BUROHAPPOLD
ENGINEERING

FUTURE VISION

THE FUTURE OF ENGINEERING

The future of engineering









As the built environment becomes an increasingly diverse, exciting and ultimately challenging realm to work in, BuroHappold Engineering is working to understand the potential impact that engineering could have over the next 30 years. As a progressive organisation that values new talent and innovation highly, we sought to give our newest recruits an opportunity to explore their thoughts on the future of engineering. With ideas spanning the reinvention of the city, working in a virtual world and engineering in space, the results are thought provoking, and demonstrate the magic of the engineering minds behind the projects that BuroHappold deliver.

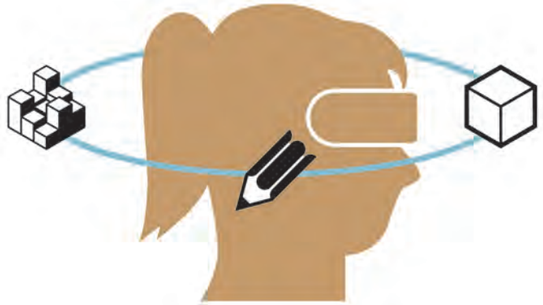
Roger Nickells
CEO, BuroHappold Engineering

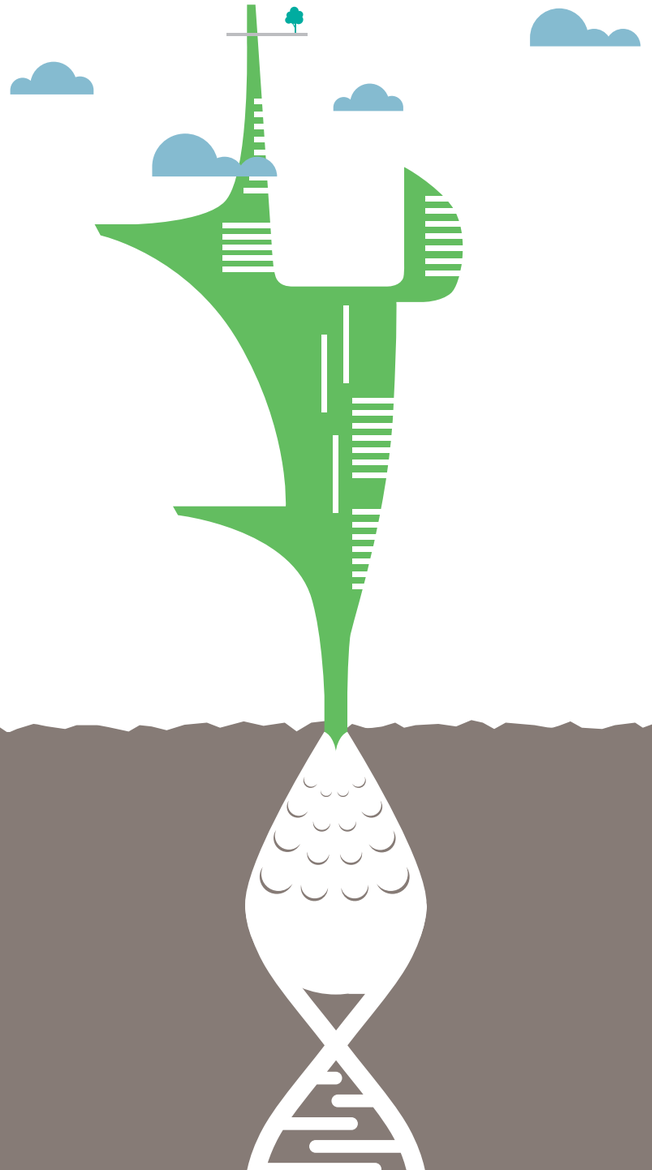
Virtual world

Bernd Paarmaan envisages a future for engineers that will be reliant on a virtual world, with work existing in a digital plane that allows global collaborative input on projects on a massive scale. Paarmaan explains, "architects, engineers, scientists or philosophers will work together, embracing a virtual reality where problems can be resolved digitally, allowing us to work from anywhere across the globe, in real time."

Believing this to be the way forward to realising a truly coordinated approach, Paarmaan details how this new digital world will enable every team involved in the project to work on the finite elements of large scale projects in unison.

Ultimately, while using such open platforms would allow technically challenging masterplans and buildings to become a reality faster and more effectively, this new way of working across sectors would also allow engineers to be embroiled in the essence of the development themselves, influencing the very ethos behind the projects and the impact they have globally.



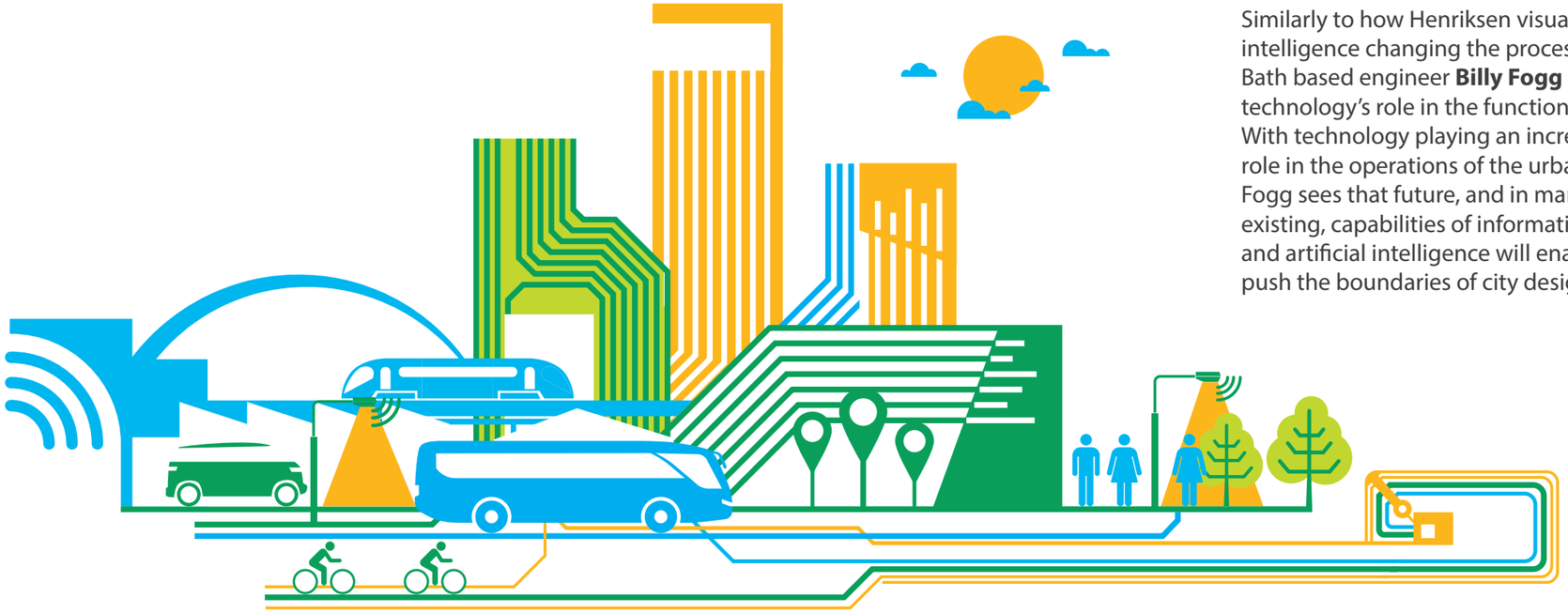


While Paarmaan considers the platform on which collaboration may flourish in the future, Copenhagen based analyst and developer **Martin Henriksen** looks at the way in which information will be processed and shared between teams across disciplines and projects. Henriksen explores how information sharing itself, will be enabled by developing a process that will not only analyse and rationalise existing designs, but actually provide the recipe to create the designs themselves.

Henriksen likens this to an organic process, one that is derived from a system that is already mapped out and refined. "The best example I can give for this is a plant…a plant is structural, it has a system for nutrient transport and it is energy harvesting, all combined in one holistic system. A plant is not designed or created from scratch; it is grown using the instructions encoded in its DNA. This is where I see us going; we will be encoding the DNA of buildings," he explains. Henriksen's vision foresees artificial intelligence as the key to creating this DNA for the built environment. With developments in artificial intelligence already at a stage where we can have answers to everyday questions at our fingertips, in the future technology will advance to a point where we can use this intelligence to create the formula for building design.

Intelligent infrastructure

Intelligent urbanism



Similarly to how Henriksen visualises artificial intelligence changing the process of design, Bath based engineer **Billy Fogg** considers technology's role in the functionality of the city. With technology playing an increasingly vital role in the operations of the urban landscape, Fogg sees that future, and in many cases already existing, capabilities of information technology and artificial intelligence will enable engineers to push the boundaries of city design.

"In 30 years' time it is likely that over three quarters of us will be city dwellers. This rapid increase in urban population will place immense strain on the infrastructure of cities and they will struggle to cope…we need the right city infrastructure in place to solve these issues," Fogg says.

His answer is a future that, rather than building today's environment on a larger scale, will see smarter city systems evolve, enabling intelligent infrastructure that monitors its own systems and reacts automatically to changing conditions.

Using transportation as an example, Fogg examines how in 30 years' time, an automated road system used by driverless cars could provide a safer, more efficient way of travel; allowing road sizes to shrink, less accidents to occur and reducing the carbon footprint. Fundamentally, Fogg sees the effective collaboration between specialisms across the industry as being essential to the successful growth of the smart city.

Revolutionary materials

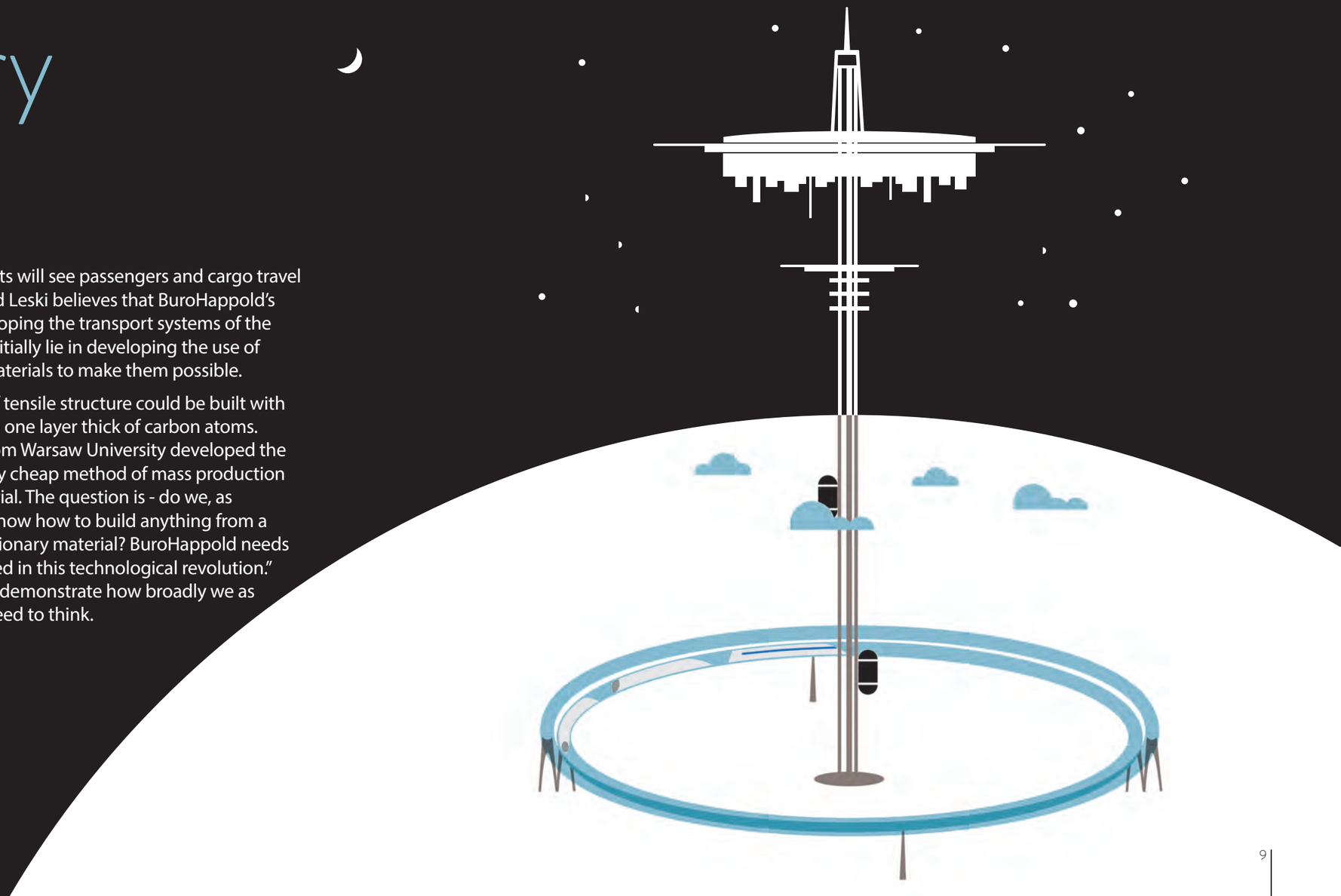
Konrad Leski's vision for the future lies beyond the current global reach that engineers aspire to. New revolutions in transportation, along with the availability of diverse structural materials, have led to exciting developments.

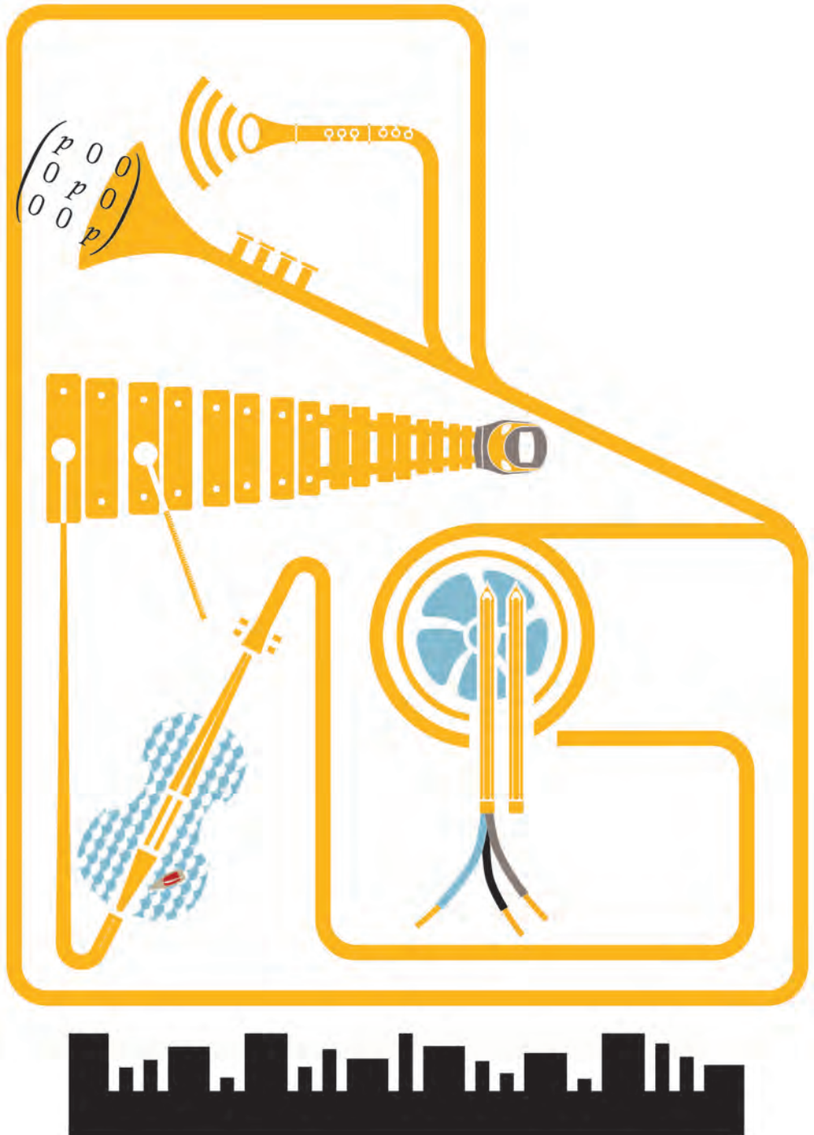
Elon Musk has recently announced plans to build the first hyper loop instalment - a steel pipe that uses air pressures to transport pods - that will enable travel between LA to San Francisco in less than 30 minutes, while a further two companies have announced their plans to build test tracks in California.

Leski believes that this technology evidences that possible developments in space exploration are also going to be significant over the coming decades. "Sounds like science fiction? I don't think so," Leski explains. "Space X and Mars One are planning to send permanent habitants to Mars in less than 15 years time…this means that in 30 years time engineers could participate in designing structures on other planets. Will BuroHappold be ready for this challenge?"

New concepts will see passengers and cargo travel to space, and Leski believes that BuroHappold's role in developing the transport systems of the future will initially lie in developing the use of structural materials to make them possible.

"This type of tensile structure could be built with graphene - a one layer thick of carbon atoms. Scientists from Warsaw University developed the first relatively cheap method of mass production of this material. The question is - do we, as engineers, know how to build anything from a new, revolutionary material? BuroHappold needs to be involved in this technological revolution." Leski's ideas demonstrate how broadly we as engineers need to think.





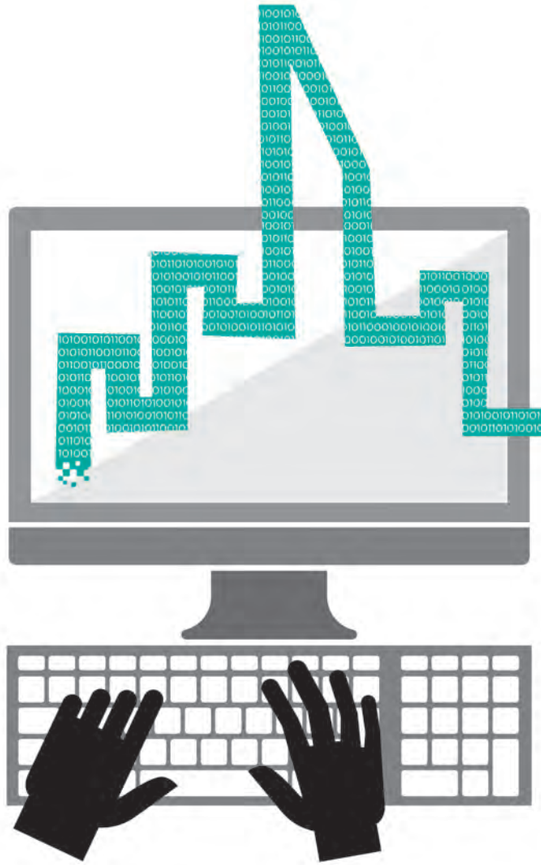
Speed to construction

The development of new technology that will enable a change in the role of the engineer is also detailed by **Pawel Mlynarczyk**, who is based in BuroHappold's Warsaw office. He explores how the availability of new software and hardware will reduce the length of time spent on the design stage by more accurately processing the significant amount of data involved in delivering world class projects.

These changes are already demonstrated in China, where engineers are able to build a block of flats in less than two weeks. "I believe that the changes in the construction process already evident in China shows that we will be able to build really complex structures, for example stadiums, much faster and more efficiently," Mlynarczyk explains, "Further advances in materials and technologies will help us to realise this.

We need to be the engineers who discover these and know how to use them – we need to win the race." Mlynarczyk concludes that the on going development of tools that will allow us to build faster and with more efficiency will see the role of the engineer evolve to a highly skilled consultant, providing a wider range of advice and services across a diverse client base. BuroHappold must prepare for this shift in emphasis and be at the forefront of future engineering practices.

Engineers as politicians



Following the theme of the future of the city, **Mehrnaz Ghojeh**, a Cities Consultant based in London, sees preparing future urban environments as an urgent political and governance challenge. While the technology to meet the complex challenges already exists and is rapidly developing, the most significant shift will rely on engineers having a greater understanding of the political and behavioural changes facing our cities, and more importantly their communities.

This, she concedes, will have a greater impact on the future of the city than technological advances themselves. "Intelligent cities may improve the efficiency and performance of urban environments but that does not mean they will be better cities. The digital/information age shows that those planning smart cities are mostly concerned with technology and data, not people. Cities are the principal civic platforms for innovation and we must ensure that our focus and fascination with data and technology does not spoil the creative process of harnessing technology at the grassroots."

The alternative is to reverse the way we currently view emerging cities, by allowing citizens to have access to data and to use technology to better integrate decisions about how their city should run. "Smart cities are one component of a successful city. It is through the integration of smart governance, smart finance, smart ownership and smart society that we can begin a conversation about a smart living city.

Our recommendations regarding reducing water consumption and energy use, or cutting down food waste, all require changes in social behaviour both from the top-down and bottom-up," she explains. Ghojeh believes the engineer's role is to understand the complexities of urban dwellers as well as we understand the complexities of urban environments. It is only then that engineers can influence the lifestyle choices required of city inhabitants that impact the emerging needs of future cities.

The balanced city

With the debate shifting focus to the role of people in the future of engineering, **Thomas Kraubitz** considers how the next three decades will focus on reimagining the city environment, and bringing both people and industry back to a more central location. With many industries becoming much cleaner, planning regulations for industrial districts should be reviewed. He describes how in order for a city to fully function and be competitive, it needs both a strong industrial presence along with the workforce located within the city itself to make it complete. "At the moment we have a lot of our production taking place outside of cities…we should motivate the right industries to come back to contribute to make cities good places to live and work".

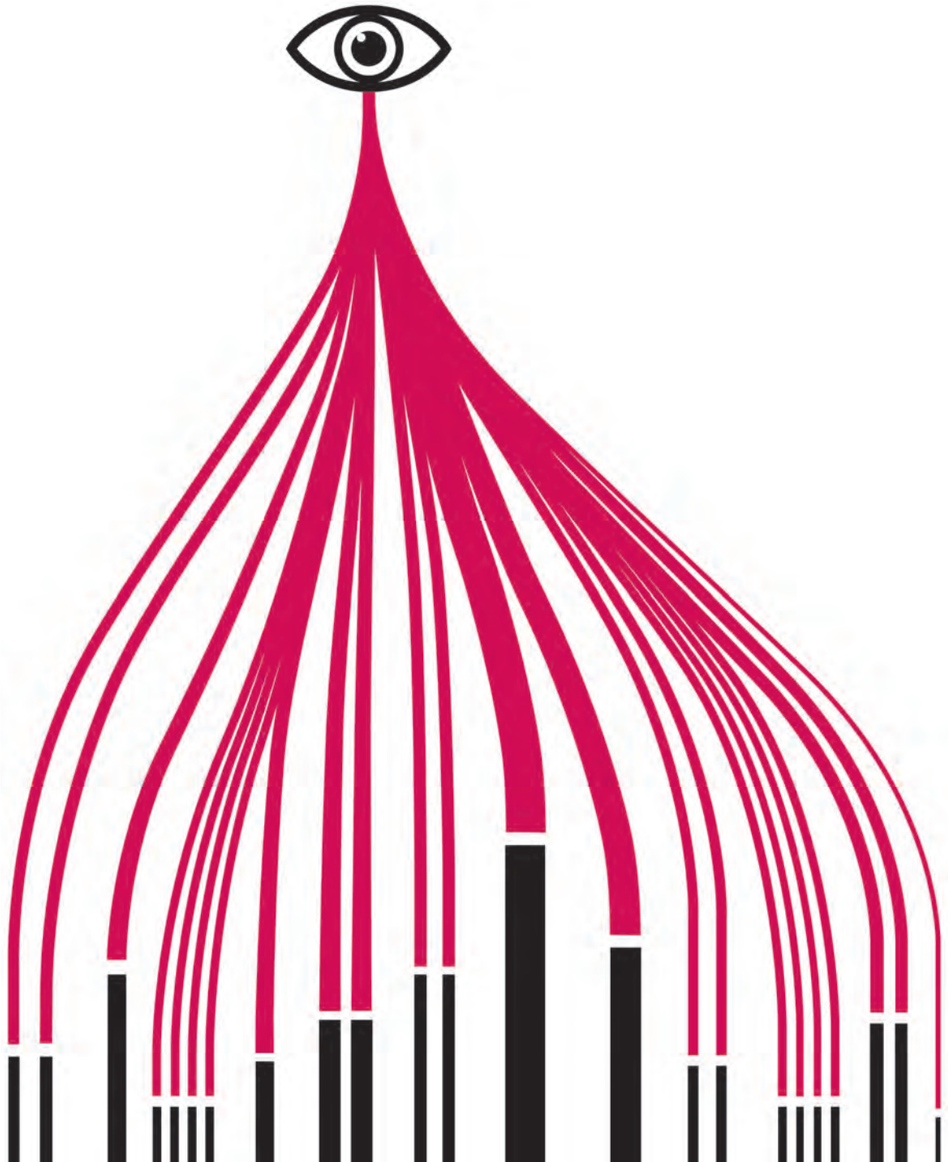
Kraubitz argues that it is part of an engineer's role to demonstrate to clients how contributing to creating cleaner and greener production facilities alongside better communities will strengthen the future of the urban environment. "If we can move towards this then we can ensure that in the future we have more happy people because travel time is reduced and job opportunities nearby are improved. By bringing industry back to the city we can also bring back valuable services that are not available currently. The future is in the strength of a complete urban environment."

Society at the heart of the solution

Keeping the ethos of people led engineering as a key theme running through the debate, **Julia Kaminska** explains her theory that the future of engineering as a profession is reliant on the ability of engineers to evolve as people, and offer more to the ever developing world.

She sees that the future role of the engineer will not only focus on the mechanics of the built environment but also on the financial, economical and social aspects.

Looking at the bigger picture will be vital to the future of development Kaminska says, "engineers will be the masters of strategy planning… the future belongs to people who will realise the expectations of society. Those people will be aware of the mutuality of social, economic, environmental and engineering impact."



Embrace unpredictability

Conversely, **Stephen Henry** argues that the time has come to begin to draw positives out of climate change, and that engineers need to embrace the unpredictability that the next 30 years will bring. "Climate change, global warming, over-population…these are all terms that historically come with negative connotations, but I believe that this doesn't have to be the case anymore," Henry reasons.

"Ten years ago, for example, sparkling white wine from the UK would have been undrinkable, but after a decade of increased temperatures, more sunshine and a longer growing season, all due to climate change, the UK can now produce sparkling wines that can compete with Champagne on a global scale. This is just one example of how land owners in the UK can take advantage of an unforeseen benefit of climate change."

Describing an opportunity to work with nature rather than fear it, Henry believes that the time has come to start considering how the seemingly negative elements of climate change can be used in a positive way. Rather than allowing factors such as floodwaters and air quality ruin our environment, it might be time to discover new ways to capture these elements and use them in a different way. "Rather than being left behind by other industries and by our competitors, let us embrace these challenges. We need to lead the way in capitalising on these changes. We need to be the ones making Champagne."

While some may debate how we should view climate change, Henry's sentiment that BuroHappold should lead the way in future thought and innovation rings true across each argument. Each engineer describes in differing ways how it is technology and the ways in which we use that technology that will shape our place in the future. To use Henry's metaphor, by being the ones to make the champagne rather than the ones who simply follow the recipe, we set the path for the next 30 years.