Public bodies across the UK have been operating in an environment of funding pressure since the 2008 financial crisis. This, teamed with increasing demand for services, means that delivering efficiency improvements and savings, and getting the most out of public money rightly remains a priority.

At the same time, the focus on unlocking economic growth and delivering transformation programmes that bring real impact for local communities is key. Given infrastructure’s well-documented economic multiplier effect, the commissioning of new schemes is at the heart of plans to rebalance and boost local economies and to provide people in communities across the country with new skills and greater connectivity. The question, then, is how to ensure value for money for taxpayers and consumers in the commissioning of new infrastructure.

Technology is rapidly redefining the construction industry as it is other sectors. Balfour Beatty believes that the rise of digitisation, offsite manufacturing and robotics in construction will bring about a huge increase in productivity in what is a very large but historically low-productivity sector. It will increase efficiency, solve the issue of skills shortages and take the danger out of building, making Zero Harm a reality. It will also lead to savings in the whole-life running costs of the infrastructure, benefiting infrastructure owners over the lifespan of the asset.

However, while local authorities and other commissioning bodies are great innovators in terms of rethinking their own processes and how they deliver their services as efficiently as possible, there remains some reticence in the procurement of new infrastructure, to embrace new techniques and technologies over lower-risk, tried-and-tested approaches.

While Balfour Beatty believes there are a number of different ways to deliver efficiencies, this paper will consider the role of improving productivity and removing wastage in the delivery of infrastructure, through the use of new technologies and innovation.

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**Key points**

1. Moving to a more digitised approach, teamed with off-site construction techniques, has the potential to address skills gaps while also maximising efficiency, consistency and precision and improving health and safety.

2. In order to future-proof their skills base, local authorities and their partners must focus on raising skills levels to ensure that local areas can capitalize on the high-skill roles that will result from automation, as the number of low-skill roles diminishes.

3. We believe that this requires more powers and resources to be devolved to local areas, to ensure they are ready for future skills needs.

4. Embracing new technology calls for contracting authorities to change the way they think about procuring and building. This will require courage, as new technologies are, by their nature, untested as they come online and public procurement often favours low risk behaviour and tried-and-tested approaches.

5. An equally important role for local authorities is ensuring that digital strategies, once committed to, are adopted throughout the supply chain in the local area, in order that smaller companies are future-ready and that the value of the changes is maximised.

6. Overly-detailed specification should be avoided where it prevents greater innovation and hinders suppliers in adapting to unexpected challenges which emerge once contracts have been signed.

7. Cyber risk must be taken seriously and programmed in. Infrastructure owners will also need to balance the benefits of increasing the amount of data they collect, with the privacy concerns of users and local communities.

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1 For example, Infrastructure spending as a catalyst of growth and transition, European Bank for Reconstruction and Development, 05 August 2015
Reshaping construction

Adopting and mainstreaming digital and other new technologies, such as advances in robotics and artificial intelligence (AI), will be a game-changer for both the construction industry and for local authorities and others in the public sector commissioning infrastructure. It will provide solutions to the need for greater efficiency, improved safety and to skills shortages.

The benefits of digitisation are clear to companies such as Balfour Beatty, which is already using them across the business and the projects it is working on. Projects can be delivered more effectively and efficiently by harnessing the power of cloud computing and enhanced mobile technology. Building Information Modelling (BIM) in the form of 3D digital representation of projects overlaid with 4D detail on scheduling and cost, together with augmented and virtual reality technology enables seamless interaction between offices and sites facilitating a “build right first time” approach. Drones allow teams to track progress safely, more efficiently and with increased accuracy, collecting data more frequently than human surveyors. Telematics are tracking how our vehicles are used, ensuring that we drive them economically, safely and sustainably. And we are using data analytics to begin to predict and prevent problems as they arise in infrastructure, rather than the slower, more expensive and less reliable “find and fix” model the industry has relied on for decades.

For example:

- **Addressing skills shortages**

  Population numbers are increasing, while the way we live is changing, becoming more focussed on urban areas. Meanwhile, the expectations local communities have of their infrastructure, and how they want it to perform, continue to grow. To meet the needs of these growing, changing, more demanding populations, we will need more infrastructure. New infrastructure. Smarter infrastructure. However, these demands will place pressure on an industry which is already facing a skills shortage in areas across the country.

  Balfour Beatty believes that continued investment in new technologies will help address these skills shortages, by helping to change outdated perceptions of the industry, enabling us to attract a more diverse, skilled labour force. Increasing use of robots and automation will also mean that the industry becomes more productive, creating new roles for skilled workers in cutting-edge areas, while reducing the need for those undertaking repetitive, manual tasks such as bricklaying, lessening long term health risks. Similarly, moving to off-site construction techniques such as precasting, prefabricating and preassembly has the potential to address the shortage of skilled labour while also maximising efficiency, consistency and precision and improving health and safety. As a consequence, the industry’s productivity is likely to significantly increase.

  Looking to the future, predictions are that 65% of children at school today will work in jobs that do not yet exist. This means that this sector and others will need a more dynamic, agile workforce, skilled at challenging conventional solutions. Existing processes and structures will need to change and companies will need robust data analytics capabilities: there is little value in the data on its own. There will therefore be significant changes to the labour market as employers begin to look for the types of skills that the workers of tomorrow will need. This will see employers such as Balfour Beatty working increasingly closely with local communities and with the education system to ensure that those being educated are being equipped with the skills the local economy will need. To succeed in future-proofing the skills base, local authorities and their partners must focus on raising skills levels to ensure that local areas can capitalize on the high-skill roles that will result from automation, as the number of low-skill roles diminishes. This will involve steps such as building closer relationships between employers and the education system, to ensure young people are being exposed to the skills they will need to succeed in the future, especially the ability to solve problems and think creatively; improving school standards in areas where they are low, for example in key parts of the North and Midlands; increasing the focus on lifelong learning and upskilling; and strengthening the further education sector to help adults retrain and ensure they are ready for the changing labour market. We believe that this requires more powers and resources to be devolved to local areas, to ensure they are ready for future skills needs.
Delivering for the customer

Customers will always, rightly expect contractors to demonstrate fiscal restraint, reducing construction costs where possible, while improving project delivery and safety. Balfour Beatty’s view is that new technologies, techniques and materials will enable us to improve our offer in terms of both the design and construction phase and the life-cycle costs and performance of the infrastructure we build, over the long-term. For instance, the availability of real-time data delivers a number of benefits for the contracting authority. For example, the ability to properly plan a large-scale construction project, where a hundred cement trucks need to access a site at the same time, by game-planning it in a virtual environment can reduce project overruns, cut costs and increase margins. The increased use of offsite, preassembled modules lowers costs and speeds up construction, offering real potential for savings for the customer.

That is why we are already offering digital features and products and introducing analytics and other new digital services to customers. Most recently, this has involved laser scanning, virtual reality (VR) walkthroughs, access control of workers via portals, and interactive “as-builts” to help us deliver our service more reliably. VR and augmented reality (AR) both have significant potential to deliver customer-focused products. For example, rather than looking at pictures of what a scheme might look like, customers can experience it in a simulated environment in 3D or 4D. This enables them to experience the structure as if it had already been built and understand what it will look like before it has been finalized, so they can give more detailed and accurate feedback on the proposals before construction has begun resulting in an end product which matches, as closely as possible, the customer’s requirements.

Balfour Beatty believes that contracting authorities need to demonstrate courage here and help companies adopt new technology by, for example, addressing the fact that they often promote low risk behaviour and favour tried-and-tested bids in procurement processes. We encourage any contracting authority concerned about trying new technologies to contact us to discuss options rather than ruling them out in preference for options they are familiar with already.

Moving to offsite manufacturing

While many companies are beginning to consider offsite and modularisation on a case-by-case basis for new schemes, Balfour Beatty has made it a core part of our strategy. We have committed to reducing onsite activity by 25% by 2025. Supporting the Government’s 2025 strategy for lower cost, lower emissions and faster delivery, we aim to remove those activities we can from sites in order to free up our workforce’s time to focus on delivery. This gives us the scope to create complex structures safely and efficiently offsite, assembling them quickly onsite. It not only saves time, but also reduces labour costs, improving overall efficiency compared with traditional methods of construction. The use of a range of different materials teamed with smart engineering and modern construction techniques helps us to deliver better against the construction requirements. We believe that a new wave of innovation, coupled with a more efficient partnership model, will enable us to increase build efficiency and speed while driving down operational costs.

However, achieving the efficiencies offsite manufacturing offers requires standardised designs and components. This has so far been missing in most schemes across the UK. Balfour Beatty is working with customers to support them in thinking about these benefits from the concept phase. Longer-term, partnership approaches operating over the delivery of several schemes will also be of benefit here, enabling greater opportunities for efficiencies to be delivered through standardisation and elimination of non-productive processes.

Taking this two-pronged approach of innovating in the way we operate and supporting our customers will enable us to tackle head on the skills and productivity challenges the construction industry is facing while delivering greater efficiencies for customers.
Innovation represents an enormous opportunity for all parties. Overly-detailed specification should be avoided where it prevents greater innovation and hinders suppliers in adapting to unexpected challenges which emerge once contracts have been signed. Barriers to developing and accepting innovative ideas must also be challenged and regulators and other key players should be encouraged to facilitate innovation, while those companies which pioneer innovative new ways to drive efficiency while maintaining quality should be drawn out for reward.

- **Greater collaboration**

  In some cases, the construction industry still relies on paper for things such as blueprints, design drawings and orders. This can result in sluggish progress and team members working from different versions of the same plans. However, process digitization means moving away from paper and toward cloud-based, real-time sharing of information which integrates all elements of a project to ensure that everyone involved has access to the latest information, facilitate collaboration and improve outcomes.

  Balfour Beatty believes that online collaboration platforms offer huge potential to keep all those involved in the project informed with the most up to date information. AR in particular will increasingly mean that people can be taken into an environment where they can work collaboratively with remote colleagues, show them what they are seeing and share their experiences as if they are physically there themselves, enabling problems to be solved more efficiently and cutting travel costs and the number of people required on-site.

- **Improved health, safety and quality**

  The imperative to constantly improve health and safety and the need to deliver high quality infrastructure demand that the industry continues to innovate and embrace new ideas. New technologies offer a real opportunity to do both, for example, through improved accuracy and reduced human error by increasing automation. Equipment with embedded sensors will also increasingly enable updates to be sent alerting teams to the fact that they need maintaining or repairing, reducing the need for “find-and-fix” in dangerous environments and therefore lessening health and safety impacts and time delays.

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**Using virtual reality to improve safety**

Balfour Beatty has been using VR simulation for Health and Safety Training. The fully immersive simulation means that we can prevent on-site accidents through better training. Featuring different real world scenarios the virtual experience gives workers the opportunity to experience live and potentially dangerous site environments, understand the space of the build, work out where heavy equipment should be placed and game plan how complex elements of the scheme can be best undertaken, from the safety of an office or training room and without the need for lengthy manuals, training sessions or specialist personnel.

- **More sustainable**

  The infrastructure and construction sector is increasingly, rightly, being challenged to improve its environmental footprint. It is a significant consumer of raw materials and energy. It can have a lasting impact on biodiversity be a source of nuisance. By improving how it engages with key stakeholders across the value chain through better design and collaboration with both designers, clients, subcontractors and suppliers it can significantly reduce resources, waste and associated carbon emissions both during construction phase and the operational life of an asset. It is key that we make infrastructure which performs more efficiently over the long-term. This will require new types of infrastructure, constructed differently. To assist us in this aim, Balfour Beatty is looking forward to wider adoption of standards such as PAS 2080, the development of new building materials which have a lower carbon footprint and smarter design that allows the efficient use of assets such as Smart Motorways.
Maximising the benefits of new technology

Maximising these opportunities will challenge both local authorities and other contracting authorities, and the industry itself. A combination of being understandably risk-averse when using public money teamed with concerns relating to security risks such as data leaks, are holding back a number of local authorities from capitalising on the benefits new technology can offer.

Embracing new technology calls for those commissioning infrastructure to change the way they think about procuring and building. This will require courage, as new technologies are, by their nature, untested as they come online. There will be some risk involved in testing them and both contractors and contracting authorities will have to manage that risk: we must both remain cautious and be prepared to experiment more.

An equally important role for local authorities is ensuring that digital strategies, once committed to, are adopted throughout the supply chain in the local area, in order that smaller companies are future-ready and that the value of the changes is maximised.

Of course, new technologies also bring challenges with them. Cyber risk must be taken seriously and programmed in. Infrastructure owners will need to balance the benefits of increasing the amount of data they collect, with the privacy concerns of users and local communities.

Encouraging innovation in our supply chain

Balfour Beatty aims to make continuous improvements to our products, services and processes. We are keen to nurture and unlock innovation wherever possible, with the goal of improving the efficiency, safety and delivery of our work for the customer. Our suppliers are market experts and often have the specialist knowledge to enable us to invest in new products, materials and services once they are ready for market. Innovation that helps to differentiate Balfour Beatty or make us more efficient, encourages growth and in turn provides more opportunities for our suppliers.

We want to encourage suppliers to generate new ideas and share them with us. Our “Innovation Gateway” is a tool that allows suppliers to put forward innovative ideas relating to products, materials and services, with a supplier feedback process in place that keeps suppliers informed. This could be a big, “game changing” idea or something which brings about an incremental but important improvement in the way we deliver our projects. We evaluate the ideas and engage in constructive discussion about them. If the ideas are workable, we pilot them before making them available across our projects.

This is just one of the many ongoing improvements that we are currently making to encourage innovation within our supply chain.

4https://www.balfourbeauty.com/how-we-work/supply-chain/supplier-innovation/
Conclusion

The public sector has seen significant financial spending reductions in the past decade. It is incumbent on all those providing services to public bodies to do as much as possible to deliver value for money. For the construction industry, this means picking up the pace in embracing and embedding new technologies and ways of working. For local authorities and other commissioning bodies, it means adapting quickly, becoming more innovative and less risk-averse, in response. We must be ready to embrace new technologies, new business models, and new possibilities and ideas as they emerge. But we must be prepared to balance the benefits with the risks.

About Balfour Beatty

The UK’s largest construction contractor, Balfour Beatty, was founded in 1909 and is listed on the London Stock Exchange. With 15,000 employees and over 40 offices in the UK, Balfour Beatty finances, develops, builds and maintains the increasingly complex infrastructure that underpins the UK’s daily life.

With a legacy of projects across transportation, power and utility systems, social and commercial buildings: from Crossrail and Heathrow T2b to the M25 and M4/M5; and Sellafield; to the Olympics Aquatic Centre, we are proud to be a British company delivering iconic structures, bold engineering feats, behind-the-scenes innovation and joined-up thinking, financing and partnerships.

To fuel this drive for continuous improvement, our innovation and technology teams are focused on research, development and the deployment of leading-edge best practices, lean processes and technologies that help us deliver higher quality, more efficient and cost-effective solutions.