and forced migration because of rising sea levels, desertification and the increased risk of natural disasters will be on a much bigger scale than anticipated.

Going forward, built environment professionals need to be aware of the complex nexus between environmental and population change, taking care to minimise their impact upon the environment while addressing the need for housing and public infrastructure for our changing population.

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Intergenerational living: a family eating together. Photo: iStock/andreswd

Demographics: slowing population growth, changing families and an ageing population

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Maria Evandrou discusses recent demographic changes and how over the next decade an ageing population will influence the type of homes, communities and cities that architects will be called upon to design.

Over the next ten years, demographic changes will impact the size and composition of national and global populations, influencing where and with whom people will live and the type of homes, communities and cities that architects will be called upon to design.

Slowing population growth

Following a century of unprecedented rapid growth in the world's population during which the size of the global population has quadrupled from two billion in 1930 to eight billion in 2022, the pace of population growth is now slowing down.

According to the latest data from the United Nations Population Division, in 2020 the global population growth rate fell below 1% per year for the first time since 1950. **[1]** Today, many countries have low or even negative rates of 'natural' population growth (measured as the difference between the birth rate and the death rate), reflecting the fact that people are choosing to have fewer children.

At the same time, advances in medical technologies, alongside improvements in sanitation and nutrition, mean that life expectancy has been rising. In 1950, the average life expectancy at birth for the world as a whole was just 46.5 years; by 2020 this had reached 72 years. Over the next decade, it is projected to continue to improve by another three years, reaching 75.3 in 2035 – a rate of improvement equivalent to seven hours a day.

An ageing population

With more people living longer and fewer births, the global population is also ageing. One measure of a population's 'age' is provided by its median age (the age where half the population is aged below this level and half above). In 1950, the median age of the global population was just 22.2 years. By 2020, it had risen to 29.7 years and by 2035 it is predicted to increase to 33.1 years. **[2]**

There are however significant differences by region. In 2022, the 'oldest' country in the world by this measure was Monaco at 54.5 years, followed by Japan (48.4 years) and Italy (47.3), with the UK at 39.6 years. The 'youngest' five countries are all found in sub-Saharan Africa, with the median age in Niger being just 14.5 years and in Mali, 15.1 years.

Another useful measure of population ageing is provided by the share of the population aged over 65 years. In 2023, Monaco was the country with the highest percentage (36%) of the total population over the age of 65 years. (This is not surprising given their population's median age.) Japan had the second highest (29%), while Portugal and Bulgaria followed in joint-third place (24 %). **[3]**

Currently, 19% of the UK's population is aged 65 years and over. According to the latest population projections published by the Office for National Statistics (ONS) in January 2024, by 2040 the size of the UK population aged 65 years and over is projected to increase from 13 million (19% of the total population) to 16.9 million (23% of the total population). **[4]**

These demographic changes have important implications for the built environment and how architects plan for and design homes, schools, workplaces, hospitals, shops, leisure facilities and many other building types.

For example, falling birth rates in many countries mean that over the next decade, fewer places in schools will be needed. In England and Wales in 2022 there were just 605,479 live births, a 17% decrease from 729,674 in 2012. **[5]** As these smaller cohorts of babies and children move through early years into reception and then into primary school, they will shape the demand for classroom spaces.

The UK is far from alone in experiencing a reduction in birth rates. In 2023, the fertility rate in Taiwan was estimated to be 1.09 children per woman, making it the lowest in the world, closely followed by South Korea at 1.11 and Singapore at 1.17, with Italy (1.24) and Spain (1.29) also in the lowest 10 countries in the world. **[6]**

Changing living arrangements

The lower number of births in part reflects trends towards delayed marriage and childbirth, which in turn are echoed in more young adults either living alone or sharing in multiple-person households. According to a recent report by Euromonitor International, child-free households are set to become the main household type by 2040, transforming consumer demand. **[7]**

Property developments providing accommodation for young adults with shared communal facilities have been on the rise over the last decade, extending the concept of 'student living' beyond the boundaries of higher education. A good example is The Collective in Canary Wharf, which offers individual studio apartments with shared living and co-working spaces along with organised events, libraries, restaurants, and cinema rooms.

At the other end of the life course, co-housing is also gaining in popularity. This is exemplified by the Older Women's Co-Housing group, which recently established a community in flats in Barnet, north London, with residents aged from 58 to 94 years.

Property developments providing accommodation for young adults with shared communal facilities have been on the rise over the last decade, extending the concept of 'student living' beyond the boundaries of higher education.

Marmalade Lane, designed by Mole Architects, is a co-housing development in Cambridge that fosters mixed, intergenerational living. Photo: Mole Architects, David Butler

Rethinking homes for intergenerational living

Across the globe, many individuals live in households with multiple generations of related adults. Indeed, in some parts of the world, especially parts of Asia, this remains the predominant form of living. **[8]**

In the UK, the past decade has witnessed a rise in multi-generational living as more young adults are returning to the parental home and more frail older adults are choosing to live with their adult children. This reflects the rising costs of both housing for young adults and social care needs for frail elders.

Analysis of the UK Household Longitudinal Survey, Understanding Society, suggests that nearly 7% of UK households are multi-generational, which is equivalent to roughly 1.8 million households. **[9]**

More family members living together for longer is likely to require a rethink in how homes are designed. Existing spaces (including lofts and basements) might need to be remodelled and extended into gardens. Opportunities for flexibly 'expanding' or 'shrinking' living spaces and changing the way they are used will become more important considerations.

Innovations such as movable walls and fold-away furniture make it possible to design spaces that can easily change uses according to the needs of family life across generations.

Examples include a room that functions as a home office – an important issue with the rise of working from home – during the day that converts into a bedroom at night, or a large living room capable of being subdivided into separate spaces to meet family members' differing and possibly clashing needs.

Meeting the rising demand for solo-living

The demand for innovative design thinking is not restricted to the growth in multi-person households and multi-generational living. It is also required to meet the global growth in single-person households which, fuelled by rising divorce rates and, more significantly, a rapidly ageing population, is outpacing other kinds of housing by far.

Data from national censuses and large cross-country surveys indicate that single-person households are becoming increasingly common across the world, albeit with large differences between countries – from more than 40% in northern European countries to 1% in Pakistan. **[10]**

According to ONS, in 2022, 8.3 million people were living alone in the UK, representing 30% of all households. Over half (51%) of the people in these households were aged 65 and over, and more than one in five men and one in three women aged 75 years or over were living alone. **[11]**

More family members living together for longer is likely to require a rethink in how homes are designed.

Innovating flexible 'lifetime' homes

Harnessing the power of innovation to help meet the needs of an ageing society was recognised by the UK government in its recent industrial strategy as one of the four 'grand challenges' facing the country. **[12]**

Key to meeting this need will be to enable people to stay put in their homes and remain in their communities for longer by ensuring that their homes can adapt as they age, whether living with a partner, with wider family or alone. This means that all new dwellings should be designed with the life course of their occupants in mind.

Architects are already producing creative solutions with adaptable interiors, using many design tactics. These include:

- making it possible for bedrooms to be relocated to the ground floor
- ensuring that all corridors and doors are wide enough for both child buggies and electric wheelchairs
- installing wet rooms and voice-controlled or remote-activated services for heating and lighting as standard

Smart house digital technologies, robotics and artificial intelligence, combined with life-course-sensitive design will facilitate even more older people to live longer in their own homes. Given changing demographics, over the next decade, such design innovations are likely to move from being the exception to becoming mainstream practice.

Recent research has also highlighted the urgent need to provide more housing alternatives for older people, including alternative assisted living and transitional environments for individuals who are cognitively challenged and physically frail. **[13]**

Such residential care environments need to be easy to navigate spatially with appropriate wayfinding and, to promote good sleeping patterns, should minimise residents' exposure to environmental stressors such as unwanted artificial light. The therapeutic benefits of having access to safe green spaces such as 'wandering gardens' are also being increasingly recognised.

In 2023, for example, the National Brain Appeal's Rare Space Garden won a gold medal at the RHS Chelsea Flower Show, and the RHS website featured advice on creating dementia-friendly gardens. **[14]**

Promoting healthy ageing for all: designing age-friendly cities

The importance of designing age-friendly cities in promoting healthy ageing has recently been recognised by the World Health Organization. They have developed a framework of eight interconnected domains that can help to identify and address barriers to the wellbeing and participation of older people. **[15]**

Included in these domains are 'housing', 'transportation' and 'outdoor spaces and buildings', areas where architects and other design professionals can play a vital role in setting the agenda.

Going forward, all new buildings and their surrounding public realm should ideally be designed for diversity and inclusion, embracing all ages and capabilities, enabling people to stay active and remain connected to their communities.

On 14 December 2020, the United Nations General Assembly declared 2021–2030 the Decade of Healthy Ageing, with the objective of combatting ageism, social isolation and loneliness, and creating better places in which to grow, live, work, play, and age. **[16]**

To achieve these goals, built environment professionals will all need to rise to the challenge.

Smart house digital technologies, robotics and artificial intelligence, combined with life-course-sensitive design will facilitate even more older people to live longer in their own homes.

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The Dharavi slum with apartment complexes behind, Mumbai. Photo: Johnny Miller / Unequal Scenes

Urbanisation: the coming decade will be make or break for cities and the planet

Peter Oborn RIBA RIAS HonMRAIC HonMRTPI HonFIStructE HonRAIA currently serves as President of the Commonwealth Association of Architects and is a member of the UN-Habitat Stakeholder Advisory Group Enterprise (SAGE). Following a successful career in private practice, Peter has spent the past decade addressing the challenges of sustainable development at city scale, working with national governments, local governments, and fellow built environment professionals around the world.

Peter Oborn looks at the challenges of urbanisation in the Global North and South against the backdrop of climate change, highlighting the need for design professionals, planners and engineers to work collaboratively and sustainably.

The United Nations' (UN) Sustainable Development Goal 11 recognises the importance of cities as contributors to sustainable development, which seeks to "make cities and human settlements inclusive, safe, resilient and sustainable". [1]

Indeed, UN-Habitat estimates that 65% of the 169 targets underpinning the 17 Sustainable Development Goals are attributable to urban and territorial development. **[2]** Little wonder then that urbanisation is now recognised as one of the five global megatrends **[3]** or that, in a speech delivered before the Rio Earth Summit in 2012, the then UN Secretary-General, Ban Ki Moon, said that "our struggle for global sustainability will be won or lost in cities". **[4]**

Today, just over half the world's population are urban dwellers. By 2050, UN-Habitat predicts that two out of every three people will be living in cities. **[5]** That's an increase of 2.5 billion more urban dwellers, 95% of whom will be in Asia and Africa, where 95% of the cities most at risk from the impact of climate change are to be found. **[6]**

Nearly half of the growth in the number of people living in cities is predicted to be in Commonwealth countries. This doubles the Commonwealth's urban population, from 1 billion to 2 billion urban dwellers in less than 30 years.

The foundations for tomorrow's cities are being laid today and, as we look forward to 2034, architects and their professional bodies, such as the Royal Institute of British Architects (RIBA), clearly have a critical role to play. So, how well-equipped are we to deal with the challenges ahead and what are the main issues to be faced?

A tale of two city types

In its World Cities Report 2022, published by UN-Habitat in the shadow of the global pandemic, the authors recognised that responding to climate change vulnerability and rising levels of inequality are global concerns. Even so, the key priorities confronting developed countries in the Global North are different to those facing developing countries in the Global South. **[7]**

Historically, cities in Europe and North America developed over time as a result of agglomeration. This is where the clustering of firms in a variety of sectors brought advantages that led to the development of large, diverse cities.

The advantages included abundant employment prospects that attracted a skilled labour force. In turn, this facilitated economies of scale which resulted in greater productivity, higher wages and a better quality of life due to increased levels of social and cultural engagement.

Such has been the success of urbanisation, particularly in industrialised countries, that today more than 80% of global gross domestic production is generated in cities. **[8]** Indeed, many of the world's wealthiest cities, such as New York and Tokyo, now qualify as megacities, with populations of over 10 million residents.

But urbanisation is not without its challenges, not least the fact that today's cities consume over 70% of the world's energy and produce more than 60% of global greenhouse gas emissions. **[9]** So, while no country has prospered economically without first urbanising, equally, no city has grown without also significantly increasing its carbon footprint.

The imperatives for cities in the Global North are therefore to rapidly decarbonise by plotting a course towards a net zero future. This means upgrading and modernising ageing infrastructure and revitalising urban centres while meeting the needs of an ageing population.

The pattern of urbanisation over the past few decades in many parts of Africa and Asia has been distinctly different. They have experienced significant levels of rural-to-urban migration aggravated by increasing numbers of people affected by forced displacement due to conflicts and natural disasters.

This has led to rapid urbanisation that has overwhelmed many city authorities' capacity to respond, resulting in large numbers of informal settlements, which in turn has led to inequality and vulnerability. **[10]**

Such unplanned growth is characterised by low density development, which has frequently resulted in uncontrolled urban sprawl. The area of the city has expanded out of all proportion to population growth, with damaging consequences. Not only has it led to the loss of productive agricultural land and damage to precious ecosystems, but it has also meant that basic utilities and social infrastructure have not been able to keep up.

There is typically a lack of basic services (for the provision of energy, waste treatment, and water) together with a lack of access to facilities such as education, healthcare and public transport. Needless to say, these all have correspondingly negative impacts on social, economic and environmental wellbeing.

Therefore, the imperatives for cities in rapidly urbanising countries are to address rising levels of poverty and the challenge of slums, and to provide basic services together with adequate affordable housing.

In many countries, such challenges are compounded by high levels of youth unemployment and the difficulty of accessing finance. Consider that the median age in the UK, which has a population of 67 million, is around 40 while the median age in Uganda, with a population of 45 million, is just 16.

Revealing the capacity gap

As we entered the Decade of Action **[11]** to deliver the Sustainable Development Goals in 2020, the Commonwealth Association of Architects (CAA), along with its planning, engineering, and surveying counterparts, published a survey of the built environment professions in the Commonwealth. Their objective was to establish how well-prepared the professions were to deal with the challenges ahead. There were three key findings. **[12]**

1. Lack of professional capacity

First, they found a critical lack of capacity among built environment professionals in several Commonwealth countries, many of which are urbanising rapidly and are among the most vulnerable to climate change impacts.

The capacity gap was most acute in the public sector and in secondary and intermediate cities, which are urbanising just as fast as their larger counterparts. For example, while the UK has approximately 40,000 registered architects in a country urbanising at less than 0.5% per annum, Uganda has barely 300 architects in a country urbanising at over 5% per annum. The situation is even more acute in the case of town planning.

2. Lack of educational capacity

Second, they found a corresponding lack of educational and institutional capacity to grow the profession fast enough to make up the shortfall in these same countries. This situation was often aggravated by a shortage of experienced teaching faculty, an outdated curriculum and a lack of the mandatory continuing professional development necessary to maintain competency among both faculty and practitioners. The UK, for example, has 61 schools of architecture whereas Uganda has just four.

3. Poor governance

Third, they found that these countries' built environment policies, including their planning policies and building codes, were weak in terms of standards, implementation and enforcement.

The size of the risk associated with this finding is thrown into sharp relief by research from the International Energy Agency. It anticipates that around 90 billion square metres of additional floorspace will be built in Africa in the next 40 years, **[13]** yet there are barely a handful of countries on the entire continent that currently operate mandatory building energy codes. **[14]**

The informal settlement of Kya Sands next to the middle-class suburb of Bloubosrand, Johannesburg. Photo: Johnny Miller / Unequal Scenes

Rising to the challenge

Such is the nature, scale and complexity of the challenges ahead that the coming decade will be make or break for cities and the planet. Together with their professional institutes, architects have a pivotal role to play – especially in the areas of advocacy, capacity building and climate action.

Advocacy

Central to this effort is the need for built environment professionals to work much more collaboratively and at scale, not only across built environment disciplines but also with economists, researchers and others to advocate for the value of sustainable development.

A critical objective is to help policymakers in both central and local government to make better evidence-informed decisions on built environment issues. The Declaration on Sustainable Urbanisation, which was adopted by 56 heads of government at the Commonwealth Heads of Government Meeting in 2022, is a good example of what is needed. **[15]**

It recognised the Call to Action published by the Commonwealth Sustainable Cities Initiative, of which the CAA was a founding member. **[16]** The message is increasingly getting through. For example, the 2023 G7 Urban Development Ministers Meeting in Japan illustrates that governments understand the issues. **[17]**

Unfortunately, these examples are the exception rather than the rule. The voice of built environment professionals is missing from many critically important policymaking forums. The sector needs to work harder and smarter to make themselves heard, helping to bridge the gap between policy and practice by bringing their experience, creativity and design thinking to bear.

Building capacity

Capacity-building and knowledge-sharing are vital if the critical issues identified in the Survey of the Built Environment Professions in the Commonwealth are to be addressed. The UK Built Environment Advisory Group (UKBEAG), a collaboration between RIBA, the Royal Town Planning Institute, the Institution of Structural Engineers and the Landscape Institute, demonstrates how uniquely well-placed professional institutes are to work with national governments and development partners around the world.

For example, UKBEAG worked with UN-Habitat on the UK's Foreign, Commonwealth and Development Office's (FCDO) Global Future Cities Programme to support 19 cities in 10 low- and middle-income countries on 30 projects in the areas of resilience, transportation and urban planning. **[18]**

RIBA is also a member of the CAA Knowledge Sharing Partnership, bringing together 16 member organisations from around the five regions of the Commonwealth to work together on shared challenges.

Climate action

Effective climate action is by far the most important and pressing aspect of the work ahead, in terms of mitigation, adaptation and climate justice. Analysis by the CAA has revealed that half of carbon emissions from Commonwealth countries is attributable to just 10% of their combined population and that these people live mainly in the industrialised countries in the Global North.

The other half of total Commonwealth carbon emissions is attributable to the remaining 90% of the population, who mostly reside in the countries that are urbanising most rapidly.

This highlights the imperative to address the issues in both urbanised and urbanising countries simultaneously. Built environment professionals need to bring their collective knowledge and expertise to bear across a broad front – including policymakers, practitioners, and the public – to ensure a just transition while leaving no one and no place behind.

The architectural community is responding to these challenges in a myriad of different ways.

At the University of East London, for example, researchers are making good progress with the development of a bio-based building material called 'Sugarcrete'. **[19]** It uses the waste from sugar cane (the world's largest crop by volume) together with non-cementitious binders to manufacture a range of products including insulating panels and load-bearing blocks. Countries in the Caribbean, Asia and the Pacific have already shown considerable interest in the material, and the project has recently been shortlisted for the Earthshot Prize.

The Architects Climate Action Network is a network of individuals within architecture and related built environment professions taking action to address the twin crises of climate and ecological breakdown. It is working together with RIBA and the Standing Conference on Schools of Architecture to develop teaching materials for both practitioners and teaching faculty to accelerate climate literacy and sustainable practice throughout the profession.

Other organisations are contributing. For example, the Feilden Foundation, the charitable arm of Feilden Clegg Bradley Studios, not only helps to deliver community facilities across East Africa but recently secured funding from ENABEL, the Belgian government's development agency, to develop a training programme for passive design strategies called the Manifesto for Climate Responsive Design. **[20]**

Other roles

There are plenty of other roles for built environment professionals, not least in connection with their technical know-how. For example, the CAA is leveraging its network to support the rollout of the IFC Edge Designing for Greater Efficiency training programme among teaching faculty throughout Sub-Saharan Africa. **[21]**

CAA has also been working with the Ordnance Survey to use artificial intelligence to produce digital base maps, the object being to provide local governments with a starting point for better planning. The pilot programme, which focused on Lusaka in Zambia – a city of 3.5 million people, 65% of whom live in informal settlements – enabled its base map to be completed in less than a tenth of the time it would have taken by traditional means. **[22]** Importantly, the technology is scalable and replicable.

Leadership for a better future

The key findings from FCDO's Global Future Cities Programme identified five common areas of weakness in many of its subject cities. These were:

- a lack of integrated and inclusive planning
- a weakness in governance and collaboration
- the ineffective use of data and lack of evidence-based policymaking
- poor business case preparation and weak procurement practices, combined with poor monitoring and evaluation, implementation and enforcement

The overarching lesson from the programme was the critical importance of effective leadership. As we face the nature and scale of the challenges ahead, we must all be leaders now.

The Architects Climate Action Network is a network of individuals within architecture and related built environment professions taking action to address the twin crises of climate and ecological breakdown.

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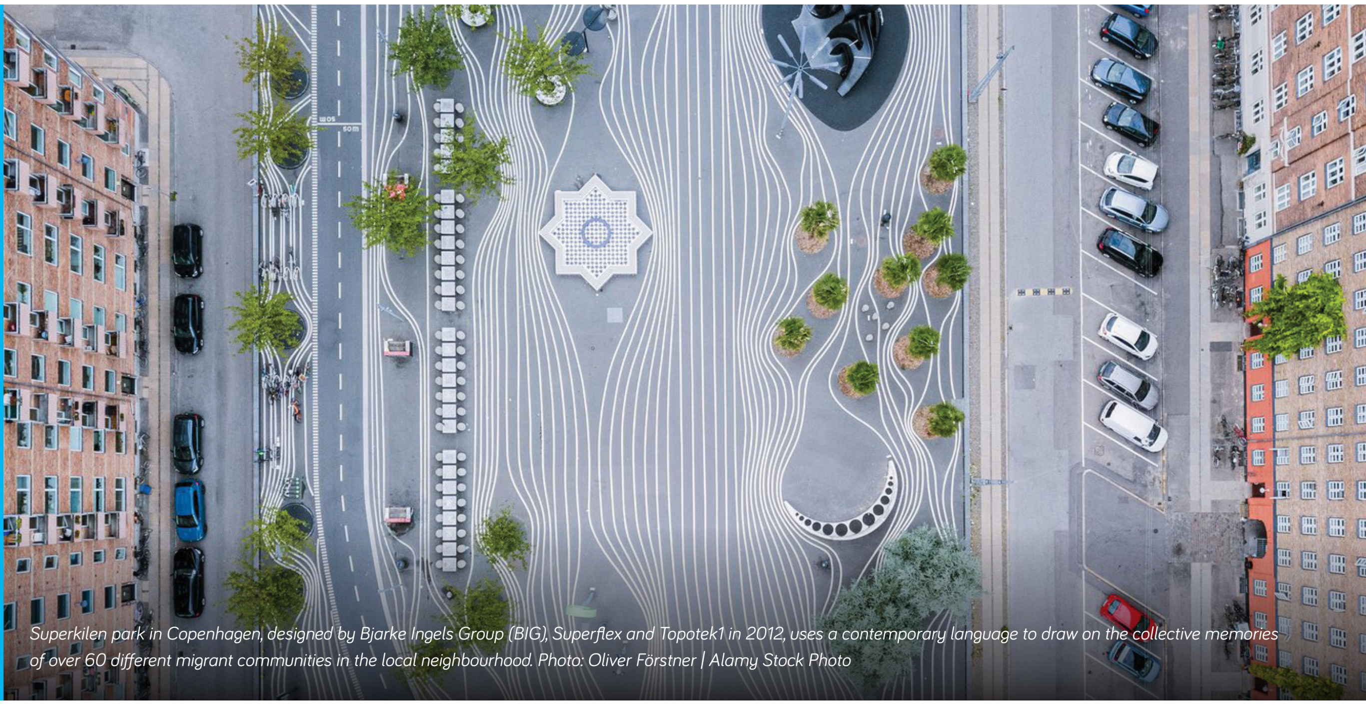
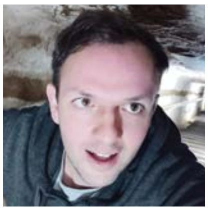


Superkilen park in Copenhagen, designed by Bjarke Ingels Group (BIG), Superflex and Topotek1 in 2012, uses a contemporary language to draw on the collective memories of over 60 different migrant communities in the local neighbourhood. Photo: Oliver Förstner | Alamy Stock Photo

International migration and displacement: the impact on the urban landscape



Guy Abel is based at the Department of Sociology, University of Hong Kong. He is a statistical demographer working predominantly with migration data to better predict past and future movement patterns and gain a richer understanding of how migration varies by core demographic variables such as age, sex, and education. He has published in leading scientific journals such as Science, PNAS and Nature Scientific Data and worked with several international agencies such as the International Organisation of Migration, the World Bank, and the International Labour Organisation.

Guy Abel discusses how trends in international migration and displacement over the next decade are likely to shape our societies, economies, and built environment. He highlights the important role of architects in designing sustainable housing solutions for displaced communities and revitalising urban areas to foster inclusivity and integration.

The global phenomenon of human migration is at the centre of contemporary public discourse and is often the subject of heated political and media debate. Regrettably, this debate is also often shrouded in misconceptions and anecdotal narratives.

This horizon scan dispels these misconceptions by providing a data-driven perspective on international migration and displacement. It seeks to illuminate the patterns, trends, and potential future trajectories of these phenomena, both globally and in the UK context.

The importance of migration extends beyond mere numbers. It is a force that shapes our societies, economies, and built environments. In some contexts, migrants – particularly those displaced by violence or natural disasters – have heightened vulnerabilities. These realities underscore the urgency of informed, empathetic, and effective policies for migrants and their communities.

In recent years, international migration has become an increasingly prominent driver of population change as fertility and mortality rates have declined in many parts of the world. For example, whereas natural population growth from the difference between births and deaths was close to zero or declining in South Korea, Germany and Canada during 2019, net immigration exceeded 100,000, according to data from the United Nations. **[1]**

Because international migration influences both population size and demographic structure, it has a direct impact on the demand for housing, public services, and infrastructure. For the architectural profession, this presents both challenges and opportunities.

Architects are uniquely positioned to innovate and adapt the built environment to accommodate the diverse needs and experiences of migrant populations. Whether it's designing sustainable housing solutions for displaced communities or revitalising urban areas to foster inclusivity and integration, their role is pivotal.

Professional membership institutes like the Royal Institute of British Architects (RIBA) also play a crucial role. By advocating for excellence in building design, they empower built environment professionals to rise to the challenges posed by migration and to contribute positively to society.

However, this significant task cannot be accomplished without adequate funding and a supportive policy environment. This horizon scan is therefore relevant not only to architects and RIBA Members but also to the wider community. It invites all to engage in a more nuanced, compassionate and constructive dialogue about migration and displacement.

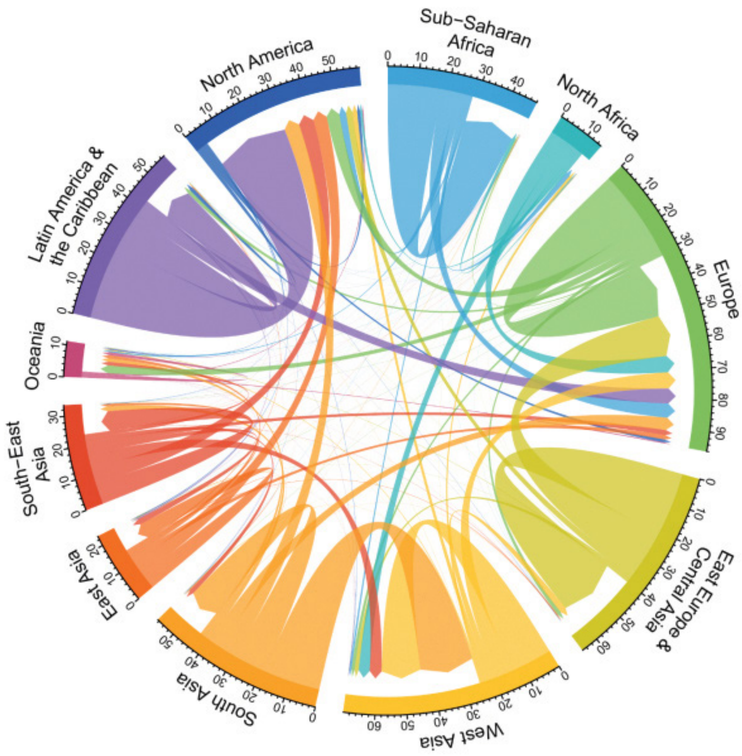


Figure 1: The global migration populations in 2020 according to data from the United Nations. The curved arrows in the diagrams represent the connection between the region of birth (at the base of the arrow) and the region of residence (at the arrowhead). The width of the base of the arrows corresponds to the size of the migrant population in millions. Arrows are ordered relative to their size, with the largest migrant populations plotted at the beginning of the region segments. Plot by Guy Abel.

The scale of international migration

International migration and displacement are complex phenomena, shaped by a multitude of factors ranging from economic opportunities and political instability to climate change and social networks. They involve the movement of people across borders, both voluntarily and involuntarily, and have profound implications for individuals, communities, and countries.

According to the United Nations, there were nearly 281 million international migrants in the world in 2020, making up 3.6% of the global population or around 1 in 30 persons worldwide. **[2]** While the absolute number of international migrants has increased over the years, this rise is largely a function of the overall growth in the global population and the increasing number of countries.

When viewed as a proportion of the world's population, the share of international migrants has remained constant, hovering at around 3% since 1960. **[3]** This suggests that, despite the numerical increase in migrants, the proportion of people with a propensity to migrate internationally has remained relatively stable.

International migration does not impact every country equally. The effects of migration are unevenly distributed, with certain countries experiencing higher levels of immigration or emigration than others. In some Gulf States, for example, the foreign-born population greatly outnumbers the native-born population.

In most Western European countries, by contrast, the foreign-born population accounts for around 10% to 20% of the total population. In many other countries of the world, the share of the population born abroad is typically well below 3%.

International migration is often characterised by regional patterns. A significant proportion of migrants tend to reside in countries within the same region; Figure 1 illustrates the global migration of populations in 2020 according to data from the United Nations. **[2]**

Migratory regional patterns can be attributed to various factors, including geographical proximity, historical ties, shared languages, and regional agreements that facilitate mobility. Even in Western Europe, most foreign-born migrants are from countries elsewhere on the same continent.

Foreign-born migrants in the UK

In the UK, those born abroad made up an estimated 16.8% of the total population in 2021, which equates to 10 million people. **[4]** Unlike most countries, the largest migrant groups are from a range of origins both near and far.

For example, people born in India now constitute the largest foreign-born population in the UK, followed by those born in Poland, Pakistan, Romania and Ireland. **[5]** The largest group from a single regional bloc is made up of people born in the EU countries.

The dynamics of migration to the UK have seen notable changes over the past few decades. During most of the 2000s, the number of migrants from EU countries increased more rapidly than those from non-EU countries. This trend was influenced by several factors, including the expansion of the EU in 2004 and 2007, which led to increased mobility for people in new member states. Since Brexit, the number of migrants born in the EU has begun to decline, although they still make up the largest regional group living in the UK.

As in other countries, migrant populations are usually younger than the native-born population. This demographic pattern can be attributed to various factors. For example, two prominent drivers of migration to the UK are the pursuit of employment opportunities and access to higher education, which tend to attract younger people.

At the same time, older migrants already in the UK tend to return to their home country to retire. The net result is that the migrant population stays comparatively young.

Misperceptions on the level of migration

In many societies, there is a widespread misperception that the level of migration is higher than the actual level. For example, in 2014, respondents to a questionnaire in the UK estimated that the foreign-born population accounted for over 25% of the total population. This was over 10 percentage points higher than the actual value at the time.

A similar overestimation was found in many other European countries. The respondents most prone to the misperception tended to be socially and economically vulnerable (e.g. were in blue-collar occupations, were on insufficient incomes, and had low educational achievements). The misperception was attributed to a variety of factors, including media coverage, political discourse, and personal experiences. **[6]**

Forced migration

Displacement is a pressing issue related to international migration. The UN Refugee Agency reported that over 108.4 million people were forcibly displaced worldwide at the end of 2022 due to persecution, conflict, violence, human rights violations, or events seriously disturbing public order.

Although most of these displaced people had stayed within their country of residence, 29.4 million were forced to migrate across international borders, turning them into refugees. Another 5.4 million had claimed asylum abroad but had not yet obtained refugee status.

Cumulatively, approximately 1 in 10 of all international migrants were forcibly displaced, constituting a relatively small component of the global migrant population.

Most forced migrants move relatively short distances, and over 70% of refugees reside in neighbouring countries. **[7]** In the UK, there were over 360,000 forced migrants at the end of 2022, of which 127,000 were asylum seekers awaiting hearings for their cases in an increasingly long backlog of caseloads. **[8]**

Since Brexit, the number of migrants born in the EU has begun to decline, although they still make up the largest regional group living in the UK.

Potential futures of international migration and displacement

Over the next 10 years to 2034, several scenarios could shape the future of international migration and displacement.

Precise predictions about future migration patterns looking beyond a few months ahead are almost certain to be wrong. Unlike other demographic trends (such as those related to fertility and mortality), there is no overarching theory on migration that can effectively predict future trends. Decisions to migrate are based on a complex interaction of perceived and actual levels of economic, social and environmental factors in both the country of origin and destination countries. They are also affected by potential migrants' personal and household circumstances.

Choices of where to migrate are further influenced by an array of informal and formal networks between migrant communities and their home countries and the policies along each migration corridor. These factors are themselves subject to uncertain change, which makes future patterns of migration even more unpredictable.

Nonetheless, migration scholars have found some regularities that can reveal broad trends and patterns, providing a glimpse into how future migration patterns might evolve.

Migration is best framed as a by-product of economic development. In the future, economic factors will continue to drive voluntary migration, which makes up the vast majority of all movements. In the search for better job opportunities and improved living standards, individuals often migrate from countries with weaker economies to those with stronger ones. This is particularly evident in the case of labour migration, where workers move to places where their skills are in demand and wages are higher.

Economic downturns, on the other hand, can reduce the attractiveness of a destination country and lead to decreased immigration and increased emigration. Hence, the future of migration both to and from countries such as the UK will be closely tied to the performance of its national economy both in relative and absolute terms.

Changes in migration policies, both in sending and receiving countries, have the potential to influence future migration flows. In recent years, there has been a noticeable rise in migration policies concerning individuals with certain skills. These policies aim to attract or retain foreign migrants with specific skills and qualifications that are in high demand in the local labour market.

Another trend likely to impact migration is the gradual demographic shifts affecting society. Migration rates almost always follow a fixed pattern across the human lifecycle, peaking in young adulthood and slowly declining thereafter.

As fertility rates in many countries of the world fall below replacement level, the potential pool of populations in origin countries will slow, and consequently, the number of migrants might also fall.

Political instability and conflict will continue to drive forced displacement. The locations and scale of future conflicts are hard to predict, but their impact on displacement can be significant, especially for neighbouring countries that tend to host disproportionate numbers of refugees.

Finally, as the effects of climate change intensify, more people may be forced to move due to environmental factors such as floods, droughts, and rising sea levels.

Increases in the severity and frequency of weather events have been found in some settings to impact the likelihood of armed conflict, and thus play a significant factor in the size of forced international migration outflows. **[9]** To date, however, most migrants driven by climatic factors tend to move relatively short distances and within countries. **[10]**

Decisions to migrate are based on a complex interaction of perceived and actual levels of economic, social and environmental factors in both the country of origin and destination countries.

Brightly painted buildings on 'the Golden Mile' in Leicester. Photo: ANDRYPHOT | Alamy Stock Photo

The implications of future international migration on architecture

For the architectural profession, the future trends and scenarios of migration present both challenges and opportunities. Architects will need to design built environments that are inclusive, adaptable, and resilient in the face of changing migration patterns and displacement scenarios.

International migrants often choose to settle in major cities rather than rural areas when they first arrive for several reasons. **[11]** Cities tend to have a greater array of employment opportunities. They also have pre-existing migrant communities that share incoming migrants' cultural heritage, language, and customs, easing the process of adaptation and integration for newcomers.

Districts within cities have developed over time into hubs of cultural diversity and social connectivity, making them attractive destinations for migrants seeking to connect with others from similar backgrounds or to forge new social networks.

A good example is Tower Hamlets in East London, which has witnessed waves of migrants over the centuries, including the French Huguenots and Eastern European Jews fleeing religious persecution, Afro-Caribbean communities after WWII and, more recently, Bangladeshi, Bengali, and Somali migrants alongside arrivals from new EU accession countries such as Poland and Lithuania.

The concentration of new migrants in urban areas is likely to have a direct impact on the urban density and housing demand in cities. Rising urban populations, thanks in part to international migrants, can result in greater demand for housing. Without adequate planning and housebuilding, this can in turn exacerbate existing housing shortages.

An influx of migrants into towns and cities can foster social integration and community cohesion, enriching the social fabric of neighbourhoods. However, it can also raise challenges related to intercultural dialogue and addressing socio-economic disparities between migrant and host communities. Urban planners and architects play a crucial role in designing inclusive public spaces and amenities that facilitate interaction and foster a sense of belonging among diverse populations.

Migration fuels diversity in the population, bringing together different cultures and traditions to the UK. This cultural diversity not only influences architectural styles but also fosters innovation and hybridisation in design. For example, areas around Brixton Market in London, the Golden Mile in Leicester and Govanhill in Glasgow reflect the diversity in their communities through their built environments.

Not only have they adapted traditional buildings for use as restaurants, shops and community centres, but they have also integrated religious institutional buildings such as mosques, temples, and churches to serve their communities. Architects can draw inspiration from diverse cultural motifs, materials, and construction techniques, which will result in a more varied and vibrant architecture.

Adapting architecture to evolving migration patterns

International migration can have profound implications for the built environment, the architectural profession, professional institutes like RIBA, and the communities they serve. Migration and displacement influence the design and use of towns and cities, impact population dynamics and community cohesion, and so pose both challenges and opportunities for architects and architectural practice.

As future migration patterns change, architects must adapt their practices to meet the diverse needs of migrant populations and displaced communities.

However, much of this adaptation is contingent upon opportunity and funding. Rather than allocating temporary housing in less affluent areas, it may be more beneficial for governments to acknowledge that longer term solutions are needed.

Communities might be better served if their governing authorities concentrate their resources on integration and community services tailored to the needs of migrant populations. Indeed, cities such as Amsterdam and Toronto have already implemented inclusive urban planning strategies that prioritise affordable housing and social integration for migrants. **[12]**

Collaboration between architects, urban planners, policymakers, and community stakeholders is essential in creating inclusive, sustainable, and resilient built environments.

Professional institutes such as RIBA can contribute to more equitable and inclusive responses to migration by advocating for excellence in architecture, promoting research and innovation, and fostering dialogue and cooperation.

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Brixton Market along Electric Avenue, London. Photo: Alamy Stock Photo/PjrTravel

Designing for an increasingly diverse population: the implications of the ethnic diversification and age polarisation of Britain's neighbourhoods

Nissa Finney is Professor of Human Geography at the University of St Andrews and Director of Research for the School of Geography and Sustainable Development (University of St Andrews). She has published and taught widely on ethnic inequalities, residential mobility, housing, neighbourhood change and segregation. She is a Fellow of the Royal Geographical Society and a member of the Centre for Population Change and the Centre on the Dynamics of Ethnicity.

Nissa's books include 'Sleepwalking to Segregation'? Challenging myths of race and migration (2009) and Racism and ethnic inequalities in a time of crisis (2023). Nissa's work has brought new understandings in population scholarship on diversity, evidencing differential opportunities and experiences in residential choices, underlying processes of exclusion, and policy narratives that marginalise groups and places.

Nissa Finney reviews the latest evidence on neighbourhood diversity and considers how architects should respond to the changing makeup of our communities to better support ethnically diverse and intergenerational communities and promote social cohesion.

Imagine stepping into an average neighbourhood in Britain 10 years from now. You will be surrounded by people whose heritage and cultures hail from across the globe, more so than is the case today and has been in the past. People in the neighbourhood will also be more similar to one another in age than they are today.

Population trends mean that soon we can expect neighbourhoods across the country to be less age-mixed and more ethnically diverse than ever before.

Ethnic diversification is not only the prospect for Britain but, to varying degrees, for most countries around the world. Indeed, the last two centuries are known as the 'age of migration', and international population movement has intensified in the decades since the Second World War. **[1]** For more on migration and displacement, see the **horizon scan by Guy Abel.**

The International Organisation for Migration reports that the number of international migrants has increased in all regions of the world since the 1990s. **[2]** This has brought increased ethnic diversity, particularly for countries that are net gainers of population from immigration. **[3]**

As the **horizon scan on demographics** by Maria Evandrou illustrated, most countries are now also ageing in that the proportions of their population in the oldest age groups are increasing. **[4]** It is in this context that residential age separation is happening.

In less developed countries in the Global South – apart from those in central and southern Africa and some parts of Asia – a history of high fertility rates and rapid population growth are today responsible for "a relatively large number of older persons". **[5]** In the more developed countries of the Global North, population ageing has been the trend for some decades already and has spurred national and international movements for 'age-friendly communities'.

How, then, can places that meaningfully connect with and serve intergenerational, diverse communities be created?

This horizon scan takes the case of Britain to review the latest evidence on neighbourhood diversity and considers the implications for the architectural profession, professional institutes and the communities they serve. It asks: how should architects respond to the changing makeup of our communities to better support diverse and intergenerational communities and promote social cohesion?

Increased local diversity has the potential to reduce inequalities, challenge stigmas, and contribute to the success and vibrancy of democratic operations. When it is properly managed, it creates inclusive places where all can feel comfortable and at home.

Well-managed diversity can improve the wellbeing of individuals and maintain peace and solidarity across and within communities. For built environment professionals and their professional institutes, considering local diversity in design enables engagement with social and spatial justice.

Where the more than 15 million people who in 2021 identified as belonging to an ethnic group other than 'White British' live is more evenly spread across neighbourhoods than in the past.

Trends in geographies of diversity in ethnicity and age: the case of Britain

The ethnic composition of people in neighbourhoods across Britain has, over the last three decades, become more diverse and less residentially segregated. In other words, local places now have people from a broader range of ethnic backgrounds than in the past and are more similar to one another in their ethnic composition.

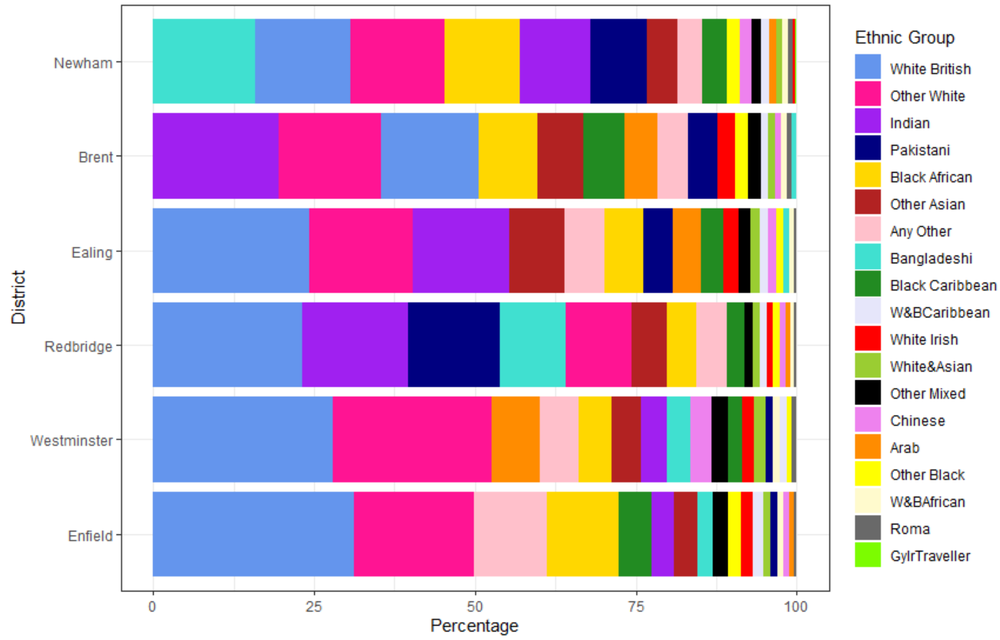
Where the more than 15 million people, who in 2021 identified as belonging to an ethnic group other than White British, live is more evenly spread across neighbourhoods than in the past.

This conclusion is drawn from looking at census data for small areas using methods of spatial analysis – such as the index of dissimilarity and the reciprocal diversity index. **[6]** Figure 1 presents the ethnic composition of selected diverse districts of England, in London (Graph A) and outside London (Graph B). In Newham, for example, there is a roughly equal proportion (around 15%) of people who identify as Bangladeshi, White British, Other White (largely Eastern European), Black African, Indian and Pakistani ethnic groups, together with people from all other ethnic groups for which data are collected.

The expectation is that these trends of increasing local ethnic diversity will continue over the next decade. This will be a result of family building (people across ethnic groups having children), inter-ethnic mixing in partnerships, continued immigration, and migration away from urban centres, where ethnic minorities have historically been clustered, to suburban and rural areas. **[7]**

An important coincident trend is also shaping Britain's neighbourhoods: age segregation. Age segregation is taking place in a context of population ageing. However, the ageing of neighbourhoods in terms of their population structure, and the increase in residential age segregation, are not happening evenly across the country.

Although older and younger age groups are increasingly living apart in urban and rural areas, the fastest rates of increase in age segregation are found in small cities and districts peripheral to the major conurbations, as shown in Figure 2. **[8]**



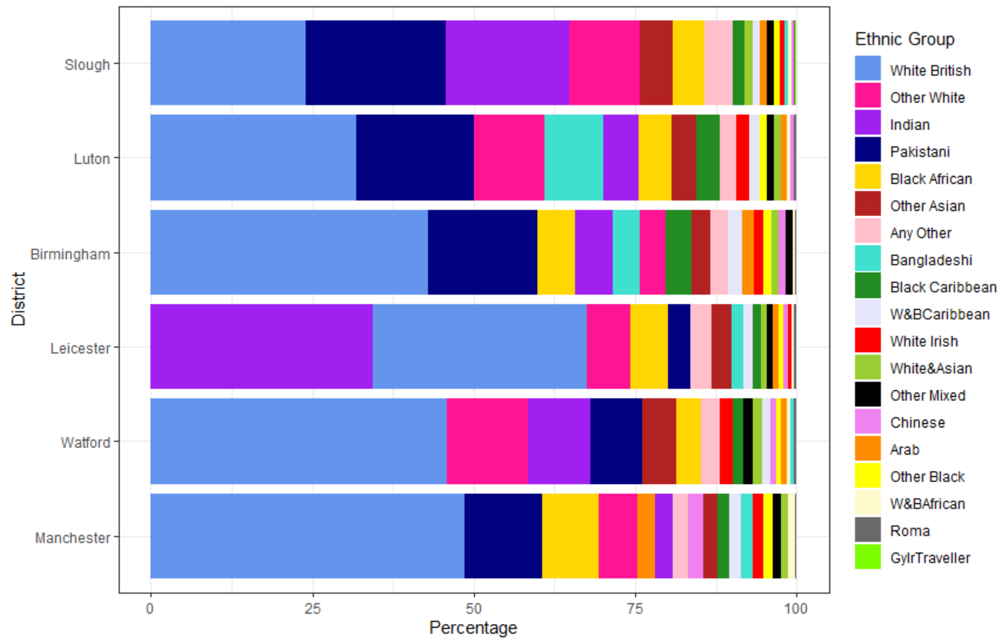
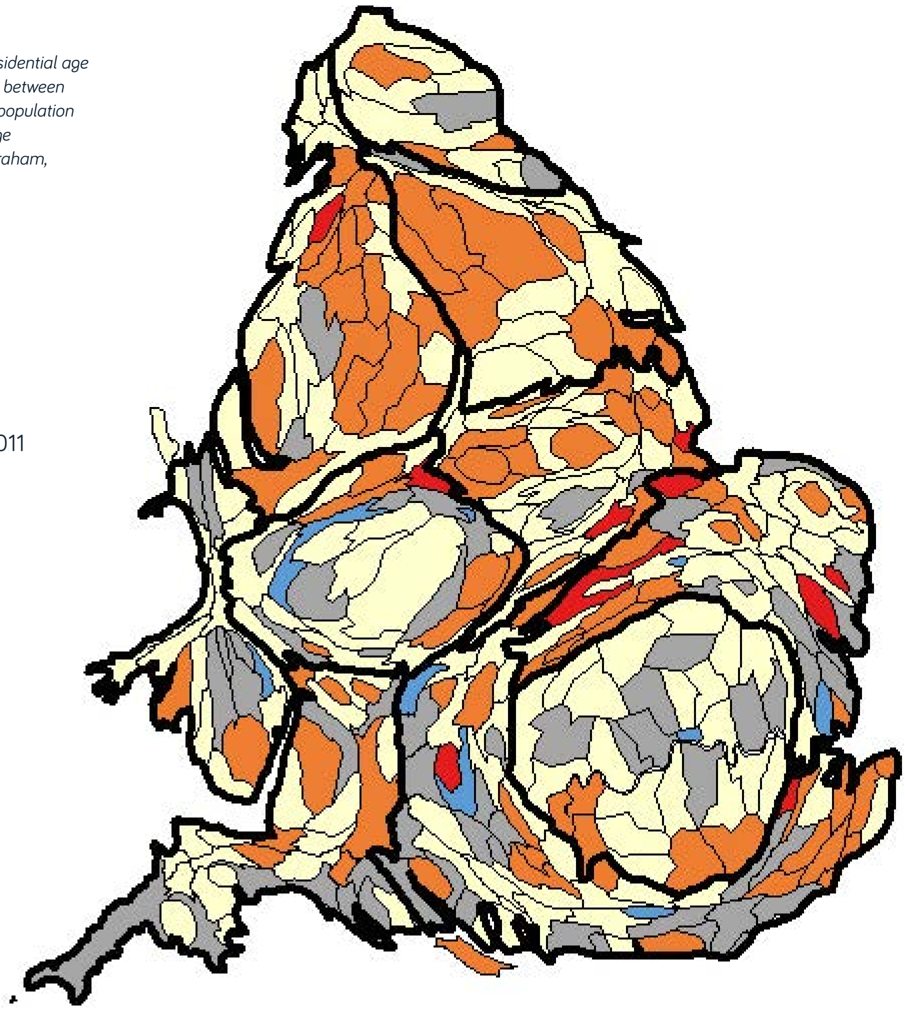


Figure 1: *Ethnic groups are, for each district, ordered left to right by largest to smallest population size in 2021. Ethnic groups in the legend are ordered by population size in England and Wales in 2021. © Gemma Catney, Christopher Lloyd, Mark Ellis, Richard Wright, Nissa Finney, Stephen Jivraj, David Manley (2023)*

***Figure 2:** This cartogram shows how increasing levels of residential age segregation changed across districts of England and Wales between 1991 and 2011. Districts are scaled proportionately to their population size to make it easier to visualise patterns in areas with large populations, including London. © Albert Sabater, Elspeth Graham, Nissa Finney (2017).*

Key: change in residential segregation, 1991-2011

- Decrease in age segregation
- Small increase in age segregation
- Medium increase in age segregation
- Large increase in age segregation
- Very large increase in age segregation



In this relatively young field of research, findings on local age segregation around the world are mixed. In the USA, for example, past work has shown increasing age segregation, but more recent analyses suggest no increase and perhaps even a decline in age segregation in some areas. **[9]**

In Hong Kong, although residential segregation between ages is generally low, it is highest (as in other countries, including the UK and the US) between young adults (in their 20s) and older adults (in their 60s and older).

What is evident across countries is that a major force shaping residential patterning – by age and ethnicity – is wealth. The type of housing and neighbourhood someone can live in depends upon their financial situation. Uneven residential mosaics by age and ethnicity are layered upon socio-economic residential segregation. **[10]**

There's a difference between the housing that older people and younger people can afford, and on average between what different ethnic groups can afford. This is an important driver of residential patterns because housing of different values tends to be spatially clustered. **[11]**

A factor that is distinguishing between young people in terms of the types of housing and neighbourhoods they can afford is access to financial (and other) support from parents. This can affect their housing experience now and also in the future, contributing to widening housing inequalities over time. **[12]**

Similarly, wealth and housing inequalities by ethnicity shape opportunities of where to live **[13]**, and socio-economic disadvantage for many ethnic minority groups in Britain is well established. **[14]**

Structural changes to housing markets also disproportionately affect ethnic minority groups. In particular, the development – gentrification – of urban centres has displaced some ethnic minority communities. The once-cheap land upon which these immigrant-origin communities settled has now become very valuable such that many ethnic minorities cannot afford to remain living there. **[15]** This is wrapped up in the increasing financialisation of housing, as outlined in the **horizon scan by Matthew Soules.**

Given the ongoing housing crises in Britain and elsewhere, we can expect issues arising from differential access to housing and its impact on residential patterns to continue over the next decade. Thus, as the population ages and diversifies, we can also expect spatial polarisation across the intersecting axes of age, ethnicity and wealth to continue to require decided intervention.

Implications for design

Achieving social and spatial justice and creating cohesive communities are set to remain prominent ambitions in political and academic movements.

Since the current trends of neighbourhoods becoming increasingly ethnically diverse and age-polarised are mediated by the built environment, its design has an important role to play in creating inclusive places. In this way, design can engage with salient policy debates including intergenerational fairness, levelling up and an inclusive Britain.

The goal of being inclusive is by no means new and, indeed, inclusivity has become rather ubiquitous. So, understanding how it could be interpreted and applied would add some important nuance. Concerning the evidence presented here, two issues of operationalisation arise. First, how to create places that welcome all ages and ethnicities. And second, how to create places whose built environments enable appropriate and affordable housing for an ethnically and demographically mixed population.

Creating welcoming places: paying attention to orientation

The notion of 'orientation' is useful in considering how building designers and their professional bodies might approach inclusivity for the next decade. **[16]** Rather than referring to a building's relationship to the street or the sun, for example, here orientation refers to building users' different senses of being, capabilities and social positions – including their age and ethnicity.

Envisioning and attending to individuals' experiences of being in and passing through space can help in the creation of places, environments and structures that consciously address different orientations. The objective is to design for people with multiple, intersecting orientations to maximise their collective sense of comfort and feeling included.

From small design features such as neighbourhood benches **[17]** to more extensive ones, attending to individuals' differing orientations enables them to access and enjoy a place, and to experience everyday encounters that instil a sense of belonging and conviviality. **[18]**

Considering multiple orientations alerts designers to 'memory justice' – that is, fairly and representatively preserving communities' memories of spaces and places through memorials of various kinds. In this way, future designs can encode the diverse histories associated with a place and its community.

Paying attention to orientation can aid a move beyond representational diversity (e.g. Black architects doing Black design) by encouraging all involved in design to position themselves in alternative ways. This, first of all, requires potentially uncomfortable reflection on their own positions, or orientations, and the privileges they hold.

Having an appreciation, for example, of everyday experiences of exclusion can support an anti-racist approach to design. It may also encourage reflections on how to decolonise the profession and its institutions.

A 'multiple orientations' approach can also be usefully applied to the creation of age-friendly places – in other words, places where people of all ages are accommodated and feel comfortable. **[19]** For example, it may spur the development of urban and rural neighbourhoods that draw on social infrastructure – that is, the existing knowledge, relationships and resources – and the agency of communities across ages to enact collaborative place-making. **[20]**

Structural enablers to residential mixing

The key to responding effectively to the age segregation and ethnic diversity trends in residential neighbourhoods is to provide their communities with access to housing that meets their many needs. **[21]** This is a complex issue but key to improving housing experience and reducing housing inequalities is to establish a mix of sizes and prices of properties that align with the needs of the local population.

Increasing age and ethnic mixing in Britain's neighbourhoods over the next decade will, for example, require innovative and creative approaches to housing. The mix provided will have to accommodate needs throughout people's lives in affordable ways.

Aspiring to intergenerational, age-mixed, age-friendly and ethnically diverse neighbourhoods (in urban and rural areas) requires commensurate diversity in housing, community infrastructure, open space and other aspects of local design.

Of course, engaging with new housing and community approaches is just part of the solution. However, the potential for significant and sustained change is severely limited without new funding models for property and housing.

Many scholars have argued that, to achieve accessible, affordable and more equitable housing – as the basis for socially just, sustainable and cohesive communities – housing needs to be de-financialised: "Excessive housing financialization undermines the social reproduction of national–urban economies and destroys urban housing systems, and the communities living within them". **[22]**

Towards inclusive places

The ethnic diversification and age polarisation of Britain's neighbourhoods poses a challenge for the architectural profession and professional institutes: how to design local places to achieve community cohesion and augment social justice?

This horizon scan proposes that a valuable approach is to think creatively about stakeholders' orientation in assessing how residential and community infrastructure can be designed to meet the diverse needs of local populations.

Collaboration across sectors and with communities will be vital to the success of this ambition, as will a commitment from professional bodies and sector leaders to embed a creative, consultative and multi-oriented approach to strategic and professional development.

The degree to which these design ambitions can be achieved in the next decade to 2034 is somewhat contingent on reforms to planning models and housing systems and a commitment to social and spatial justice.

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Technological Innovation

Introduction

Phil Bernstein is Deputy Dean and Professor Adjunct at the Yale School of Architecture, where he has taught since 1988. He is a former vice president at Autodesk, where he was responsible for the company's Building Information Modeling strategy that included the development of the Revit platform. Prior to Autodesk Phil was an associate principal at Cesar Pelli & Associates where he managed many of the firm's most complex commissions including projects for the Mayo Clinic, Washington National Airport, and Goldman Sachs. He writes and lectures extensively about issues of architectural practice, project delivery, and technology. He is the author of Machine Learning: Architecture in the age of Artificial Intelligence, RIBA Publishing.

Machine learning has recalibrated the human relationship with technology. Moving beyond the existential threat of replacement, which artificial intelligence can pose, this theme explores the emergent technological tools and how architects can best take advantage of their innovative use.

When Nicolas Negroponte speculated about architects empowered by the new-found agency of computers in his 1970 book The Architecture Machine, [1] he envisioned powerful tools that could depict, analyse, and help construct a design. And while his contemporaries were experimenting with the rudimentary precedents of what had recently been deemed 'artificial intelligence,' he could not possibly have anticipated a world where computation, digital information, and connectivity were both extraordinarily powerful and ubiquitous. The digital tools of yesterday – CAD, BIM, even the internet – will soon give way to autonomous AI agents that may drive our architectural processes from project conception to industrialised construction in ways far beyond that book's wildest speculations.

2034: the automated future of AI

While the tools of today extend the architect's human agency, those of 2034 are likely to be less instrumental and more autonomous, shifting the role of the architect even further from singular author to orchestrator of both human and algorithmic processes. The anticipated shifts are numerous: from supervising drawing production to prompt engineering; from exploring three-dimensional implications from perspectival rendering to using immersive environments partially authored by AI agents; and from generating construction details from assembly diagrams to transferring assembly instructions to manufacturing platforms.

The two-decade transition to BIM occurred within the bounds of architectural practice, undergirded by advances in computer speed and graphic resolution. Ironically, the graphic processing units (GPUs) that made BIM possible are powering the move to AI, suggesting the pace of change is accelerating and making 2034 feel as if it is far in the future. But best to begin preparing now.

Four scans, four perspectives

The four perspectives offered by the horizon scans in the Technological Innovation theme anticipate this future while prescribing an interconnected series of recommendations that are a template for a proactive practice strategy.

Innovation Strategy counsels that the inflection point offered by the digital turn is not to be missed by an industry sorely in need of less friction and higher value. It suggests that the entire ecosystem of delivery – designers, builders, and asset owners – collaborate by capturing data and connecting it through new systems and infrastructure like digital twins.

The Digitalisation of Design suggests that the novelty of AI will give way to pipelines of information and autonomous agents that will smooth – and in some cases, replace – traditional modes of service and delivery.

Automation in Construction envisions the construction site of 2034, not bristling with robots and drones, but refactored by principles of information-enabled industrialised construction, where certain assemblies are created by designers and manufacturers offsite, and the resulting building is optimised by sensor controls.

Finally, **Architecture in the Age of AI** asks four important questions about professional knowledge, the meaning of professional judgement, business efficacy, and professional responsibility and risk as measures of the potential for AI to transform the building industry.

Through a purely technological lens, the contributors each frame the implications of a design and construction industry that is inevitably digitised and where liquified information flows freely between the various participants in the supply chain. Collective efforts will be required – to define data standards and workflows, to set new automated process protocols, and to design new mechanisms of risk and reward – that the technology makes possible, but does not guarantee. If the original vision of BIM as frictionless digital collaboration was never realised, is it likely that AI-enabled, high-resolution, data-driven, computationally intensive processes will reach that goal?

Retaining professional responsibility

Here lies the critical logic behind framing this section as 'Technology Innovation' rather than 'The Future of More Cool Technology in AEC.' The title itself implies an obligation of the architectural profession and the collaborators on which they depend to not just demand and episodically deploy every new instrument that the emergent world of AI-powered technology is sure to provide, but rather to thoroughly examine everything about how the built world is created and where the resulting processes can be embraced, rejected, or refactored. That effort, at the heart of an industry-wide innovation strategy, must broadly consider an array of questions involving issues as disparate as design ethics, digital assets, education, risk and reward balance, new models of delivery, and social equity, just to begin the lengthy list.

The demand for industry innovation catalysed by – but not solely reliant upon – technology is nowhere more apparent than in the tragedy at Grenfell Tower that occurred 17 years before 2034, these scans' cut-off date. The fire resulted from an epistemic failure of modern design, construction, technical standards, product testing, regulatory oversight and asset operation, where critical decisions were disassociated from a coherent understanding of their implications and, even worse, an enforceable model of responsibility. From the most charitable perspective, data about the circumstance might have been available, but not in a way that the danger could be detected. The systems to connect, evaluate, and predict behaviour of the deadly assembly were impossible, made inoperable by the means and methods of modern project delivery. Everyone on the Grenfell team had access to plenty of technology, but with no chance of using it to prevent disaster.

2034 might see multi-modal process automation tools where this data will cohere in digital twins and predictive technologies will evaluate performance prior to assembly on automated platforms. But, as the AI scan contemplates, all will turn on an industry consensus about the meaning and implications of professional responsibility in a world where the line between computation and human work is increasingly blurred.

Other components of the RIBA 2034 Horizons project examine architecture's role and responsibilities for externalities that will also shape the profession – climate, economics, and population. Each sets out a fundamental challenge that architects can address with its skills. Our ability to translate those skills will turn, however, on whether we can convert the enormous opportunities of newer technologies into tangible, relevant, and critically needed results. A fascination with the instrumental possibilities of technology is not enough to achieve this end. It demands an innovative and collaborative stance that can challenge and dramatically improve the way the industry works. Dame Judith Hackitt's recommended Golden Thread, from the independent review of building regulations and fire safety, **[2]** is not just an information theory, but rather an innovation strategy to be applied across the entire delivery spectrum. Perhaps technology-driven innovation can help.

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US startup Built Robotics is developing autonomous excavators for the construction industry. Credit: Built Robotic

Innovation strategy: committing to innovation is the path forward

Jesse Devitte is co-founder and general partner at Building Ventures, the venture capital firm dedicated to supporting early-stage startups creating a better built world. Previously, Jesse helped grow Softdesk to a public company, concluding in the sale of the business to Autodesk. While at Autodesk, he was the AEC Market Group's VP/GM. Jesse has invested in many startups that are now part of industry-leading solutions, including Assemble, Honest Buildings, Newforma, SketchUp, SketchFab, Honest Buildings, and TinkerCad. He is currently on the boards of AeroSeal, enVerid, Join.Build, Skillit, and SmartPM. Jesse graduated with distinction from the Indiana University School of Public and Environmental Affairs.

Venture capitalist Jesse Devitte, an investor in built environment start-ups, highlights how the design and construction industry needs to learn from its past mistakes to move forwards. To effectively employ AI and drive beneficial change, innovation strategy must target three key areas: leveraging data, adopting a systems approach, and realising the digital twin.

I have been involved in the architecture, engineering and construction sector (AEC) for 35 years, and over the last decade have worked as a venture capitalist investing exclusively in the built environment. During that time, I have witnessed the industry's focus evolve from the drive to digitise and the rush to leverage cloud-based technologies to its current inflection point: wrestling with how to apply AI.

Since the next decade will be critical for the global economy and the planet, it will also be critical for the building industry. How we approach innovation will be the single most important factor in determining how well our industry advances by 2034.

The first step in moving forward will be learning from past mistakes, notably the overpromise of the Building Information Modelling (BIM) revolution. Armed with this knowledge, the industry's innovation strategy can be centred on three key targets for beneficial growth: leveraging data; adopting a systems approach; and, finally, realising the digital twin.

To support this growth, the industry will need to work together, breaking down traditional professional silos and making tech adoption and experimentation more accessible. And it must do this better than ever before.

Learning from the overpromise of BIM

The promise of digital technology has been shaping the building industry for decades, but its adoption and implementation has been painstakingly slow. While the conceptual origins of BIM date back to the 1960s, its development began to steer the future of the industry in the 1990s. **[1]** Indeed, BIM's early promise was prodigious. By representing the physical and intrinsic properties of buildings with a software-based digital rendering, these specifications could be readily shared between stakeholders during the building's lifecycle. This would usher in an era of real-time collaboration not only for design, but also for construction and operation.

Thirty years later, however, and supporters' promises that BIM would revolutionise the industry are mostly unrealised. While BIM now produces excellent drawings, the full vision for it outpaced its underlying technology.

One reason for BIM falling short was that it was conceived and began to be developed well before the current cloud era. Without leveraging the cloud, the technology was not able to deliver the means for stakeholders to collaborate effectively. To compound matters, stakeholders were in any case hesitant to share too much or accept the risk that deep collaboration demands. Without participants being willing to share openly, working through the technical limitations proved impossible. As BIM struggled to meet the industry's high expectations, architects, civil engineers, general contractors and even investors shifted their attention and capital to other areas of innovation.

The vision for BIM technology – a single tool that would transform the way the building industry worked – was arguably too idealistic. Drawing attention to this failure is relevant because we see parallels today with emerging technologies, most notably artificial intelligence (AI).

The hype surrounding BIM touted capabilities and benefits that the technology couldn't support. With AI, the technology is impressive, but it remains unclear how the applications will prove useful. Determining the best uses for AI in AEC will require significant work to prepare the ground. Phil Bernstein put this imperative crisply: "The advent of machine-learning based AI systems demands that our industry does not share toys, but builds a new sandbox in which to play with them together." **[2]** If we prepare in the right way, developing an industry-wide practice of information-sharing and collaboration will be as important as any application of AI – if not more so.

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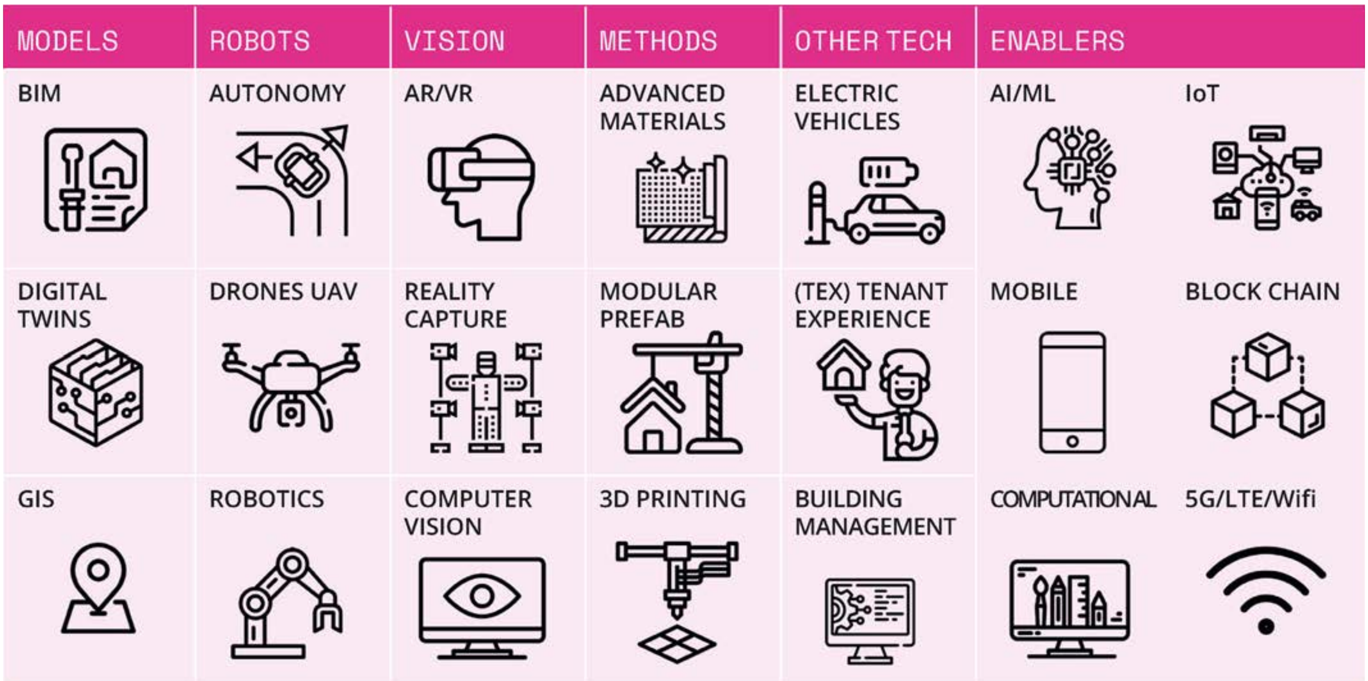

Digital information sources as suggested by the Building Ventures Innovation Network; featured in Phil Bernstein's 'Machine Learning: Architecture in the age of Artificial Intelligence', RIBA Publishing.

Driving meaningful, industry-wide change

Meeting the challenges the built world faces over the next decade through innovation will require the industry's ecosystem to work together, including technology creators and suppliers, legacy institutions, professional organisations like RIBA, and even built environment-focused investors.

We need existing technology vendors to be committed to advancing tomorrow's solutions while maintaining the tools critical to delivering and managing today's projects. Their innovation strategy must prioritise integration with adjacent technologies, data transparency and improved use and access, all of which address BIM's biggest miss: facilitating collaboration between stakeholders.

Now that the underpinning technology exists, a new category of collaboration platform has begun to emerge. Join.build, a Building Ventures portfolio company, and others are enabling the active dialogue and recording of key decisions jointly made by stakeholders across a project. Capturing interactions and keeping an audit trail will become a central part of all projects in the next decade, an aspect of innovation that should be supported by the whole industry.

Securing this collective support will be a challenge. Technology in AEC has been dominated by a few large global leaders, and it is not clear if they will provide the next-generation solutions needed for the future of design. After all, today's standard technology stack is based on products that, at their core, are more than 20 years old (older indeed than the new talent joining the industry). Without buy-in from these companies, the technology the industry depends on is unlikely to change.

Instead, it will take broader customer-based leadership and pressure from large new tech entrants and emerging startups, along with investors and industry organisations like RIBA, to drive meaningful change. By growing the market and making technology more cost effective, technology vendors can lower the current cost burden on architecture firms and make experimenting with and adopting new technology more accessible. This increased access to new tools will help the construction industry to focus their innovation strategies on the most important areas.

There are three priority issues that will drive meaningful change and support the technology needed to meet the challenges facing the industry over the next decade.

Focusing on data as a resource

The first is data. Years ago, an architect friend told me that trying to understand the progress of a building project was like driving in the pouring rain without windscreen wipers. My friend was referring to the opacity of working without the benefit of clear communication, tracking and collaboration. The same analogy could be used to describe more recent workflows, with systems that fail to connect resulting in a deluge of data that collects without a plan in place for their curation or analysis.

Today, however, things are changing. Technology platforms that connect these disparate systems and establish not only crisp hand-offs but also opportunities for real-time collaboration are being adopted more broadly. Going forward, AI has the ability to parse these masses of data to synthesise useful information, identify patterns and shape improvements. The architecture profession is on the path to eliminating 'production architecture,' where the value is in producing drawings.

Leveraging new AI-enabled tools will mean that no new projects will start from scratch. Instead, they will build on a firm's previous work to enable better decisions early in the design process. Imagine, for example, a project where an 'AI principal' – a virtual assistant informed by data available at scale – kicks off a design charette. This new AI principal will ensure the broader design integrity of a project. It will also enable instant checks against the many time-consuming considerations architects must navigate daily, from client programs and local building codes to choices of building products. This safeguards projects against human error while providing architects with the time and headspace to focus on the best design options.

Adopting a systems view of the built environment

Building on this approach to data, the second area of focus for our industry's innovation strategy is to adopt a systems view of the built environment.

Greater access to data and insights as well as more opportunities for collaboration enable all stakeholders to view the building lifecycle as an interconnected, interdependent system. Safety concerns and sustainability measures will accelerate this shift. For example, the UK's Building Safety Act 2022 requires accountable designers to maintain a golden thread of digital information for buildings from design through to operation. Also, in a 2022 study on the built environment as a system, Hari Kumar Suberi notes a lack of precedent in referring to the built environment as a system as a limitation in his own research analysis. **[3]** Despite this, Suberi posits that sustainability will require this change. A "paradigm shift" is needed to capture, track and visualise the built environment as a system to meet the social and legislative demands for net-zero buildings.

Technology is laying the foundation for this paradigmatic shift to capture data and connect stakeholders. We will soon have the ability to follow the golden thread not only during the design and build process but also through operation in a way that accounts for occupant experience.

Today, platforms are starting to leverage AI to measure the carbon emissions associated with building products, materials and even furnishings and fixtures for a full picture of the materials' carbon impact. As this information becomes easier to access, architects, builders and owners will be able more widely and consistently to include carbon accounting and circularity planning into their design process. Other AI powered tools are beginning to equip building owners with predictive maintenance suggestions, saving costs and ensuring safe occupancy.

These are all facets of a systems approach that will help the building industry to create safer, more resilient structures with far less environmental impact, which must be a critical outcome of any technological innovation in the next decade.

Going forward, AI has the ability to parse these masses of data to synthesise useful information, identify patterns and shape improvements.

Realising the digital twin – finally

If the industry is successful in leveraging data and adopting a systems approach to remove the barriers between traditional industry silos, then it will have set up the opportunity for the final critical issue: the digital model as a single source of truth. The industry must, finally, realise the elusive digital twin.

The industry's current process of design, construction, handover and operation of the built environment is too disconnected – a drive through the rain without wipers. A digital twin would improve the process at every stage. To work, the model must be complete earlier in the process, validated against reality throughout design and building, and flexible enough to adapt to changing needs. The digital twin must contain not only the information from the BIM model but also the golden thread. It must record accurate and up-to-date information about an asset's design and construction and, during operation, about its maintenance and improvement.

Once the technology is available, the industry will be able to ensure that buildings age better than ever before. With digital twin technology finally realised, every new and existing building or piece of infrastructure can have its own unique digital model to help direct and capture necessary improvements over time. These improvements can be both planned and strategic, based on usage data, materials data and more. That way, the industry will be able to maximise the use of the existing built environment instead of defaulting to construction, thereby avoiding the embodied carbon footprint that comes with new buildings.

Innovation requires industry support

These three issues line up with activity in the market. More sustainable design and construction will be enabled by better informed and transparent choices throughout the design process. Under business as usual, taking more decisions earlier and enabling collaboration from the start risks a longer and more complex design phase. With the support of technology that has fully harnessed asset data across lifecycles in digital twins, however, these risks will recede. Projects won't start from scratch and can more easily and successfully be developed from initiation through to operation. This will only continue to improve with the growth of modular, prefab and off-site construction as the industry leverages modern methods of construction.

A data usage study by Building Ventures found that, prior to 2010, there were fewer than 100 startups launched in the AEC technology space annually. During 2018, it tracked 700 new startups in a single year.

This vertical growth lined up a rapid expansion of venture-backed businesses in general, and these AEC startups were able to capitalise on it. Between 2020 and 2022, the global investment in AEC technology grew to $50 billion, nearly doubling in just two years. **[4]**

The next generation of tools brought to the market by startups will allow the industry to approach designing, building and operating the built environment as one process, rather than discrete phases with clumsy handovers. To accomplish this, however, the startups will need to capitalise on recent advancements and sustain their ambitious growth with the collective support of the building industry.

The increased capital invested in AEC tech is a good thing, but is only one step in a longer journey. The industry needs to play its part too by adopting, improving and integrating the best of this technology. Firms in the industry need to invest in partnering with vendors to pilot new tools. Their feedback will not only help in the evolution and continuous improvement of the tools but also encourage investor confidence.

Embracing innovation for the future

Ultimately, innovation strategy is not about technology. It is about evolving our processes and adapting rapidly to change. While I have provided a broad perspective, what innovation happens over the next decade and what the industry will look like will be driven by individual firms' analyses and approaches. Leveraging data more effectively and moving towards an integrated systems view of the building lifecycle will inevitably shift the professional reality for architects, as it will for civil engineers, general contractors, builders and all stakeholders involved.

As a part of a more tech-enabled business model, architects will move on from hourly rates and utilisation calculators to instead charge on the basis of outcomes. This transition will prompt them to accept fiduciary duties in their clients' interests. If architects don't seize this opportunity, including taking more responsibility for the risk and even financial aspects of projects, design may increasingly move into the realm of construction. But those architecture firms that embrace this future by extending the application of technology will surely be the beneficiaries. After all, there is much work to be done constructing new efficient buildings, retrofitting our existing structures to combat the climate crisis, and improving our growing cities as they house more and more people.

Technology may feel like a threat to existing practices, but it also presents an opportunity. The potential to re-shape our built environment, our building industry, and our future for the better is there. Committing fully to innovation is the path to creating a better built world.

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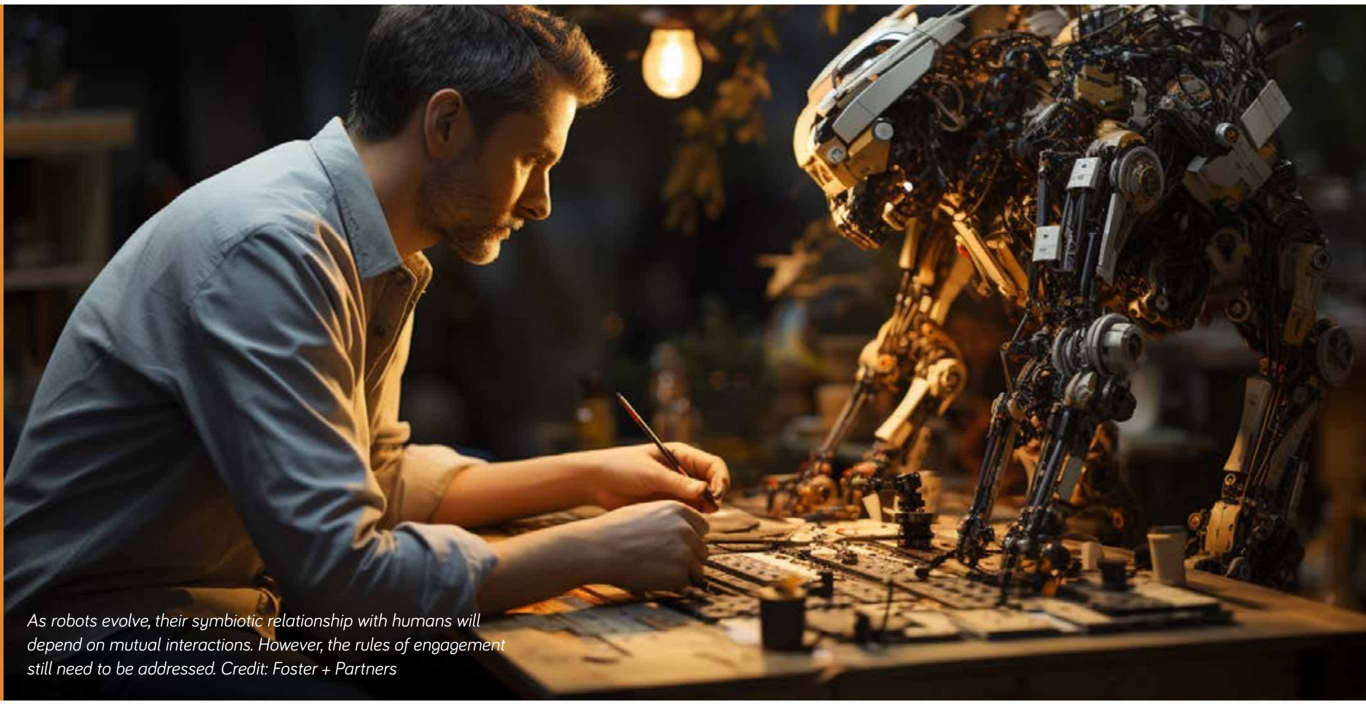


As robots evolve, their symbiotic relationship with humans will depend on mutual interactions. However, the rules of engagement still need to be addressed. Credit: Foster + Partners

Digitalisation in design: skills commoditisation, data battles and the re-invention of creativity

Martha Tsigkari is a Senior Partner and Head of the Applied R+D (ARD) group at Foster + Partners. Her background spans architecture, engineering, and computer science. She has two decades of experience working in projects of all scales and uses. Her work incorporates computational design, human-computer interaction, machine learning, and optimisation. She has investigated the usage of deep neural networks and genetic algorithms in the design process, aiming to solve problems ranging from passively actuated micromaterials to performance-driven urban layouts. She is also an Associate Professor at the Bartlett, UCL and has lectured and published on the subject of computational design internationally.

Martha Tsigkari, Head of the Applied R+D (ARD) Group at Foster + Partners, explores what is coming down the road for architects. What will be the impact of automating manual and often repetitive design processes? Will AI-led automation place architects firmly in charge of creativity, or will it make their role as designers increasingly redundant?

Arthur C. Clarke's third law states: "Any sufficiently advanced technology is indistinguishable from magic." [1] Fifty years on, this adage is truer than ever before. The advent of AI and its 'black box' operations have come to challenge not only our understanding of technology and how it works but also our place in this brave new world (thank you, Mr Huxley!). [2]

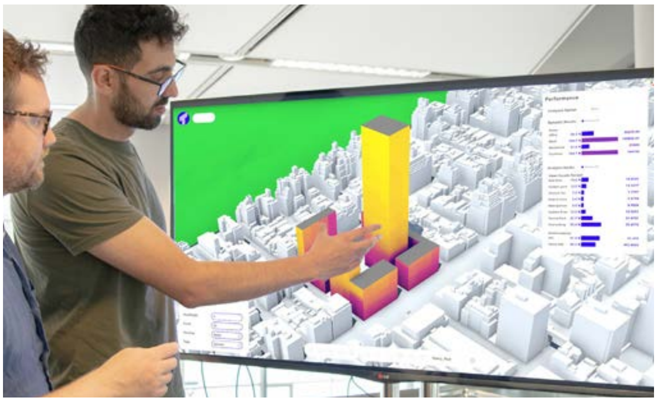
These science fiction references are apt. After all, many sci-fi authors have written about the transformational potential of technology with uncanny accuracy, decades before reality caught up with them. RIBA's Horizons project provides a similar opportunity to predict, occasionally warn, but more often to dream about the profession's future.

The past and present

Technological advancements that have been transforming the architecture, engineering and construction (AEC) sector are not new. Ever since Ivan Sutherland's Sketchpad was released in 1963, working practices in the sector have undergone unprecedented change, with pen and paper gradually giving way to mouse and screen. This rite of passage from analogue to digital meant that designs could be realised not just by hand sketches, but also by using, first, Computer-Aided Design (CAD), then Building Information Modelling (BIM), and now, finally, artificial intelligence.

These technological breakthroughs have helped not only to augment and automate but also to re-invent the way the architecture profession approaches design, collaboration, and creativity. Very soon, though, they are likely to be replaced solely by systems capable of creating architecture from language – the ultimate interface between humans and machines.

I have always been fascinated by the fact that the focus of the AEC sector's digitalisation efforts has for the past 20 years been about BIM. This is understandable: BIM has allowed stakeholders to collaborate using a single, shared source of truth from conception to completion – a long-cherished objective. And yet, the disruptive technologies that are powering the AEC sector today are much more diverse, developed first for the games, films, and computer science industries. Their potential to revolutionise the way architects design the built environment has only recently been properly recognised.



New technologies can analyse and predict how well a solution performs against different Key Performance Indicators (KPIs) in real-time, informing decisions early on in the design process. Credit: Foster + Partners

The near future

Performance-driven design powered by two technologies – graphics processing units (GPU) and distributed computing – are transforming the process of design, simulation and evaluation of key performance indicators. What once took hours and days has become a real-time experience. Both technologies were initially developed for gaming and rendering and are now used in the AEC sector to, for example, run optimisation studies on an urban scale, capable of creating hundreds of thousands of options in a matter of hours – a solution pool for architects to start working from.

Open formats such as Pixar's USD (Universal Scene Description) are breaking down both software and disciplinary silos, allowing data and design changes to flow between different software applications and devices, connecting people and locations in real time. This newfound interoperability and API-first (Application Programming Interface) approach allows the AEC sector to customise design workflows with various SaaS (Software as a Service) components. We can now seamlessly connect project workflows across different disciplines at a fraction of the time it took doing it the traditional way.

Augmented, virtual and extended reality technologies with headsets first developed for the military are now transforming the way that people can appreciate spaces in and around buildings. (The virtual worlds they create are hosted in what are called metaverses, a term first coined by Neil Stephenson in his seminal sci-fi novel Snow Crash **[3]** and later popularised by Meta.) By enabling people to work together to customise virtual spaces on the fly, these immersive experiences not only improve clients' understanding of the design of 3D spaces long before they are built but are also providing collaborative interfaces.

Physical space also finds a digital counterpart in digital twins, a technology introduced decades ago in the aviation industry and now on the rise in the built environment. Using information generated from conception, design and construction, digital twins are live, as-built representations of completed assets in operation. The information they yield feeds back to the project team, completing the data loop. Digital twins help their stakeholders to monitor and regulate how well buildings (and cities) perform and, importantly, identify ways to improve their occupants' experience. Buildings' performance can be optimised with Machine Learning (ML) and the resulting knowledge can be used to inform future projects for better outcomes.

Distributed computing can run optimisation exercises on a city scale in a matter of hours. Credit: Foster + Partners

Augmented and virtual reality have the potential to transform spatial experiences and customise them in real time. Credit: Foster + Partners

Digital technologies are transforming building design from a labour-intensive, time-consuming, occasionally fragmented and often repetitive process into a real-time, immersive and collaborative experience. They automate mundane tasks and enhance designers' creativity and problem-solving capacity.

The software underpinning these advances, particularly in artificial intelligence (AI) and ML, emerged because of the exponential growth of computing power, the creation of continuously growing datasets, and the ease with which they can be adopted. In the years leading up to 2024, growth in computing capacity was doubling every six months, entirely overtaking Moore's Law, which predicts a doubling of chip capacity every 20 months. **[4]** This allows AI models to be created and trained against vast amounts of data. To top it all, the rate of adoption of these systems is unprecedented: whereas Facebook took 10 months to reach one million users, ChatGPT reached that number in just five days. **[5]**

The next 10 years will see advancements that were not thought possible just a few years ago, and at a rate that will surpass everything that came before it.

Speculations on the (not so) distant future

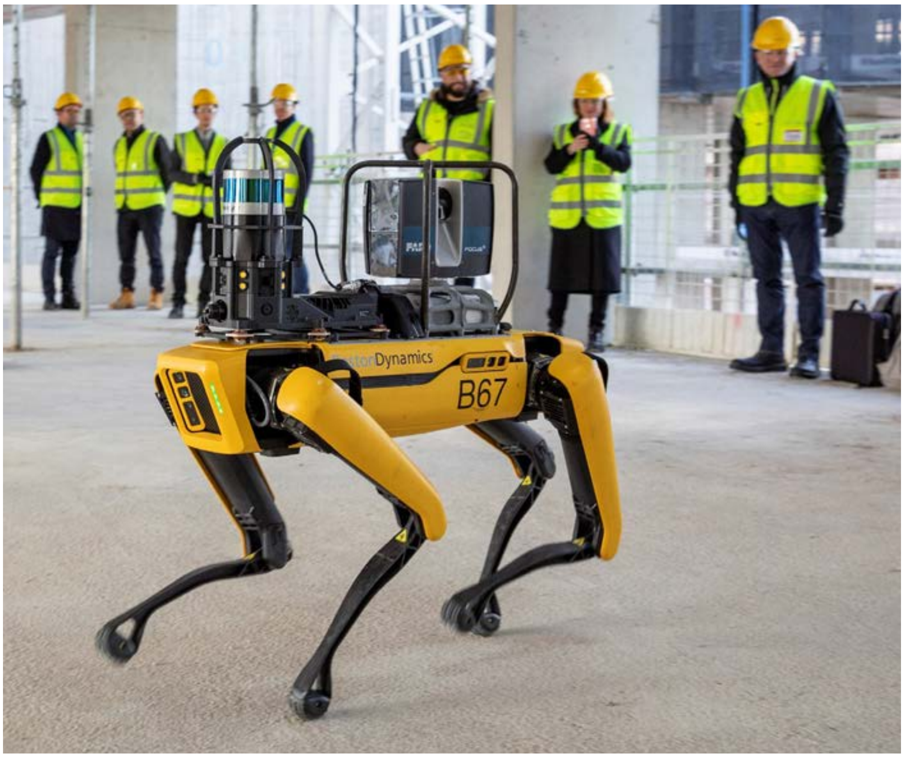
So, where do we go from here?

There is little doubt that, of all the technologies, AI and ML will be the ones to revolutionise design processes and ultimately change the architecture profession as we know it.

The next 10 years will see advancements that were not thought possible just a few years ago, and at a rate that will surpass everything that came before it. Trained on information collected through designers' everyday communications, AI will perform as personal assistants. From AI agents – in other words, "autonomous intelligent systems performing specific tasks without human intervention" **[6]** – that execute tasks in response to **verbal commands** (without the need for bespoke customisation to connect across apps), to fully **autonomous AI software engineers**, the designer's role will be unrecognisable. In fact, as I discuss below, it is even possible that domain expertise will be commoditised.

Conversations about AI in the AEC sector usually mean Large Language Models (LLMs) (such as Open AI's ChatGPT, Anthropics' Claude, Google's Bard and Gemini, and Meta's Llama 2) and diffusion models (such as MidJourney, DALL.E 3, Stable Diffusion, and Firefly). The automation and augmentation afforded by AI and ML is hugely versatile, supporting surrogate modelling, knowledge dissemination, generative design, business insights, and models to assist design. Despite these benefits, it has been the creation of images through prompts using diffusion models that has really taken the architectural world by storm. Architects seem mesmerised by the imaginative and creative possibilities of AI generating pictures simply from descriptions using natural language. **[7]**

While charming and doubtless innocent, this approach to design is rather superficial, lacking in critical thinking about the essence of architecture, the creative process, and architects' professional responsibilities to society. Preferring prompt engineering to actual design, they see themselves as moulding new realities with words, conjuring what is in their mind's eye using a machine's dreamscape blended from other people's imaginations. And as such, words are important as much as they are limiting, as humans' existing vocabulary does not and cannot yet describe styles and solutions that have yet to emerge.



Robots like Boston Dynamics' Spot can become real collaborators during the construction and operation of the built environment. Credit: Foster + Partners

Defining architectural creativity in the era of AI

So, what is coming down the road?

AI is already moving far beyond image and text creation. In a short space of time we have moved from unimodal learning to multimodal, 'zero-shot' models. These are AI models that have great generalisation abilities and are capable of understanding context and connecting across different media without being given an example of how to do so. They are allowing the development of speech-to-movies or even to 3D models, with many new models by the likes of NVIDIA **[8]**, OpenAI and Meta **[9]** coming out all the time. Some models now integrate text, images, video and robotic kinematics.

Tools like these hold the promise of fully automated processes that take design from conception to completion. From massing, performance analytics and layouts, to automatic configuration of solutions, drawing documentation and even code compliance checks – all controlled just with language and verbal commands. In this future, all the workflows that today are run manually would be automated, with AI agents providing the connecting glue and unifying the whole process by stitching different applications and actions together.

AI is also going to automate and augment every aspect of construction. Humanoid robots to replace or support site workers are already being developed by BostonDynamics and Figure. AI tools developed by companies like BuiltRobotics are affecting the installation of piling systems. ML-powered software such as nPlan is already used in project management, cost estimation and schedule optimisation. Products and services that use AI and ML are being used to support the operation of buildings, including everything from asset management, security, and diagnostics to the development of digital twins and even cognitive buildings that learn from their own data and optimise themselves.

Imagine this as a joined-up system: a project brief would ignite an AI-powered chain reaction. A feasibility report would be created automatically. Different generative AI models orchestrated by AI agents would start delivering ideation material based on verbal guidance by the human lead designer. Drawings would be fed to ML models pre-trained on company design data.

From there, options would be automatically tailored to comply to stakeholders' KPIs. Different layouts would be generated automatically and adjusted to fit the brief. A sustainable supply chain would be engaged to suggest components, materials and timeframes. Drawings would be produced and shared automatically with consultants and contractors. All data would be accessible and updated in real-time by the whole project team.

Environmental performance, structural design, material specification, contractual duties, construction details and regulatory compliance would all be dealt with and fulfilled automatically through AI processes. Robots would be valuable collaborators, and problems on site would be identified and resolved in real-time.

Beyond that, AI-powered digital twins would make buildings smart or 'cognitive', able to self-regulate to accommodate the needs of their occupants – or even keep going without them, like Ray Bradbury's fictional house in his cautionary 1950 short story There Will Come Soft Rains. **[10]**

The tight curve ahead

If this future is realised, what role will architects play? Will they be orchestrators still firmly in charge but now free to focus mainly on creativity? Or would any such role in fact be redundant, merely a comforting illusion that human architects entertain to quell their anxieties about ceding control?

Answering these questions requires consideration of three factors.

Quality of data

The first is data. Data about the built environment is siloed and flawed. The AEC sector lacks any universal and open standards for encoding not just buildings' structures and systems but also how they perform socially, contextually and operationally. And because the quality of ML outputs depends on access to good quality data to train, bad quality data will result in the inference of bad solutions. As the old saying goes, 'garbage in, garbage out.'

For this to change, the AEC sector must improve the collection, organisation and processing of data across disciplines by reconfiguring workflows to collect it properly, pooling and cleaning it, and organising and managing it to industry-wide standards.

Skills commoditisation

The second consideration is about the commoditisation of AEC skills. **[11]** Studies have already shown **[12]** that with AI, high-skilled workers see less improvement in their skills than low-skilled workers. This levelling of the playing field means that skills premiums will eventually be lost, making it more likely that highly skilled services will be commoditised.

Just as anyone with a smart phone can now become a taxi driver (with Uber, for example), in the future anyone could become the architect of their own house. As technologies evolve, specialised, hard-earned knowledge may no longer be a differentiator. Going back to our taxi driver analogy, thanks to GPS it is no longer necessary to have a knowledge of streets. In the AEC sector, there is no guarantee that an extensive education in any domain will safeguard any profession's future viability.

Whether this makes the architecture profession obsolete or ushers in a redefined role (much as the advent of photography gave rise to alternative painting styles in art) will depend on how we define the idea of creativity through architects' work and its value to their businesses. To make this transition requires a decisive stance that enshrines critical thinking and domain knowledge as key. As mentioned earlier, this strength of purpose is lacking in the profession's engagement with AI to date.

Defining professional value

Finally, architects must re-assess their worth. If automation means the same jobs can be carried out faster and with fewer people, how will it affect architects' value proposition? If AI automation results in reduced timeframes and resourcing requirements, the value proposition should be shifted to architects being compensated for their competence in collaboration, innovation and creativity. Architects' survival depends on ensuring that disruptive technologies augment rather than replace their services.

Afterword: deeper into the future

If this is the not-so-distant future, where could it lead beyond 2034? Will architects have to compete with conscious, creative machines (run on a hypothetical computer program called Artificial General Intelligence, or AGI) for their livelihoods? Or will they coexist harmoniously, walking hand in hand into the sunset?

As most surveys place this technological singularity beyond 2034, I will not attempt to elaborate on how sentient machines will affect the AEC sector, let alone humanity as a whole. (For anyone interested in finding out more, the debate on the advent of AGI is quite polarised, and the definition of 'sentience' in this context is contended, with syntactic or semantic points of view depending on whether you're a fan of Turing **[13]** or Searle. **[14]**) However, one thing appears certain: humanity needs to agree appropriate rules of engagement with these systems and to understand not only the business opportunities they hold, but also their potential to reinvent our creative capabilities.

Before we anticipate introspective AIs like Cutie (the protagonist in Isaac Asimov's short story Reason) to declare, "I myself, exist, because I think…", we may do well to first understand our role as creators in this new chapter of humanity. **[15]**

Just as anyone with a smart phone can now become a taxi driver (with Uber, for example), in the future anyone could become the architect of their own house.

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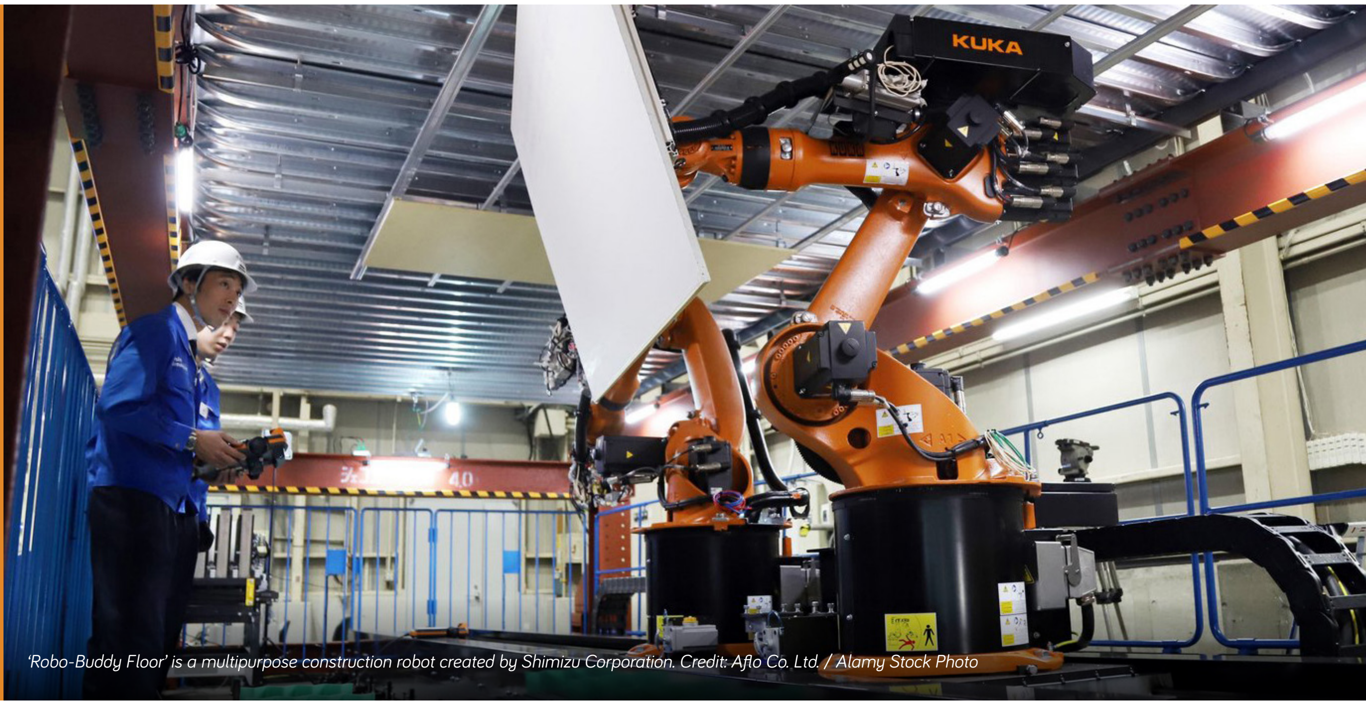


'Robo-Buddy Floor' is a multipurpose construction robot created by Shimizu Corporation. Credit: Aflo Co. Ltd. / Alamy Stock Photo

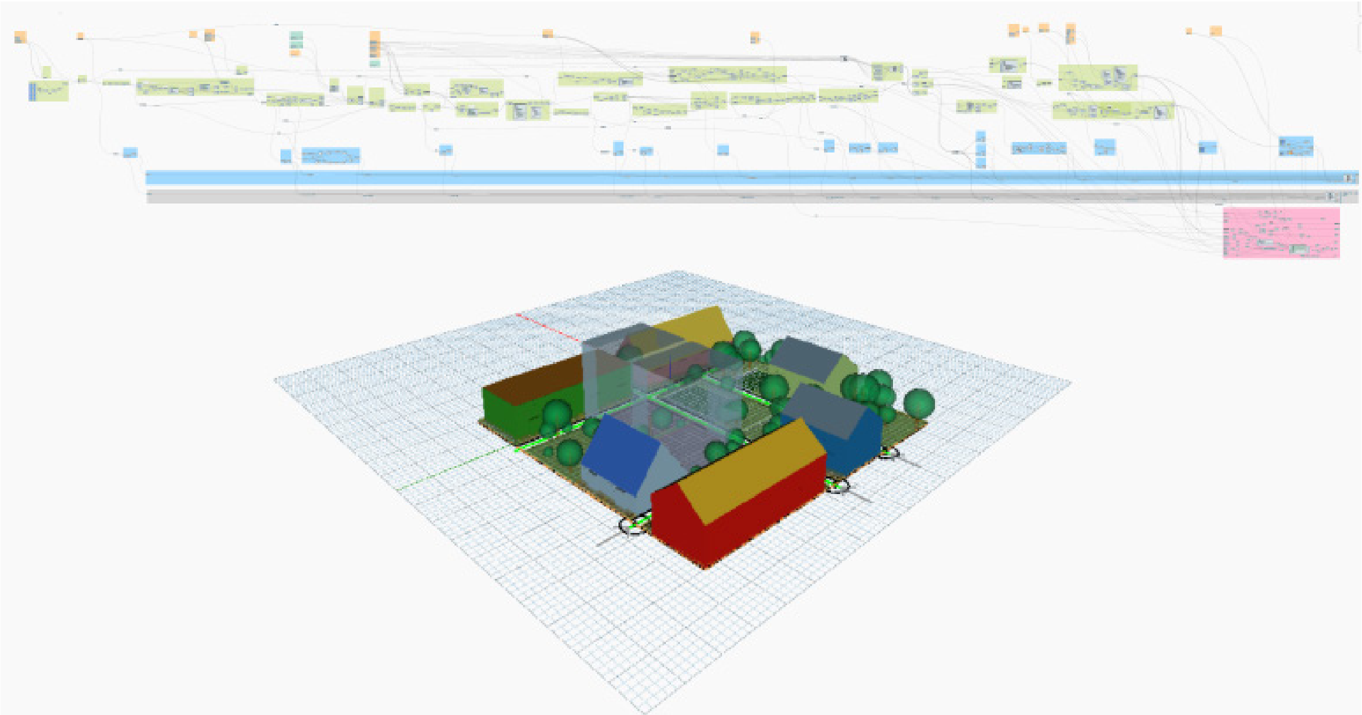
Automation in construction: how industrialised construction can redefine the role of architects for the better

Jim Lynch is Senior Vice President & General Manager of Autodesk Construction Solutions. He leads Autodesk's efforts to accelerate the construction industry's transformation from analogue-based processes to digital workflows. Jim manages all aspects of business operations, including product development, marketing, sales, and support. Jim and his team are focused on delivering innovative, cloud-based solutions to help the global construction industry reduce risk using Autodesk technology. During his 20+ year tenure at Autodesk, Jim was a key contributor in scaling Revit into a market leading solution and establishing BIM as an industry standard. Jim holds a BS in Computer Science from Fitchburg State College.

Jim Lynch, Senior Vice President & General Manager of Autodesk Construction Solutions, explores how the automation of building processes and industrialised construction have the potential to deliver increasingly sustainable, efficient, and safe projects. Could the improvement of stakeholder relationships provide architects with a more creative and strategic leadership role?

Automation in construction often sparks strong reactions. Some people are excited about its possibilities. Others are full of trepidation about its potential impact on human resources. Importantly, we tend to focus on the most futuristic elements of automation, visualising droids laying bricks on site or AI lead designers generating perfect models.

Rather than automation for the sake of it in the form of cyborg-led construction sites, the goal should be process improvement, specifically through the industrialisation of construction. Pursuing this path over the next decade should lead to improvements that enable us to deliver increasingly sustainable, safe, efficient construction projects that address the systemic failures of the sort that led to the Grenfell tragedy to create a platform for future advances.



Urban design generative model by Van Wijnen in collaboration with Autodesk. Credit: Autodesk DA

Industrialised construction is the convergence of our industry with the principles of manufacturing. This means applying controlled and refined processes for greater certainty. Modern Methods of Construction (MMC), which involves the use of integrated processes and products (including off-site manufacturing), will play a significant role. And, yes, so will robotics – where appropriate.

Automation will be central to this improvement, whether it's applied to processes at the factory and jobsite, to the design phase, or to the flow and analysis of data from the whole supply chain (with crucial insights offered by AI). High quality data from sensors throughout the process will drive real-time improvements for better outcomes. This is already happening, particularly in Europe, with the likes of ABB and Weinmann helping firms to implement BIM-driven factory automation.

Process improvements are sorely needed within construction, which is facing widespread labour shortages from traditional skills to digital talent, **[1,2]** a challenge intensified by low productivity. **[3]** Projects are growing in complexity, but predictability remains elusive. There is a high level of waste, a poor safety record and a lack of trust throughout supply chains. With labour shortages projected to worsen, all these issues will become even more acute. **[4]** Architects can respond by embracing industrialised construction and taking a more active role in process improvement.

Industrialised construction – supercharged by automation – has the potential to overhaul both how we build and the relationships between architects, clients and the whole supply chain. This could create a role for architects that spans the highest creativity and the most strategic buildability – an even more promising prospect than bot bricklayers.

A vision of 2034

By 2034, the act of construction will have been transformed, with automation – and especially robotics – playing a growing role. Many of the technologies are already in use in pockets today. For example, Shimizu in Japan has developed a smart site, **[5]** complete with autonomous robots like the Robo-Buddy, which handles construction work for ceilings and floors. Likewise, robots and drones are frequently used for automated site mapping to track progress in minute detail without health and safety risks for workers. During the next decade, we'll see companies identifying which applications of robotics are the most effective. It might be that whereas they are suitable for assembling precast concrete, they are not suitable for MEP pipework, for instance.

The application of robotics on site is important but the real paradigm shift will be where construction work is completed and the processes used. MMC will become the predominant model for construction. Moving work offsite into the controlled conditions of the factory can immediately provide a higher level of certainty, productivity and safety, simply because people are able to work at the right height with tools close at hand and because the controlled conditions mean that it is possible to know exactly when components will be ready.

Companies like Mace are demonstrating the value of this standardised approach, developing a system called High Rise Solutions across multiple developments. On the ongoing Chapter London Bridge project, a 39-storey student housing tower, the team has used 120 precast components preassembled off-site. **[6]** This has improved quality, reduced the number of workers used on-site and enabled each construction team member to deliver £1.59m of value over the course of a year, compared to the overall company average of £1m per person. Importantly, lessons will be carried forward onto the next development, so it is not one and done.

All these workflows depend on data, which at present are not well-utilised across much of design and construction. According to analysis by Deloitte, 80% of global construction businesses today have beginner or emerging data capabilities, meaning limited use of data, strategy and skills. **[7]**

This is set to change by 2034, when data will be used more frequently and much more effectively throughout the industry, as technology matures and the workforce upskills. With more sophisticated digital tools and greater sensor use, accurate information will flow more readily between stakeholders, from the initial planning phase right through to operations. Artificial intelligence will play a key role in analysing, augmenting and automating this information to ensure that decision-makers can quickly act on key insights and implement long-term improvements.

Generative AI will also be in greater use as the companies currently experimenting with it demonstrate its advantages. The Dutch construction company Van Wijnen, for example, has applied generative design at the urban scale **[8]** to explore its possibilities for the layout of residential areas based on financial, sociological, or environmental metrics. The programming tool could quickly iterate designs, structuring and managing the complex and sometimes conflicting requirements of urban developments.

Deploying generative AI can not only save time but can significantly improve outcomes. Because of the bespoke nature of construction today, the role of AI has been limited by a lack of datasets to train the system. Presently, the main applications are in concept design (RIBA stage 2) and go no further. However, by 2034, as Mark Greaves shows in his **horizon scan on AI,** the technology might have developed to the point where the industry has refined the best use cases of generative design for architects.

The role of architects

From robotic automation to AI-assisted processes, the automation of construction will have significant implications for the role of architects over the next decade. The design process itself will dramatically improve with the use of robust data that will inform choices and optimise outcomes.

Inherent to industrialised construction is productisation – that is, the creation of standard modules or components that are reused on multiple projects, including anything from plaster walls to bathroom pods.

The combination of generative AI and productisation can supercharge architects' role and the quality of the designs they produce. Architects will be able not only to present multiple design options, but those options will comprise manufacturable products with known geometry, data and performance.

Workflows are already available today which allow manufacturers of construction components, from facades to bathroom modules, to provide digital 'recipes' for architects to use – along with the parameters that can be adjusted and configured. Architects get the right level of detail for the building design, while manufacturers can be assured that the design will be configured correctly for their capabilities.

This will have significant benefits for the buildability of projects that use the system. As already outlined, it will improve productivity, predictability and safety. It will support the principle of the golden thread of information established by the Building Safety Act 2022. Productised solutions will also allow architects to use real world data to identify the best response to project needs more easily.

For example, the system could provide a project team developing dozens of design options with the cost and schedule estimates for each based on actual data from previous similar projects in a matter of days, rather than the weeks or months it takes today. This would enable the entire team to choose the right option and make the right decisions as early as possible, making it more likely that the project comes in on time and on budget.

The evolution of generative AI will benefit from productisation, making it a more useful tool for detailed design. Generative AI's current limitations (caused by the lack of consistent, comparable datasets) can be overcome with the 'kit of parts' approach offered by productised design information. With components – like bathrooms, staircases and walls – underpinned by data, the AI will be able to learn to create the design detail demanded by RIBA stages 3 and 4.

Generative AI will augment, not replace, the architect's responsibilities, enabling them to focus on higher value, creative elements of their projects. Specific objectives like cost targets and sustainable performance will be achieved early on in the design process, providing architects with greater scope to focus on the unique elements that will differentiate their projects.

Meanwhile, use of automation across construction processes will keep architects and builders in lockstep. With the flow of real-time data supported by automation, builders will have the information they need to truly reflect design intent, while architects will be even more closely involved in the construction phase.

As an early indication of the future, London-based design and engineering firm Bryden Wood have been realising the benefits of productisation with their Design for Manufacture and Assembly (DfMA) methodology, **[9]** which centres on buildability. For example, their work for Heathrow and Gatwick airports aimed to minimise disruption to travelers by establishing manufacturing facilities near each airport, allowing entire sections of corridor to be built off-site. At Heathrow, the construction timescale was reduced by 38% and the number of personnel on-site by 75% compared to traditional construction. This resulted in an exemplary safety record, with zero RIDDORs, lost time injuries and operational impacts. Across both airports, the total cost saving from using MMC was £15.5 million, or 36% compared to traditional construction. Data-sharing across the supply chain, using a 3D BIM model, enabled Bryden Wood to spatially coordinate much more successfully.

Although the uses of automation – and especially AI – might create some uncertainty for the regulatory process, the improvements it brings will help firms to meet the requirements of legislation like the Building Safety Act more effectively. With higher quality data and transparency between stakeholders, providing the golden thread of information and a true as-built record of the building will be more straightforward. It may well be that the principles behind the Building Safety Act drive the adoption of industrialised construction, with benefits for owners and occupants across the board.

Evolving relationships and risk

With the move towards industrialised construction, there is the potential for architects to play an even more pivotal role on projects over the next decade, demanding a new relationship with the supply chain.

Currently, responsibility for the actual build – and the liabilities involved – resides almost exclusively with the builder. But for industrialised construction to work, clients and architects must select the methodology together from the beginning, with design detail and procurement decisions moving to the start of the process. This is because, in embracing design for buildability, architects must design with the method of construction in mind. In turn, this means that clients and architects must work closely with the supply chain from the outset of a project, making decisions based on the kits of parts available.

The most successful designers and builders will build longer-term relationships with manufacturers to create partnerships over multiple years and projects to support the viability of industrialised construction. This 'left shift' is already being seen, with global-scale clients (such as leading cloud-computing companies and pharmaceutical manufacturers) taking more ownership of the process and the risks involved, defining the kit of parts to use and making early supply chain decisions.

Finally, industrialised construction will require moves towards integrated project delivery, a highly collaborative method that brings the design team, delivery and manufacturing suppliers closer to the client. In contrast to the inherently defensive dynamic that can play out in construction projects when responsibility is pushed down the line, this shared risk and reward model requires true project team collaboration.

Preparing for 2034

The advent of automation and the parallel rise of industrialised construction will have widespread repercussions not only for architects, but everyone involved in the industry in the next decade. From greater predictability and safety to higher productivity and a more balanced model of risk and reward, the benefits could be enormous. When it happens, the role of architects will evolve very quickly – and it's important that the profession is ready.

A greater awareness of MMC will be vital. Many university courses already include MMC on their curricula, with new architects entering the field ready to use them. This means that existing professionals must stay up to date with the latest capabilities, too.

More than ever before, it will be important to have a desire and curiosity to embrace new technology. Architects should play with generative AI, become comfortable with it, and understand what it can (and can't) do. They should make better use of the project data already being produced today to inform future designs – by ensuring that data is well-structured and can yield useful insights. For a possible long-term advantage from a professional perspective, they should learn to code.

As industrialised construction takes off, architects will need to understand more about buildability and what the supply chain can do to deliver better project outcomes. Greater openness between collaborators will benefit everyone, from main contractors to clients. This will elevate the architect's role and create long-term opportunities to build much better.

Professional associations and the government will play a crucial role in convincing clients – and the industry as a whole – to embrace the move towards industrialised construction and automation.

By 2034, we won't have Star Wars' C-3PO as the job foreman, leading builds overnight. But we could have consistent, predictable and exceptional construction projects, that deliver meaningful societal outcomes in a leaner, cleaner way. And that is far more exciting.

Architects should play with generative AI, become comfortable with it, and understand what it can (and can't) do.

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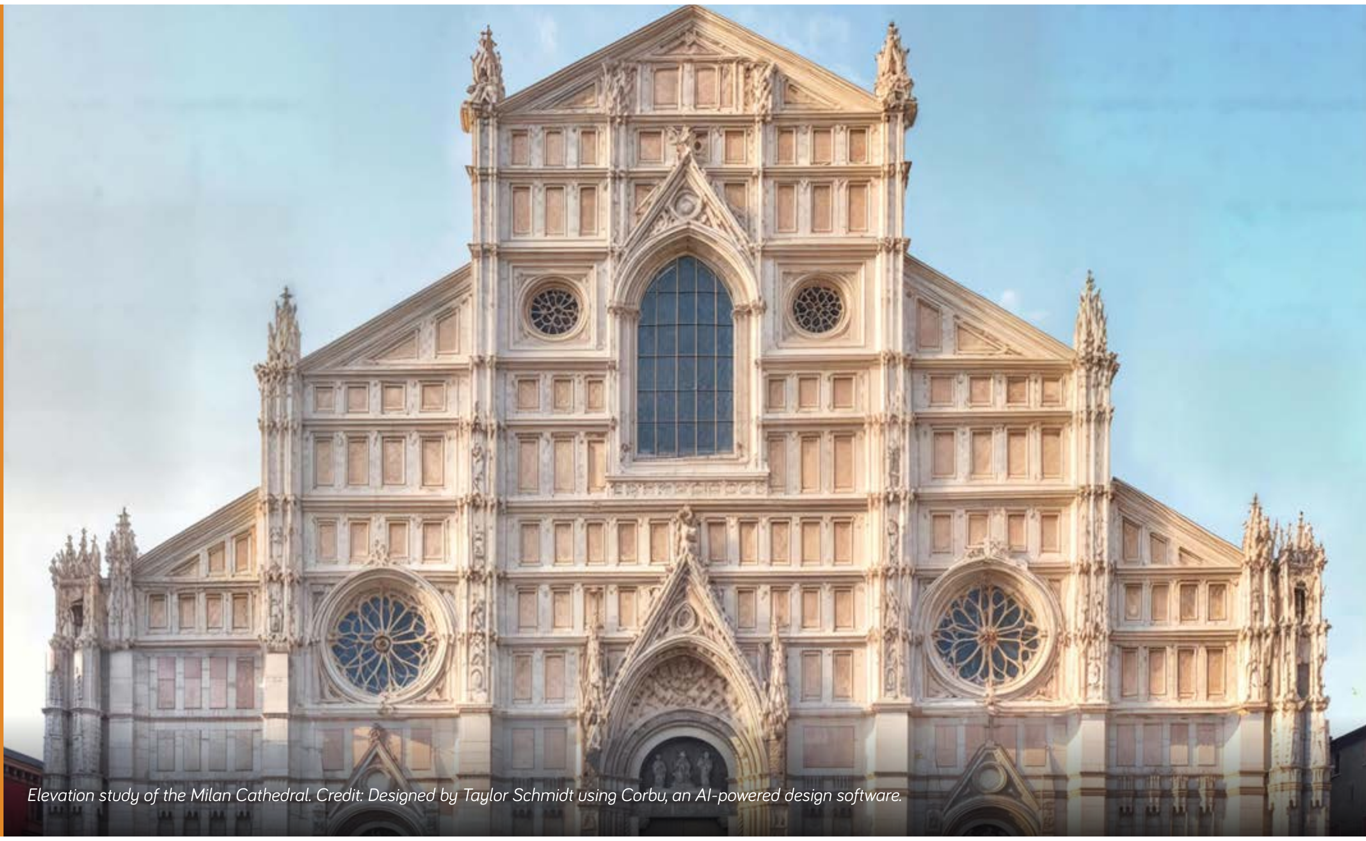


Elevation study of the Milan Cathedral. Credit: Designed by Taylor Schmidt using Corbu, an AI-powered design software.

Architecture in the age of AI: four signposts to watch

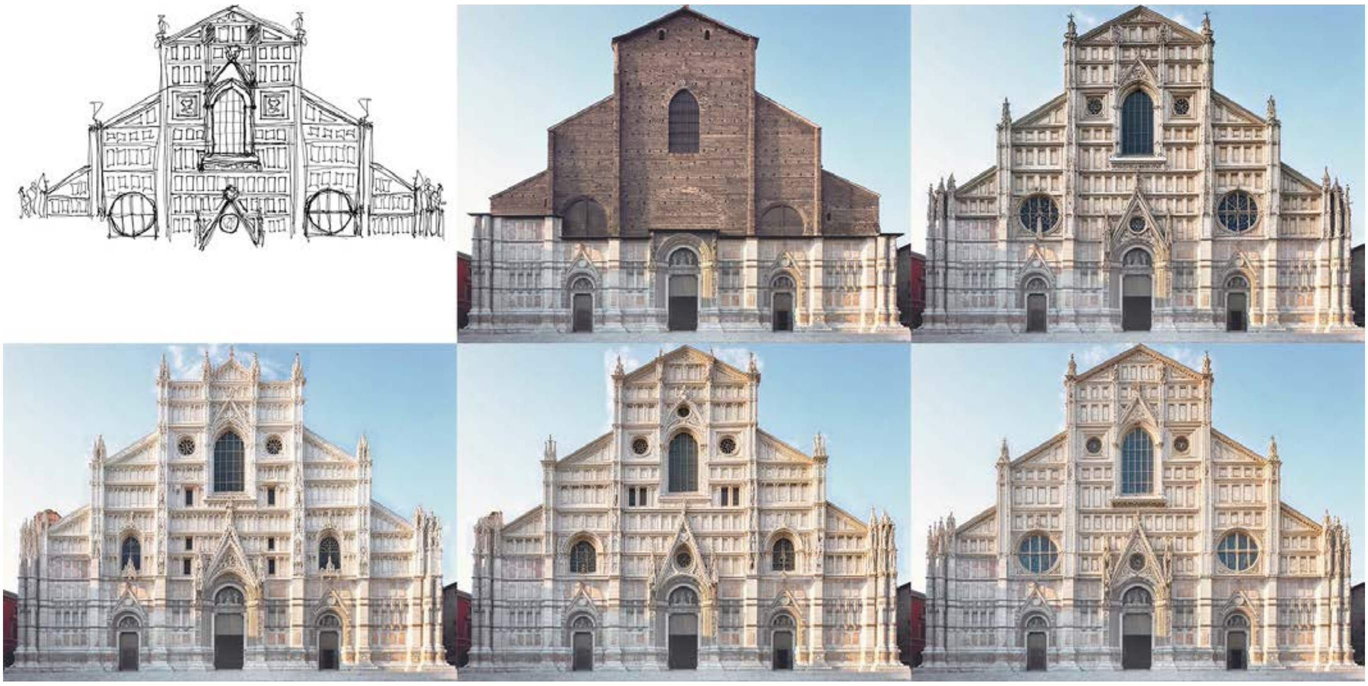
Mark Greaves is currently Executive Director of the AI and Advanced Computing Institute at Schmidt Sciences. Prior to that, he was a senior leader in AI and data analytics within the National Security Directorate at Pacific Northwest National Laboratory, where he created and managed large research programs in AI on behalf of the US government. Before then, he was Director of Knowledge Systems at Vulcan Inc., Director of DARPA's Joint Logistics Technology Office, and Program Manager in DARPA's Information Exploitation Office. He has published two books and over 40 papers, holds two patents, and has a PhD from Stanford University.

How will we know over the next decade that AI is delivering beneficial outcomes for the practice of architecture? AI thought-leader and computer scientist Mark Greaves highlights four key signposts for its development: acquisition of professional knowledge, achievement of human-like judgement, integration into business and clarification of professional responsibility.

Let's perform a thought experiment. Imagine that it is 2034, and AI has turned out to be an enormously beneficial force in the practice of architecture.

Recently completed projects are noticeably safer, more harmonious and more sustainably constructed. The use of AI throughout architectural firms has enabled an explosion of design creativity, coupled with a more collegial relationship with engineers and builders. Even the smallest and most routine structures bear the touches of thoughtful design.

Clients are delighted, professional employment is stable, and fees exhibit steady growth commensurate with the greater overall value that the profession brings.



While AI-based image generators often have a mind of their own, they can be persuaded to create provocative alternatives.
Credit: Designed by Taylor Schmidt using Corbu, an AI-powered design software.

Architects and their staff routinely work collaboratively with a suite of AI-enabled software that allows them to access an immense bank of empirical and theoretical knowledge concerning the ways that the built environment can support human practices and aspirations. They routinely leverage AI-based capabilities to fluidly support all phases of interaction with clients and builders in the delivery of a building.

This vision is the 'Ideal Outcome' for AI and architecture in 2034. To have reached this goal, what issues must have been solved along the way? What signs would indicate that progress was being made?

To answer these questions requires a basic understanding of the way that modern AI works.

How AI works

AI has historically been concerned with giving computers sufficient knowledge of relevant aspects of the world so that they can perform tasks that require some degree of intelligence.

Until the early 2000s, the dominant AI method was to use complex and obscure mathematical tools to manually author thousands of distinct statements about the world, download these statements into computers, and then employ specialised AI software to process and combine these statements to support intelligent behavior. This method was laborious and difficult to scale, had severe challenges encoding uncertain or imprecise knowledge, and typically resulted in systems with narrow and often very brittle capabilities.

The great revolution in AI over the past 20 years has been the development of machine learning algorithms. These take advantage of immense amounts of computational power to process internet-scale quantities of text and imagery, automatically derive knowledge of the world from correlations in this data set, and encode this knowledge into enormous and opaque numerical structures.

These algorithms have been astonishingly effective. **[1]** Using these techniques, computers have quickly become remarkably fluent in language and reasoning and have been able to acquire subtle information about human experience from deep patterns in human communication.

Current AI systems – those trained using machine learning – leverage these patterns in ways that are not fully understood. They enable computers to exhibit human-like conversational behavior, demonstrate superhuman skills across many tasks, acquire new capabilities, create novel artefacts, and make new scientific discoveries.

Four signposts

Given this capability, how will the worlds of architecture and AI intersect in 2034, and what early signs of change will indicate progress towards the Ideal Outcome?

Scientists have observed that machine learning systems appear to follow 'scaling laws' that quantify how capability might increase in AI systems as they learn from more and more data. **[2]** These scaling laws allow AI companies to predict how much capital and computing power they need for a particular level of desired capability.

For our purposes, these scaling laws undergird a set of four fundamental signposts that allows us to monitor progress towards AI capabilities that would enable the Ideal Outcome.

Acquiring professional knowledge

The first of these signposts involves the acquisition by AI systems of characteristically architectural data and epistemology.

In 'The Future of the Professions,' Richard and Daniel Susskind argue that "knowledge asymmetry" between professionals and their clients and the hoarding of "practical knowledge" are fundamental to professionals maintaining their status as experts. They also argue that computation and the internet have the potential to redress the imbalance between the providers of professional judgement and their consumers. **[3]**

Modern AI has this potential. The AI scaling laws show that increasing AI capability depends strongly on its ability to train on increasing quantities of relevant text, imagery and other data. In their ceaseless quest for data on which to train their AI systems, AI companies have already mined huge swaths of text, images, and video from the internet, and have leveraged the contents of the world's great libraries and information repositories. AI systems will soon have absorbed most of the world's publicly accessible essays, textbooks, curricula, blog posts, and media concerning architecture and related topics, and will have derived an immense amount of knowledge of what works and what doesn't.

This has given rise to ferocious battles about the degree to which the use of this information for AI training falls under the doctrine of fair use and fair dealing. AI's dependence on vast amounts of training data certainly risks transferring resources from those who create to companies who use their creations to train models that supplement or replace the creators. The legal status of training AI systems from copyrighted architectural designs or buildings is not currently settled. **[4]**

However, in the field of architecture, much of the Susskinds' "practical knowledge" is locked away in firms' private repositories of artefacts such as contracts, sketches, correspondence, standards, floor plans, building sections, and 3D representations (e.g., digital models, renderings, and analytical and physical models). Furthermore, these artefacts are based on a specialised epistemology and set of abstractions, in which junior architects gain fluency through the human process of architectural education and workplace mentoring.

For AI systems to acquire this critical practical knowledge of the profession, and thereby gain capability in the processes needed to operate in a firm, this private knowledge must be made available for AI systems to train on.

In domains like medicine and law, we are already starting to see commercial AI systems that claim to safely combine the power of general-purpose AI models with an individual business's proprietary data. An important signpost for this capability would be seeing powerful AI systems being marketed to architectural practices which can incorporate firm-specific proprietary data and artefacts.

Achieving human-like judgement

A second signpost for progress towards the Ideal Outcome involves AI systems achieving the capability to interact in a professional way and to form professional judgements from uncertain information.

Architects rely daily on a refined intuition to guide subtle decisions about imprecise tradeoffs and engineering constraints, and to account for ill-defined ethical, cultural, and perceptional interpretations. Not only do they need the skill to make design decisions, but they must also persuasively defend their decisions to a client who will choose, experience, and pay for it.

Today's AI systems have rudimentary capabilities in these areas, but they are not yet close to acquiring the insight and awareness of the human context that is characteristic of an experienced human architect. Still, AI systems are on a trajectory to develop a level of proficiency in areas like these. AI-enabled assistants for scientists, lawyers, and other professionals are starting to emerge commercially, as are early (and somewhat creepy) AI-based social and romantic partners that exhibit early signs of emotional intelligence.

More fundamentally, many of the largest AI companies are actively working on how to modify the behavior of their systems to match enumerated human values so that their systems exhibit behavior consistent with standards of fairness, cooperation, truthfulness, and the like. This type of work is referred to in the AI industry as "alignment." **[5]** Progress here would be a clear indicator that the Ideal Outcome is becoming more possible.

AI image generators lack spatial understanding but are beginning to show partial spatial awareness, as these images of a living space, into which the designer was asked to insert mirrors, suggest. Credit: Designed by Taylor Schmidt using Corbu, an AI-powered design software. Original image by interior designer: Noz Nozawa. Photo: Colin Price Photography.

Integrating into business

A third signpost for progress towards the Ideal Outcome involves agreement on how to best integrate AI systems in business contexts.

AI systems can greatly speed up tasks and allow humans to be more efficient. Creating initial good drafts of essays and documents, generating images and video renderings, answering questions, following chains of reasoning, checking artefacts for compliance and other properties, summarising large amounts of material, and exploring the implications of specific design choices are examples of professional tasks that AI can perform in seconds with an impressive degree of quality.

As AI-based computation displaces the human intellectual effort to perform architecturally relevant tasks, the cost of providing architectural services could be substantially reduced, possibly leading to a corresponding reduction in firm staffing and the fees architects can charge. Significant advances in automation technologies have often dramatically displaced workers (the Luddite era is a well-known example), especially during the transition period.

But some argue that this is too facile. The scholar Kathryn Lofton, for example, has cautioned against the “delusion of efficiency,” and reminds us that the introduction of powerful new technologies often results mostly in a rebalancing of job requirements and stimulates the introduction of new jobs that are required to take maximum advantage of the new technology.

In short, it is currently unclear how the integration of AI into architectural practice will impact staffing and fees. AI is just starting to have real involvement in different sectors of the economy, and there is very little data that would allow us to confidently predict how the rhythms of architectural work will evolve in the face of powerful new AI systems. One signpost to watch, though, is the rate of introduction of new AI-specific jobs, especially in architecture. The advent of AI systems has already produced several new job categories (e.g., ‘prompt engineer’ and ‘AI auditor’) as businesses experiment with ways to integrate AI systems. This suggests that using AI in the context of an architectural firm will bring with it a reordering of jobs instead of simply displacing architects.

Clarifying professional responsibility

A fourth signpost for progress towards the Ideal Outcome involves clarifying the relationship between professional responsibility and intelligent machines.

A fundamental characteristic of professionalism is personal, human responsibility – being on the hook. Critical concepts of obligation, culpability, duty, and trust are currently rooted in a social contract where the morally accountable actors are humans acting in specific roles. AI systems can exhibit superhuman knowledge and abilities, but they are currently treated exclusively as helpers to humans, and humans still have ultimate accountability for actions.

However, the Susskinds foresee a "post-professional society" where knowledge and expertise reside not just in people, but also in machines. **[6]** In such a society, it is vital to be explicit about where responsibility lies. The Grenfell disaster in London was attributed to the dissolution of professional responsibility in the complex web of decisions, material choices, and failures of the building delivery chain, simultaneously making everyone and no one responsible.

A signpost for progress towards the Ideal Outcome is therefore a more careful delineation of responsibility between humans and highly capable AI software. If we see examples of actual delegation of legal accountability to a piece of software (instead of always to a person who serves as a professional guarantor of its outputs), this would be an indicator for the Ideal Outcome.

AI, architecture, and society

The dramatic development of AI over the last decade suggests that a transformational impact on architectural practice is on the horizon. However, the signposts we propose demand that architects consider issues beyond raw AI capability on the way to achieving the Ideal Outcome.

The pace of AI development currently exceeds the ability of wider society to absorb and come to consensus on those developments. Although the computational capability needed to achieve these signposts might be available by 2034, each of the signposts also involves deep collective tradeoffs, which will be resolved in different ways and at different speeds in different societies.

Furthermore, the impact of AI on architectural practice will not develop in a vacuum – it will have a tremendous impact on the overall ways that we live and work, and this will inevitably shift our goals for the built environment. How will the design of physical spaces need to change to reflect this changing nature of human work and leisure? **[7]** How will possibilities for these spaces evolve as it becomes feasible to embed AI and robotics into the building itself?

The ways we create, build, use, and experience space in an AI-enabled world, as well as the ways in which the purpose of the built environment will itself transform, are difficult to anticipate. They will play out over decades as the dividing line between physical and digital experience continues to blur in the information age.

AI capabilities will be enormously advanced by 2034. Their impact will drive changes in architectural practice and coordinating these changes will be the joint work of all the players in the architectural ecosystem. Working to realise the Ideal Outcome will become increasingly critical as the architectural profession strives to tackle the larger challenges addressed in the RIBA Horizons 2034 programme, including creating a built environment fit for a changing population amid a climate emergency. The signposts proposed here will help the profession to monitor and evaluate the growing impact of AI over the next 10 years.

The ways we create, build, use, and experience space in an AI-enabled world, as well as the ways in which the purpose of the built environment will itself transform, are difficult to anticipate.

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RIBA Academy (17 April 2024, 1 to 2pm). RIBA Horizons 2034: The Environmental Challenge

RIBA Academy (8 May 2024, 1 to 2pm). RIBA Horizons 2034: The Economics of the Built Environment

RIBA Academy (12 June 2024, 1 to 2pm). RIBA Horizons 2034: Population Change

RIBA Academy (10 July 2024, 1 to 2pm). RIBA Horizons 2034: Technological Innovation

RIBA Academy (24 July 2024, 1 to 2pm). RIBA Horizons 2034: Reflecting on the Horizon

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