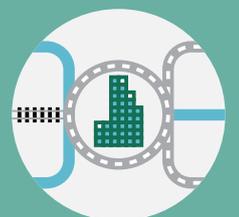
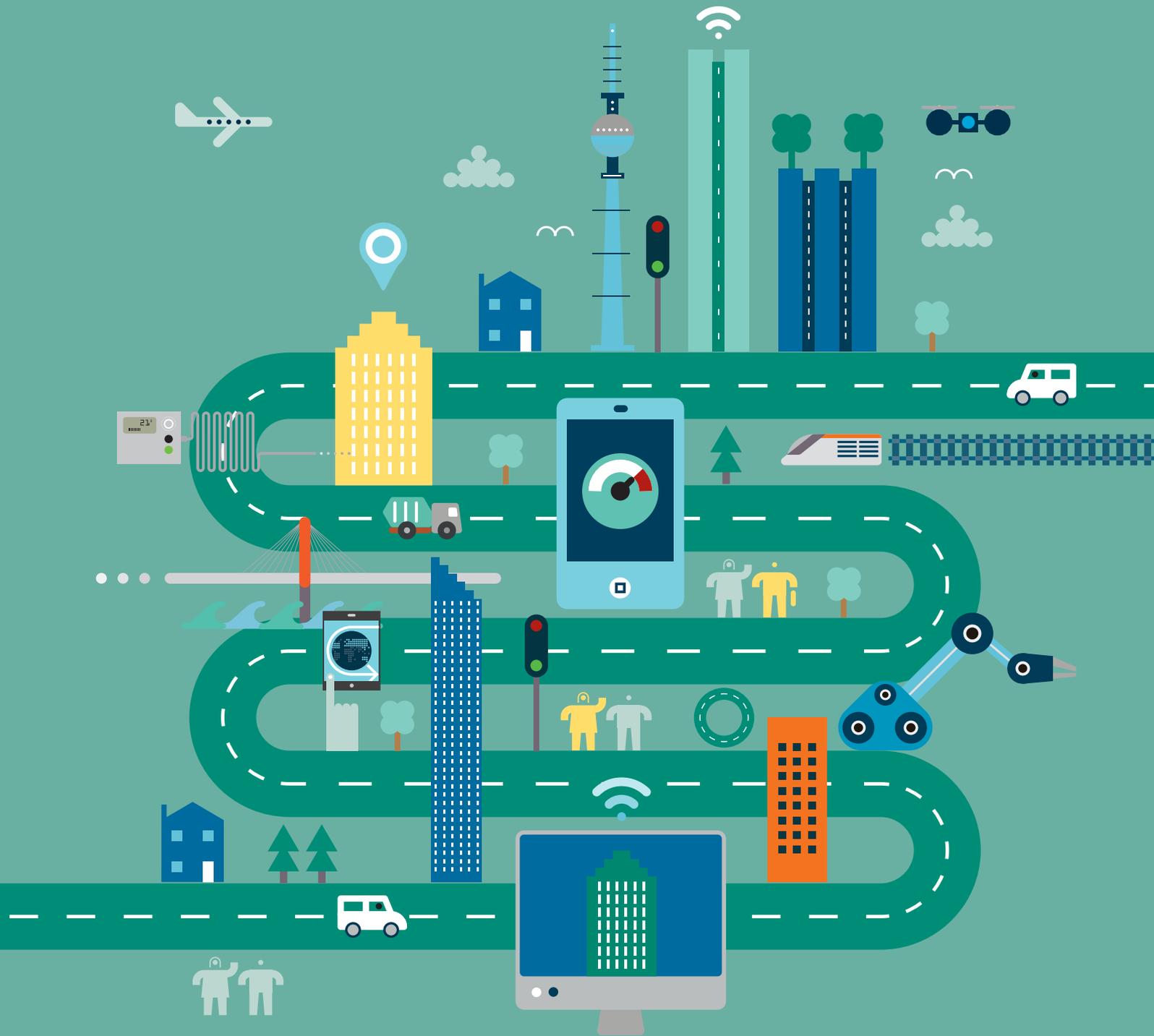


# Smart cities in Europe

The future of the built environment



# What are 'smart' built environments?

How can the built environment become smarter? What are the challenges and obstacles that might prevent this from happening? These are the two core questions this report sets out to address. To obtain answers we spoke to some of the leading individuals in the smart built environment movement, from innovative technology start-ups and specialist consultancies to global multinational corporates, large real estate investors and government agencies.

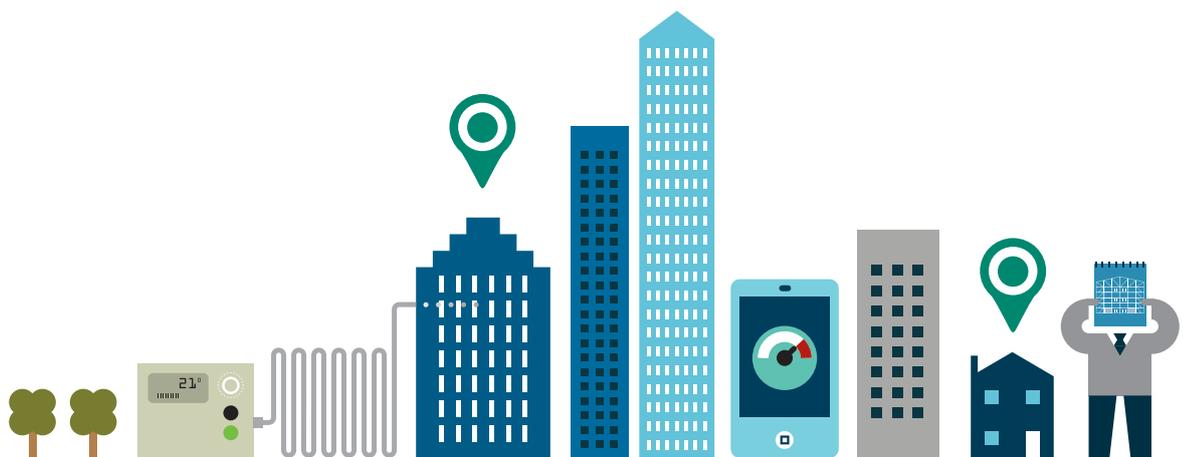
What answers did we get? In short there is a veritable smorgasbord of innovative technologies, business models, architectural designs and new ways of thinking being adopted to make the built environment smarter. These range from individual technologies such as responsive heating, ventilation and air-conditioning (HVAC) systems, desk occupancy monitoring and LEDs through to collaborative workspaces, intelligent facilities management and multipurpose transportation hubs.

We also asked every interviewee how they actually define the built environment. Understandably, we got a variety of different responses. Taking all of these into account and reviewing the literature on this topic, we believe the built environment is best defined as the manmade setting for human activity, including residential, commercial and industrial buildings as well as parks and public spaces. It also includes supporting infrastructure such as energy networks and transport.



*“There is a clear shift in perspective among the real estate community to marrying the built environment with technology. The days of building a mixed-use scheme or office building cheaply and renting for as much as you can are numbered. Investors have realised that tenants are becoming customers. The provision of space is becoming a service and with that service you have to move with the times and provide technology to attract the best tenants, the best rents and the best return on investment.”*

**Peter Day,**  
Partner, Osborne Clarke



What does a 'smart' built environment look like? In short, it's all about driving better usage and utilisation of existing and new assets through data and analysis to deliver services as sustainably as possible for the benefit of citizens.

In practice, smart built environments are those that employ more sophisticated technology than the average building to ensure it is an efficient, productive and comfortable place to live, work and travel to or from. Smart built environments also make good use of data regarding how buildings operate and what individuals do within buildings. They have also been designed to fit in seamlessly with local transport infrastructure and amenities.

More than anything, smart built environments are those that have been developed or refurbished with a smart attitude in which the activity within a building or group of buildings is more important than the raw infrastructure. In this new mind-set, services provided within a building are more important than the building itself. Tenants paying rent for bricks and mortar are instead customers paying to consume space and services.

Why is it important that the built environment smartens up? For a start, buildings are responsible for huge volumes of carbon emissions. According to the Climate Change Commission, buildings accounted for 37% of total UK greenhouse gas emissions in 2012 (the most

recent year for which this data is available). Improving the energy efficiency of buildings is therefore crucial if countries are to meet their emissions reduction targets.

Environmental considerations aside, there are hard economic motivations for making buildings smarter. For large corporations, a 'smart' office headquarters is now essential to retain top talent and improve workplace productivity. For sophisticated real estate companies, the installation of smart technology enables higher rents to be charged.

"When we invest in a building it is key that our capital expenditure program improves energy efficiency and sustainability," explained Loïc Cohen, Fund Manager at CBRE Global Investors, which invests in redeveloping and repositioning obsolete office properties. "This enables us to attract more high-profile tenants that are prepared to pay higher rents. It is a powerful tool in the marketing phase and tenants are now really demanding this."

The built environment is also a vital part of the broader smart cities agenda. It is impossible for cities to become smarter if buildings don't become more intelligent or are not integrated with other aspects of cities, such as the transport or energy infrastructure.

To understand how the built environment can become smarter it makes sense to look at some initiatives that have successfully introduced an element of 'smart'.



# Case studies

## The redevelopment of King's Cross

Situated in North London, the renovated and expanded King's Cross station included the creation of the new £550 million western concourse, which houses new shops, restaurants and larger departure boards.

It also included the creation of a 7,000m<sup>2</sup> square in front of the station containing upgraded underground entrances covered by a glass canopy, granite benches, lighting, trees and areas dedicated to art.

The station redevelopment has been the catalyst for a wider regeneration scheme in the King's Cross area. As part of this wider scheme, 67 acres of brownfield land is being converted into offices, retail and 2,000 homes.

Why is this redevelopment a good example of a smart built environment? For a start, the building utilises renewable energy. Solar panels that generate around 10% of the station's energy requirements were installed on the 2,500m<sup>2</sup> renovated train shed roof. A combined heat and power (CHP) plant will also provide locally generated power to new businesses and homes on the site.

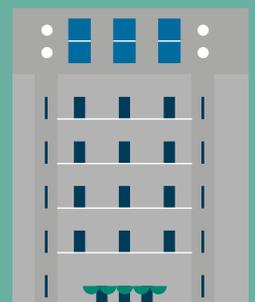
But as Ian Wilkinson, Partner at Osborne Clarke, explains, the King's Cross redevelopment is 'smart' for many more reasons. "King's Cross is not just smart because of the CHP component, it's also the way the buildings are configured to draw people into different areas and allow them to pass each other," he said. "It's also about how you can use your bank card to travel there, hire a bike and pay for everything in the station. With one card you can do everything. Locating the bike docking station in the main square is also smart. So it's smart because of the overall design and joined-up thinking. It's not just about the technology. You now have buildings on Caledonian Road that

really exciting tech and media businesses are moving into. They realise that it is a place where people want to come to work. There are facilities and symbiotic businesses nearby, which creates value."

Many stakeholders were involved in the redevelopment of King's Cross. The land is jointly owned by Argent King's Cross Limited Partnership, itself a partnership between property developer Argent and Hermes Real Estate, and pension fund AustralianSuper. There were three master planners (Allies and Morrison, Porphyrios Associates and Townshend Landscape Architects), four primary contractors (Carillion, BAM Construct, BAM Nuttall and Kier Group) and over 20 architects and design partners.

As touched on later in this report, having such a diverse range of interest groups involved in a project, each with their own priorities, means there is potential for 'smart' aspects of the project to be watered down. But a strong governance structure where decision-making power resided with a small group meant this was not the case with the King's Cross redevelopment.

"A core team ended up controlling key decisions over the land rather than a series of organisations," explained Simon Hobday, Partner at Osborne Clarke. "This meant there was an integrated approach rather than atomised thinking, which doesn't fit into the wider community. It's dull but governance is crucial. People don't get excited by this, but it's critical to get this to work, whether it be a new city, a redevelopment or a single building. You need to get the right combination of the clarity of purpose, the principles that underline it, your underlying design specifications and requirements early enough so that it becomes part of the DNA of the overall development."



# Case studies

## Business improvement districts (BID) in Hamburg

Hamburg has established a scheme to encourage property owners within a certain district to invest collectively in making their area a more attractive business location. Initiatives to promote these areas include structural redesign of public spaces, creating green areas, better lighting, intensified road cleaning and special events.

A commissioner implements these measures once a BID has been established, using funds contributed by each property owner. By the end of 2015 21 BIDs were established in Hamburg with a combined budget of more than €50 million. Nearly 100,000m<sup>2</sup> of

public ground were redesigned with private resources. These schemes are beneficial to local property owners as increased footfall enables them to charge higher rents. Citizens benefit from a greener and more pleasant landscape.

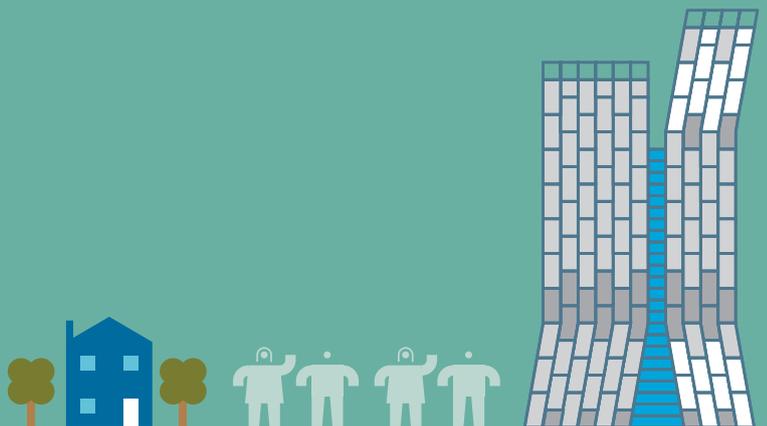
This is a smart built environment initiative because it demonstrates how collaboration can help revitalise an area. There is not only collaboration between individual property owners but also between the chamber of commerce, institutional investors, insurance companies, real estate companies, wealthy individuals and local communities.

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“BIDs are tremendously successful because they have made the city centre more attractive for consumers and help shop owners compete with shopping malls on the outskirts of the city centre. Visitor numbers have really increased and even on Sundays, when the shops are closed, these places are busy with tourists. Rents rose substantially in these areas and have attracted new tenants such as the big luxury fashion labels. Some of these brands were completely new to the city. There is now huge demand for retail space within these BIDs. They're clean and nice and the consumer feels appreciated, they are part of a high-quality surrounding which enhances their self-esteem. The actual money comes from the property owners. Once you establish a BID and have a majority of landowners in favour, the minority cannot quit. They have to pay whether they like it or not.”

**Katharina Feddersen, Partner, Osborne Clarke**

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# Hearing from the experts

To understand how the built environment is becoming smarter, what the main challenges and obstacles are and how this revolution will impact the current city landscape, we interviewed ten market experts.

Some main themes emerged. First, while it's easiest to install smart systems at new buildings, it's essential to make the existing building stock smarter given the large percentage of the overall building stock that they represent. Second, interviewees frequently mentioned that making better use of existing data that is captured about building use can lead to vast improvements in building efficiency. In short, it's not all about installing the latest technology.

When quizzed about the challenges to the built environment becoming smarter, the fact that decision-making power often resides in silos was cited as a major hurdle. This is not just a problem in the public sector. Large corporations are also guilty of not appointing an individual or business unit to oversee the implementation of smart initiatives.

## Don't forget existing buildings

It's easy to get carried away with the intelligent designs, the deployment of ultra-energy-efficient technology and the provision of wifi connectivity in communal areas that are often features of newly built office complexes, transportation hubs and residential developments.

But in reality this is the low-hanging fruit. It's much easier, not to mention cheaper, to integrate smart systems, whatever those might be, during the construction of buildings than retrofitting or refurbishing existing buildings with smart technology.

"It is a lot easier to introduce smart proptech into new-build," confirmed Dominic Wilson, Managing Partner at property technology venture capital fund Pi (Property Innovation) Labs. "The most energy-efficient office buildings tend to be the newest ones. Retrofitting is a hugely expensive exercise. This is comparable to railway infrastructure – it is far easier to install superfast railway links in China on a blank canvas compared to a retrofit within the UK's convoluted system. This is why tenants are increasingly just relocating to new buildings, where they just expect to have energy-efficient and smart technology in place."

However, a consistent message from our interviewees was that new technology also needs to be implemented at existing buildings if the built environment really is to become

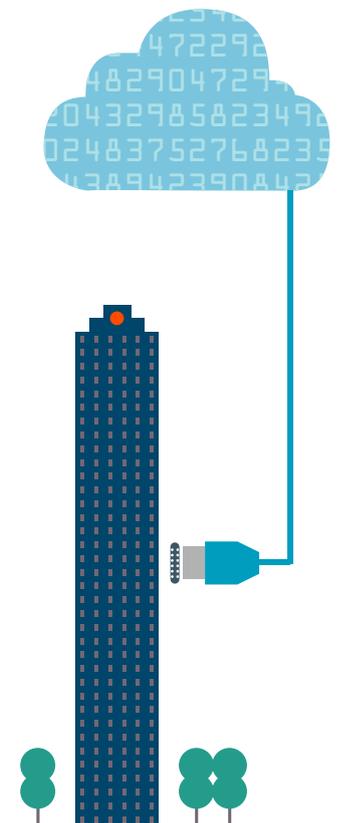
smarter. "Reducing emissions from existing buildings is a really important part of countries' drive to decarbonise," explained Bruno Gardner, Managing Director at Low Carbon Workplace, a partnership between the Carbon Trust, fund manager Columbia Threadneedle Investments and property developer Stanhope, that acquires commercial office buildings and refurbishes them into modern, energy-efficient workplaces. "In the UK, about two-thirds of the building stock that will be around in 2050 has already been built. So if you just focus on making new buildings energy-efficient you are going to have missed a huge chunk of the UK's overall building stock. Existing buildings have to be a massive focus."

This, then, becomes the challenge for proptech companies. How can they develop innovative technology in such a way that it can be retrofitted into existing buildings?

## Making better use of data is key

Innovative technology may grab the headlines, but our panel of interviewees constantly pointed out that buildings can become smarter simply by making better use of information that already exists.

Bruno Gardner, Managing Director at Low Carbon Workplace, explains how data can be used to make buildings more efficient. "Data can be used to drive behaviour change to



ensure buildings are used better,” he said. “We do this by installing lots of energy sub-meters that gather very granular data on how buildings are consuming energy. We also use occupancy sensors to gather data on how buildings are being used. These anonymously but accurately monitor how many people are in the building at any point in time. Combining these two data sets enables us to identify opportunities for our tenants to save energy. It’s not rocket science but it’s powerful nonetheless.”

Information about a building and its occupiers can not only just be used to improve the efficiency of that building. Indeed, clever building owners can turn that data into an asset that can potentially be monetised. Rainer Nonnengässer, Managing Director at MPC Micro Living Development, a developer of student accommodation in Germany, explains how this can be done.

“In principle you can monetise building occupant information because this information is an asset,” he said. “Having 3,000 young tenants all aged between 18 and 24 that are all in higher education could potentially be a reference base for companies targeting that group to better test their products and research their new products. There are hurdles relating to data protection about this in Germany. But as long as they provide the data themselves or agree that it can be used for marketing purposes, it’s something that is highly relevant for technology, leisure, sport, retail and other companies.”

This is perhaps a niche example, but it’s easy to see how the wealth of information collected about human activity in buildings, be that how people work, shop or live, could be highly valuable. There are, of course, challenges to doing this. Number one on the agenda for building owners is whether this data can be monetised in a way that is compliant with data protection and privacy laws. Second is the reputation risk around selling personal information.

However, this risk can be mitigated if managed with care. “Building owners and investors

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“Companies are adopting many good smart ‘point’ solutions in their buildings, such as smart working, room booking, security access, or more innovative things like desk sensors that detect when you are at your desk. All this creates lots of big data, but most of the time this isn’t brought together into a very easy to use enterprise analytics tool. The same applies at a city level. Smarter cities need smarter technology, but with this you need something on top to help visualise and analyse all the data that is created. People just don’t have time to analyse data coming from many different point solutions and require a top hat solution.”

Nigel Warrick, CEO, NJW

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increasingly think that in ten years the data around all the people that use the services in the building will be more valuable than the actual bricks and mortar,” explained Ian Wilkinson, Partner at Osborne Clarke. “Property investors are not currently engaged with this but they really should be. This is partly because they perceive there is a reputational risk, a bit like when investors were hesitant to invest in private rental properties because of the reputational impact of potentially having to evict a granny from her house. But they got around this by having great property management. And actually not doing anything with this data or letting it fall into the wrong hands could be more of a risk. Data needs to be treated as an asset, not a risk.”

Making better use of data can also be used to make collections of buildings, commercial districts or even entire cities smarter. This is especially the case when data is made public. For example, in New York a huge bank of data has been released to the public in an easily digestible format that depicts where road accidents occur. This makes drivers aware of high-risk areas and encourages safer driving specifically in these locations.

“Data, analysis of data and data-based decision-making are all very important to the work that



we do,” explained Cordell Schachter, CTO at NYC Department of Transportation. “For example our [visionzeroview.nyc](http://visionzeroview.nyc) website is a data analysis platform that shows throughout the city where fatalities and serious injuries have occurred going back to 2009. You can limit the data to fatalities and serious injuries and whether they relate to vehicles, pedestrians or bicycles. Technology is one part of the picture but making information available to the public is also critical.”

## Energy is a real focus

Buildings can get smarter in a number of different ways, but one core aspect of the built environment that is seeing lots of focus and investment is specifically building energy efficiency.

“When I think about how our buildings have become smarter in the last five years the main changes have been with respect to energy consumption controlling and carbon footprint,” explained Loïc Cohen, Fund Manager at CBRE Global Investors. “We now sign green rental agreements with our tenants in which we report on energy consumption on a quarterly basis. On a semi-annual basis we meet with the property manager and the tenant to discuss how we can reduce the carbon footprint of the building. When it comes to ‘smart’, this is what our tenants value most.”

We also asked our panel of interviewees which types of smart technologies they have seen deployed most frequently in the built environment and which have the potential to be deployed at scale in the next ten years. The answers varied, but nearly all had an energy-efficiency angle. LEDs were specifically cited as a technology that has been deployed en masse in certain buildings and that has improved efficiency.

In the future buildings must truly integrate with local energy networks if they are to really be considered smart. The installation of efficient lights is only one way buildings can become

smarter with respect to energy. Indeed some buildings might be able to generate renewable energy onsite while others might be able to participate in demand response.

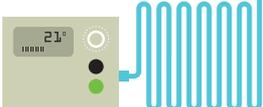
“We are in an LED lighting revolution that is unstoppable, but this is not particularly disruptive,” explained Steven Fawkes, Managing Partner at EnergyPro. “The more interesting thing is about how you integrate buildings into the power system, so instead of buildings being a separate entity to the power system where buildings are the consumers, you should combine local generation, energy efficiency and demand response and think about them as part of the energy infrastructure in a two-way relationship.”

That said, energy efficiency is not synonymous with a smart built environment. Buildings need to integrate better with modern transport modes and provide a more comfortable and efficient environment for their inhabitants, be that employees, residents, commuters or something else, if they are to truly be considered smart.

## The construction industry – starting to innovate

Construction companies are naturally crucial if the built environment is to become smarter. However, our panel of interviewees frequently mentioned that the construction industry lags way behind others when it comes to innovation. Of course, some construction companies are embracing new technology, designs and business models. But the industry as a whole seems to be moving at a slow pace.

In some respects this is an opportunity to create or invest in technologies that can help construction and real estate companies become more efficient. “Construction and real estate companies are very slow innovators, it’s pretty shocking in some respects,” said Dominic Wilson, Managing Partner at Pi (Property Innovation) Labs. “This is partly because it’s traditionally based on asset growth through bricks and mortar and partly because it’s quite



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“The silo issue has come up in lots of IBM’s Smarter City work. I worked on a Smarter Cities Challenge in San Isidro, Peru, and in this case all municipality departments worked together very well. But it was complex because neighbouring municipalities had different priorities and levels of funding. The city of Lima also controlled two of the roads that ran through the municipality and the parking rates for the entire city. The municipality of San Isidro wanted to further develop its sustainable mobility policy, but this had to be done in line with wider initiatives and other stakeholders. This silo mentality also applies to individual buildings. There has to be a paradigm shift in thinking. You can have lots of sensors detecting important information that, for example, tells you when air con is needed. But if building managers just turn the air con on for a set period without really using the data, there are no benefits.”

Lynne Saunder, Senior Counsel, IBM Asia Pacific

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an insular industry, particularly in the UK. Power is held by a relative few and it hasn’t seen the same level of innovation as in other sectors at all. But as a frontier investor we see this as a huge opportunity. For example, at present development managers constantly have to go to the site and tick off various stages of a project, approve budgets and release funds. Is there a way that process can be automated and made more efficient? Of course there is.”

## The silo mentality – obstructing innovation

The most frequently cited barrier to the built environment becoming smarter was that decision-making power resides in isolated silos, resulting in the safest and least innovative solution being procured. A more joined-up approach might result in a more efficient solution being procured. The most obvious example of this is in public-sector procurement.

“One of the most significant challenges is the way that public procurement is typically structured,” explained Robin Daniels, Managing Director at Redpill Group. “During someone’s commute to work, for example, they will touch several different aspects of city infrastructure and services along the way, each of which is likely to be the responsibility of a different city council department. Indeed, a number of these

services are increasingly likely to be outsourced. In order to avoid the deployment of unintegrated point solutions, there needs to be better horizontal integration within public procurement so that when the call goes out for a specific piece of infrastructure it is ultimately delivered within the context of the broader citizen journey or experience.”

The onus here must be on cities to integrate their decision-making processes when it comes to public procurement. It will be interesting to see whether the introduction of city mayors in the UK will assist this. But the silo mentality is not just a feature of the public sector. The development and construction of major infrastructure projects, from transport hubs to skyscrapers, involves a series of architects, contractors and suppliers, each of which have the opportunity to deviate from introducing innovative smart technology and designs, even if it has been specified at the outset. Strong project management is therefore needed to ensure that smart aspects of buildings are not lost during construction.

“Energy-efficient products and services might not be specified in procurement packages for all sorts of reasons,” confirmed Gardner. “It could be because people want to stick with what they know or perhaps aesthetic requirements trump everything else. And then there is the whole procurement chain, which means that even if energy-efficient products and services are



specified initially, there are multiple points for whoever is taking the decision to revert to what they know. We ensure that all the way through the procurement process energy efficiency remains central to decisions, which means that our aspirations are not watered down or value engineered out.”

Our panel of interviewees also identified the procurement departments at government organisations or large corporations as another example of a silo of decision-making power that often prevents smart technology from being implemented, even if the wider organisation is keen to implement smart systems.

“Procurement is very process driven and most large corporates have a set procurement methodology that requires certain criteria to be fulfilled in order to be eligible for a procurement tender or process,” explained Dominic Wilson, Managing Partner at Pi (Property Innovation) Labs. “Some early stage companies might for whatever reason fall outside of that envelope despite having absolutely the right product at that point in time.”

## Government can lead the way

It would be wrong to characterise government procurement as a constant blocker to innovation. In some instances, governments have been proactive in encouraging the built environment to become smarter.

Take the example of building information modelling (BIM). As of April 2016, contractors working on UK central government projects must utilise BIM level 2 technology. This is a platform that visualises buildings in 3D and importantly includes information relating to where building components were sourced and their maintenance history. It enables significant costs savings because it allows architects and construction teams to communicate more effectively. It also leads to efficiencies in project management and facility operation.

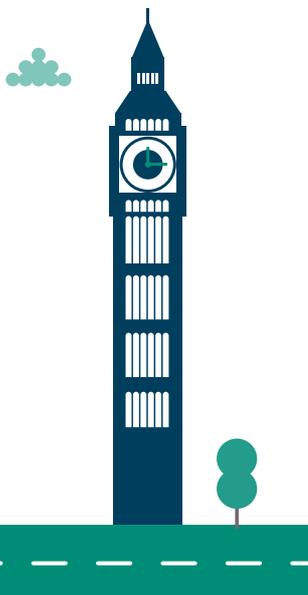
“From the beginning of April 2016, BIM level 2 was mandated on all government projects going forward,” explained Daniel Cashmore, Senior Associate, Osborne Clarke. “The government is already looking at working to BIM level 3. They are really leading the way on the BIM front. They are playing a major role in leading the construction industry into the 21st century, because historically it hasn’t been willing to invest in and adopt technology. Through this initiative more construction companies will become familiar with BIM and as the benefits are realised and the technology better understood it will become the norm on private projects too.”

## The evolution of city infrastructure

As mentioned earlier, the built environment is not just about buildings. It also includes the infrastructure that powers and connects buildings, be that transport or energy networks. An interesting question is, therefore, how city infrastructure might change and whether some city infrastructure might become obsolete as cities introduce smarter technologies and business models.

Take the example of car parking. If use of car sharing and more innovative methods of transport such as driverless pods really do take off then there might be less need for car parking infrastructure. This is something that city planners and designers of all types of buildings need to consider given the long construction lead times.

“Maybe you will still need car parking but for fleets of shared cars or Uber taxis,” commented Alex Tosetti, Operations Director and Head of Smart Cities at Aecom. “The behaviour of car ownership is changing. Rather than having two cars on your drive, you might have one small electric car and then rent another.”



# Conclusion



**Simon Beswick**

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Smart built environments leverage data, new technology and innovative and collaborative thinking to deliver services that benefit citizens. As explored throughout this report, there are many ways this can be achieved.

In our series of interviews, it was frequently stated that built environments must become smarter through better use of data. But what does this actually mean in practice?

At its most simplistic level this means adjusting the settings of building systems in response to occupancy levels. There is no point, for example, in air-conditioning systems running at full throttle when a certain area of an office is only 30% occupied. Leveraging data intelligently is also a must if buildings are to participate in demand response.

But data can be leveraged for means far beyond improving the efficiency of a building or set of buildings. Data about buildings' inhabitants, be those workers in an office, students in student accommodation, or individuals in private rental accommodation, should actually be considered as an asset that can be monetised. Of course, property owners and property occupiers will naturally have concerns about data privacy and data

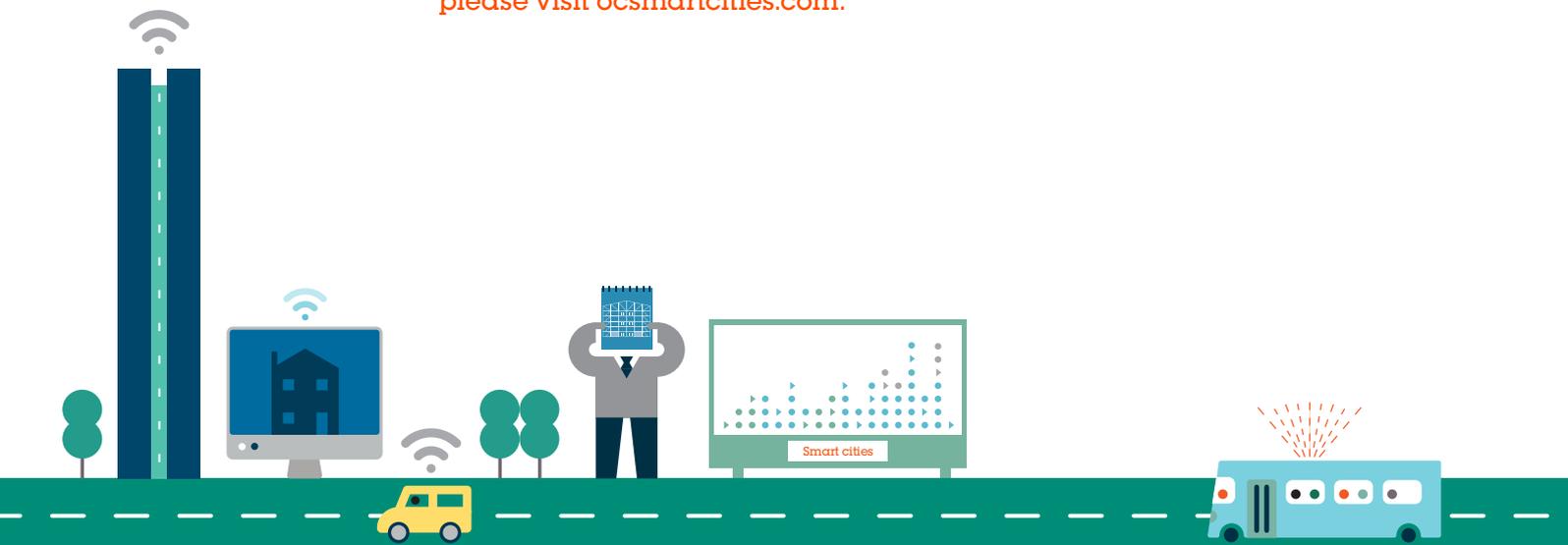
security. But this is just another risk that can be managed with specialist advice.

Our series of interviews also highlighted a huge number of obstacles to the built environment becoming smarter. These range from unsuitable governance structures that result in atomised decision-making power, outdated procurement processes and the natural challenges to retrofitting new technology into existing buildings.

Yet despite the challenges, the case studies outlined at the beginning of this report demonstrate that built environments are becoming smarter. Our series of interviews also confirmed that an essential shift in mind-set to a smart way of thinking is under way.

What are the key ingredients for success? Like the topics our previous reports have addressed, collaboration between investors, real estate companies, government agencies, technology companies, architects, construction companies and the local community is essential if the built environment is to become smarter.

**For more on smart cities and how OC is involved in developing smart cities, please visit [ocsmartcities.com](http://ocsmartcities.com).**



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