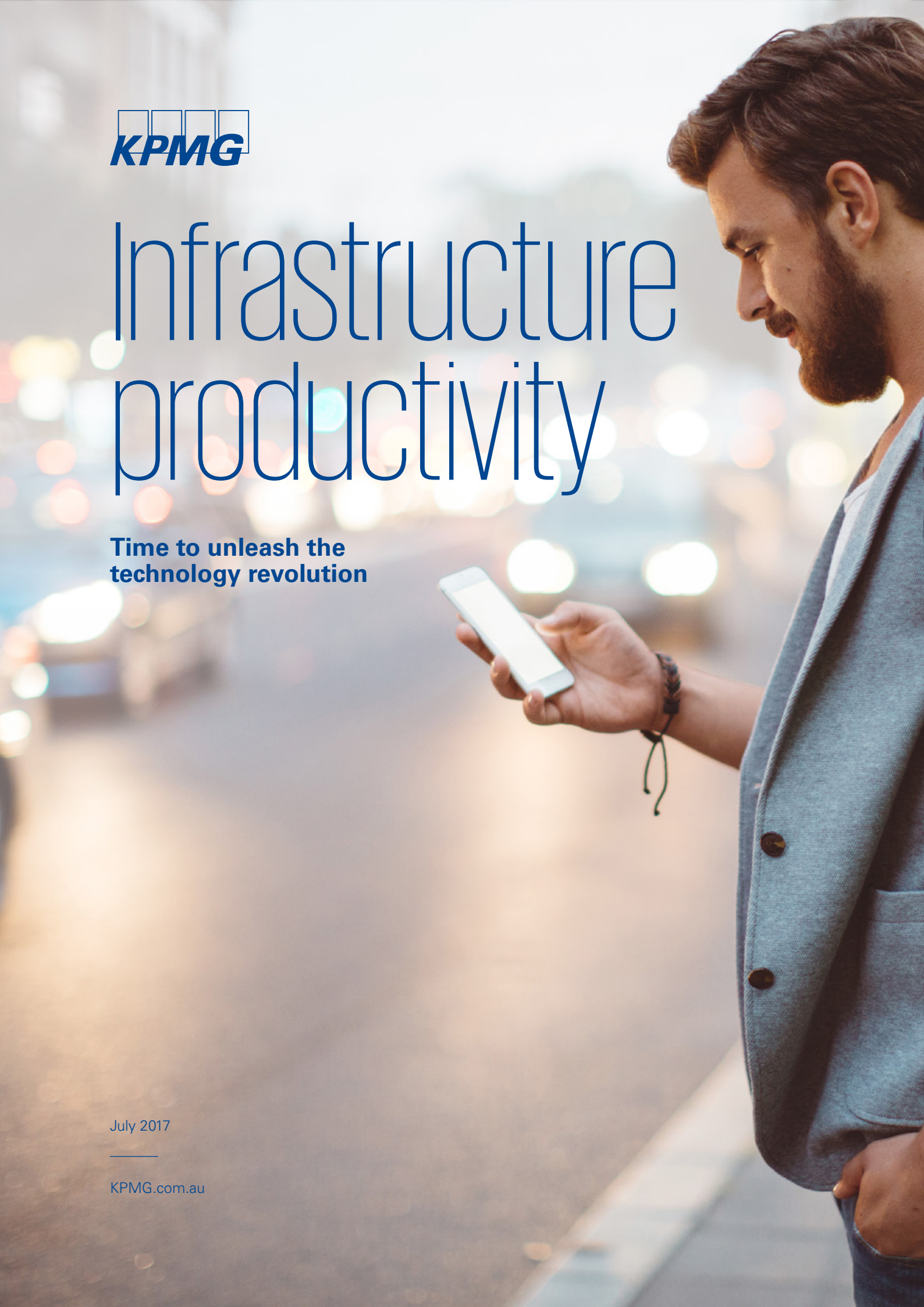

KPMG

Infrastructure productivity

Time to unleash the technology revolution

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The digital revolution is starting to disrupt the infrastructure sector and has the potential to unlock productivity gains that have been missing for many years. While governments are uniquely placed to facilitate this change and ensure the benefits are distributed across the whole economy, the sector faces many engrained practices and policies that must be overcome if the revolution is to have a lasting impact.

Infrastructure is one of the great enablers of economic productivity. Energy, transport, utilities and telecommunications networks, along with education, housing and health facilities, have underpinned economic growth and our quality of living since the first industrial revolution. It is a blueprint that has served us well.

But new investment is no longer delivering the productivity improvements that it used to. And while the fourth industrial revolution is sweeping through the wider economy, infrastructure has been stuck in the past.

This is about to change. For infrastructure, the technology revolution is here. It should be welcomed but governments will need to act boldly to realise the full economic and social benefits of this transformation.

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Vanguards of the revolution

As these examples show, leaders in the sector are starting to find ways to adopt new technology including 3D printing, data analytics, artificial intelligence and the Internet of Things to increase productivity at every stage of the infrastructure life cycle.

Design

Design innovation using the latest technology is evident across all infrastructure subsectors. In transport for example, Melbourne's Metro Tunnel has been designed around the use of Communications Based Train Control, a form of high capacity signalling technology that improves headways while improving safety – enabling more trains, more often. Queensland will also experience capacity benefits from its European Train Control System upgrades, allowing trains to travel closer together and at better regulated speeds. Even the Hyperloop concept is quickly moving from research to pilot.[1]

In the telecommunications sector, future deployment of 5G technology will see ultra-fast data speeds and network reliability improvements to support the huge increases in demand for mobile, video and internet-of-things (machine-to-machine) connectivity.[2] In turn these advancements are influencing the design decisions of infrastructure asset owners, for example improvements in cloud data services could remove the need to build a traditional physical data centre.

Construction

The construction industry has not seen a significant productivity improvement for a long time but a step-change is now in reach. Leading engineering and construction firms are starting to explore the use of drones, remote monitoring, robotics and smart sensors to increase efficiencies and safety while cutting costs. But with only 8% of companies in the sector seeing themselves as "cutting edge technology visionaries" there are many challenges ahead to adopt a more digital mindset.[3]

What technologies are engineering and construction firms adopting?

42% use **drones to monitor** construction status

30% use **robotics** or **automated technology**

65% use **remote monitoring** on sites

30% use **radio-frequency identification** to track equipment and materials on site

17% use **smart sensors** to track people on site

61% use **Building Information Modelling** on a majority of their projects

1 https://home.kpmg.com/xx/en/home/insights/2017/01/trend-5-technology-increases-productivity-risk.html

2 https://www.brookings.edu/wp-content/uploads/2016/07/5G-Health-Internet-of-Things_West.pdf

3 https://home.kpmg.com/xx/en/home/insights/2016/09/global-construction-survey-building-a-technology-advantage.html

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The sector will also soon start to adopt a manufacturing approach with the use of industrial 3D printing to fabricate modular components for on-site assembly. For example, GlaxoSmithKline (GSK) piloted its 'Factory in a Box', a kit of flat-packed, standardised components which can be assembled quickly by a team of eight non-specialist workers into a defect-free pharmaceuticals factory, anywhere in the world.[4] While the pilot cost 10% more than the conventional construction approach, further possible factories could be built to the high compliance standards required by the pharmaceuticals industry in a third of the time.

Maintenance

The disruption caused by infrastructure failure is a major issue for companies, communities and governments alike. Indeed, a recent report highlights the economic impact of corrosion in the Australian water sector alone to be nearly 3-5% of GDP every year.[5]

With mature data collection regimes and advanced data analytics software now available, both private and public owners of infrastructure will find it easier to not only monitor assets in real time but also proactively predict and prevent asset failure to minimise disruption to our ailing infrastructure. For example, in the oil and gas sector, by combining ultrasonic sensors and cloud computing GE is able to help asset owners monitor pipelines in real time and predict corrosion and failure rates, reducing the cost of corrosion maintenance by up to 30%.[6] In the electricity sector, a growing number of distribution companies are using drones to inspect large sections of their network to help inform vegetation clearance plans.[7] In Xiangyang, China, the electricity utility has taken the use of drones a step further by using flame throwing drones to burn off rubbish tangled in the overhead lines.[8]

The significance of technology for aiding infrastructure maintenance is there for all to see; not only can it help limit and target the maintenance performed, but it can also be used to reduce the cost of executing the maintenance if and when it is required.

Operation

The single greatest challenge of infrastructure operations is meeting what is often highly variable, if predictable, demand. In many cases, building more capacity to meet peak demand is not the most cost-effective option; in some cases, it is simply not an option at all. Instead we need to balance supply and demand by making smarter use of capacity.

Supply – In the power and utilities sector, as demand increases and the generation mix evolves, electricity network operators must supply the right level of power at the right time. Understanding a complex web of data and using it to predict demand and optimise networks in real time will become a vital capability. Companies such as GreenSync[9] are working with network owners in Australia to trial demand management systems that use machine learning, stream analytics and big data tools to make better use of existing infrastructure and defer capital investment.

Demand – Technology is also transforming operations from the 'bottom up' by making it easier for users to tap into available resources. We can see this very clearly in the transport sector, where digital technology is driving the concept of 'Mobility as a Service' (MaaS). Uber, for example, has made it easier for travellers to tap what has historically been unused capacity in the existing car fleet. Whim,[10] a MaaS app which is to be trialled in the West Midlands in the UK, and has recently been deployed in Helsinki, integrates public transport, rental cars, taxis, trains and bikes into one virtual network, distributing demand across a wider range of transport solutions.

Adaptive and integrated networks – A long standing problem with transport infrastructure has been the disconnect between the various 'modes' such as road, rail, cycle, and pedestrian, and the ability for the whole system to adapt as demand changes. A new collaboration between government and private sector in Melbourne is taking the demand modelling out of the computers and onto the streets in a 'transport living lab'.[11] The 4.5 square kilometre test bed will capture a wide variety of real time data enabling vehicles, people and infrastructure to adapt as demand changes.

4 http://www.offsitehub.co.uk/industry-news/news/offsite-the-building-built-by-ghurkas/

5 https://membership.corrosion.com.au/blog/cost-of-urban-water-infrastructure-failure/Challenges – Urban Water Industry by Greg Moore, 2015

6 https://www.ge.com/digital/products/predictive-corrosion-management

7 http://fortune.com/2015/10/23/ge-drones-power-grid/

8 http://www.popularmechanics.com/flight/drones/a25282/flame-throwing-drones/

9 http://www.greensync.com.au/greensync-partners-with-united-energy-for-landmark-asset-deferral-project/

10 http://maas.global/transport-for-west-midlands-and-whim-set-to-pioneer-maas-in-the-uk/

11 http://themelbourneengineer.eng.unimelb.edu.au/2017/01/melbourne-launches-world-first-connected-living-transport-lab/

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Going global – lessons from solar?

The infrastructure sector can learn from the rapid adoption, commercialisation and globalisation of solar energy technologies. Just 20 years ago, the technology was in its infancy with most solar energy projects developed purely for research or as proof-of-concepts. Today, solar is a mainstream technology – governments want to invest in it, consumers want to use it, investors want to profit from it and regulators understand it. The technologies have become standardised and global. And almost everyone – including the world's poorest and most isolated citizens – can now tap into cheap electricity from solar power at home. Technology advancements have also dramatically improved battery storage capacity, making the case for solar investment more compelling for both home owners and grid operators.

While not all of solar's advantages can be duplicated in the infrastructure sector more broadly, there are valuable lessons:

1. Simplicity improves confidence.
2. Industrialisation drives investment.
3. Evolution inspires improvement.
4. Cost is not everything.
5. Think long term.

Find out more: Going global lesson from solar https://home.kpmg.com/au/en/home/insights/2017/03/lessons-from-solar.html

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Autonomous era: an infrastructure and productivity paradigm shift

While Uber and Whim make it easier to use existing transport capacity, autonomous vehicles will revolutionise the way people and goods move from A to B. Connected and autonomous electric vehicles are expected to increase productivity and labour-market flexibility, significantly improve road safety and reduce emissions. In the United States alone, productivity could be boosted $422 bn per year[12] with economies such as the UK seeing an overall economic and societal benefit up to £51 billion each year by 2030.[13]

These benefits are not guaranteed though. Adding autonomous vehicles to the transport mix could in fact increase congestion; Melbourne for example could see a 29 percent increase in average car trip time and a 23 percent increase in average car trip distance.[14]

To secure productivity gains, governments need to take the initiative with better modelling of potential impacts on infrastructure, investment in supporting technologies such as connected sensors, clear direction in policy settings and regulation and regulatory practices that incentivise the development of new and more efficient commercial models and private sector innovation.

And autonomous transport is not just about people in cars. The freight and logistics industry will be revolutionised by autonomous trucking, logistics centres using robotics and delivery drones. Globally, driverless metro systems, in conjunction with advances in signalling and control technology, are also enabling productivity benefits through increased train frequency, reduced journey times, increased reliability and reduced delays.

12 https://robotenomics.com/2014/02/26/morgan-stanley-the-economic-benefits-of-driverless-cars/

13 https://assets.kpmg.com/content/dam/kpmg/images/2015/05/connected-and-autonomous-vehicles.pdf

14 https://home.kpmg.com/au/en/home/insights/2016/10/connectivity-congestion-autonomous-vehicles-future.html

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The challenge for government

The benefits of technology adoption are there, but there are also risks and challenges. How can governments and public infrastructure agencies ensure that the benefits of this revolution play out across the whole economy?

Rethink data

Data is now *the* key infrastructure asset and while governments own vast pools of it, few understand its value. This must change. Governments will need to get to grips with data, extract information from it and use it to better plan and manage infrastructure. Only with high quality information will planners be able to model demand across infrastructure networks and find ways to reduce load and maximise capacity. The secure collection, management and analysis of data will help governments minimise maintenance costs over the life cycle of network assets.

Open access to data will also allow governments to demonstrate the value for money of major investments. And from electricity usage to transport flows, governments can return a 'democratic dividend' to their citizens from this often untapped resource.

Rewrite the plans

Governments first need to recognise that they cannot continue doing what has been done before in piecemeal fashion. Instead, plans that take an economy-wide and industry-specific perspective are needed to build capability, drive sustainable growth and open new opportunities locally and globally.

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Breaking up transport bottlenecks with data and analytics (D&A)

As public transport operators struggle to match roadway and transit network capacity with rising demand, ground breaking D&A techniques – powered by real-time traveller information – can help ease the ever growing congestion.

Transport for London (TfL) is leveraging its many established databases like the Oyster transit user-card, contactless payment systems and the Congestion Charge driver toll system. By doing so TfL is gaining a better understanding of typical travel patterns. This has the advantage of segmenting those travellers experiencing congestion or delays and suggesting (via SMS, apps, email) different ways to reach their destinations, making best use of available capacity (rather than diverting everyone in the same direction, creating new congestion problems).

Using mobile phone networks to track increases in road traffic in real time, along with the growth in 'connected cars' which transmit data on their movements and satnav destination, will soon provide transport managers with enhanced tools to predict and immediately respond to the formation of traffic jams – for example to amend traffic light timing.

To develop actionable roadmaps, governments will need to better understand the technologies that are driving this change. They will need to put in place incentives for innovation, align the diverse regulatory frameworks that fragment industries and make sure we have a workforce educated and trained for a knowledge and skills-based economy. Governments will also need to understand the likely impacts of those technologies and the demographic changes ahead, so that they can manage the inevitable social change. The Australian Government's Smart Cities Plan responds to many of these challenges, including driving the take up of smart technology to improve sustainability and revolutionise how cities are planned and function. By taking a technology first approach and working alongside the private sector, the Smart Cities Plan potentially provides a platform for 'safe-fail' innovation and investment – a scenario that guardians of public infrastructure (government agencies) have intrinsically resisted, resulting in relative late adoption of technological change.

Review our laws

Current laws and regulations reflect the responsibilities, constraints and opportunities of a previous era. In some cases, they stand in the way of potentially beneficial changes. Connected and autonomous vehicles, for example, are currently forbidden on most roads. New practices in data collection, aggregation and analysis are challenging law on privacy and security. Tax laws will need to change as electric vehicles erode government revenues from fuel excise. And Uber has shown the potential for private sector innovations to challenge existing laws and regulations.

These are just a few examples where the pace of technological change is outstripping the pace of legislative change. Governments will need to take the initiative and remove legal obstacles but also anticipate emerging responsibilities and risks with new law, regulations and incentives.

Recognise its buying power

As a major buyer of infrastructure, governments can drive change throughout the industry. This purchasing power can influence investment in new technologies, the use of data in decision-making, the functioning of supply chains and the skilling up of the work force. For example, the decision by government in the United Kingdom to require building information modelling for all its infrastructure projects influenced the entire industry to change its practices.

Reform project selection

As we have said previously,[15] our infrastructure project selection processes continue to push construction and 'traditional' new build projects at the expense of more technology-based initiatives to manage demand and enhance capacity.

The business case must reclaim its decisive role in weighing up options in the light of evidence, detailed economic analysis and transparent governance by independent infrastructure agencies. A wider range of options need to be considered and assessment guidelines, such as the Australian Transport Assessment and Planning (ATAP) guidelines, must be reviewed to ensure there is no bias towards construction projects over technology-based initiatives. Existing frameworks also tend to favour an individual project-by-project assessment process, stifling integrated long term planning that encompasses holistic programs of work with a focus on innovative and technology-led investment.

15 https://home.kpmg.com/au/en/home/insights/2017/02/rethinking-infrastructure-project-selection.html

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This project-by-project approach makes it difficult to invest in new technologies or approaches. GSK's investment in developing its 'Factory in a Box' pilot would not have made sense if the first implementation was considered as a single, standalone project; the investment in this new approach only stacked up as part of a potential program of factory roll-outs. Governments rarely take this approach – and cost benefit ratios are typically weighted down by the costs of new technologies without any recognition of the benefits for future projects.

Implementation

The public sector will also need to look beyond the procurement phase to make sure new initiatives are implemented on time and budget. Increasingly, technology projects require a collaborative approach to work with an ecosystem of partners including technology vendors, start-ups, implementation specialists, customer experience designers and other government agencies. The rapid pace of technology change is also challenging infrastructure investors to assess the risk of their investments becoming technologically obsolete before the end of their anticipated operational lifecycle.

Conclusion

The infrastructure sector is taking its first steps in a truly exciting new phase of exploration. Current technology applied intelligently at every stage of the infrastructure life cycle can unlock substantial productivity gains that will benefit the whole economy.

Governments must proactively facilitate this shift by removing obstacles to innovation, setting the standards for best practice and exploiting the value of their vast data assets to realise both economic and social benefits. More broadly they must use their unique position in the economy to transform the way we plan, deliver and operate infrastructure, ensure competition, build a knowledge and skills-based economy and buffer the social impacts of change.

The revolution has already begun. Now is the time to act.

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