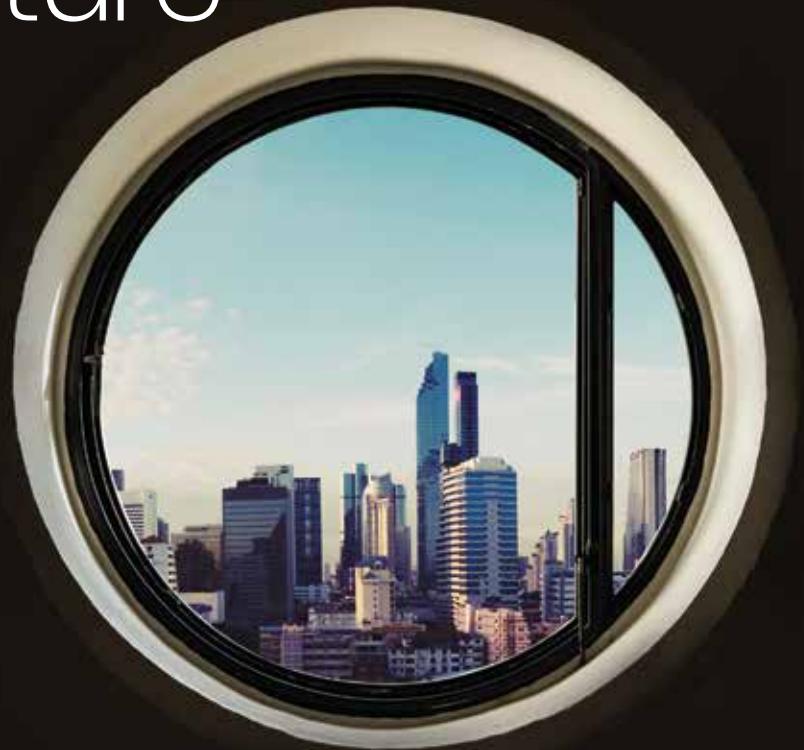




Emerging Trends in Infrastructure

KPMG International

kpmg.com/emergingtrends



About the trends

This will be a year of data-driven enlightenment for the infrastructure sector. It is the year where data and analytics matures in the sector; it is the year where evidence-based decision-making starts to become commonplace; it is the year where all organizations begin to uncover new insights that lead to new opportunities and — ultimately — important choices.

It is not surprising, perhaps, that one of the key themes throughout this year's edition of *Emerging Trends in Infrastructure* is the new focus on data and analytics. As we note, governments and infrastructure authorities are starting to recognize the true value of their data in driving insights, operational performance and broader innovation. This year, we expect to see adoption spread — across sectors, ecosystems and life cycles.

This year's *Emerging Trends* also makes a point of noting an ongoing shift towards more evidence-based planning and prioritization in the infrastructure sector. In fact, some governments are already at the forefront of leveraging new data-driven models to improve the way they plan, deliver and maintain their infrastructure.

This is all good news. With a greater focus on evidence, decision-makers will see a wider range of opportunities and choices

than ever before. And by making better choices, they get closer to delivering better outcomes for their communities.

We believe that many of the opportunities facing infrastructure authorities over the coming year will influence the world order for decades to come. Technology is providing the scope for radically different solutions to infrastructure needs, and often much more cost-effectively. In fact, in some cases, the answer may not involve any civil engineering or building at all. As a result, there is significant potential for emerging markets to leapfrog the developed world. What a change.

As in years past, there continues to be massive opportunities emerging for infrastructure owners, operators, developers and investors. And, while finding the correct path forward may be difficult given our history and perceptions, we believe that this Year of Enlightenment will allow infrastructure players to start achieving a clear view of the opportunities, risks and choices that will need to be made along that journey.

Those that are able to stay on top of the emerging trends and understand their broader implications will be well placed to make the choices they need to drive their future success. And that is what this edition of *Emerging Trends in Infrastructure* is all about.



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Trend 1:

The public sector
begins to reassert
its role



Governments are keen to encourage innovation in the infrastructure sector. But as the solutions being brought to the market become more radical, some have challenged the traditional role of authorities and raised questions over what constitutes appropriate regulation.

Many governments have struggled to keep up and be clear about their role. But, recently, we have seen a reassertion of control, as authorities focus on the governance and delivery of services and their right to regulate activities and actors within their jurisdiction.

In last year's *Emerging Trends*, we correctly predicted that the lines between public infrastructure and private infrastructure would blur as nimble upstarts sought to capitalize on new customer expectations, shifts in demand and underserved populations.

Now, however, the implications of these changes are becoming clearer. Consider, for example, how new ride-sharing apps have disrupted public transit models. It's not just that these new apps are challenging the existing order by changing ridership patterns and investment plans; they are also creating unexpected congestion and (according to some cities) safety concerns.

This year, we expect to see governments at all levels start to become much more assertive. Many will take a more proactive approach to defining the rules for private sector infrastructure provision, both traditional and nontraditional.

Ride-sharing apps are just the start; many governments are also now starting to consider how they will oversee a range of new and emerging models across the infrastructure world — from distributed power generation through to nascent technologies such as hyperloops and drones.

While we agree that government must maintain (and the public expects it to maintain) a level of control and oversight over the provision of infrastructure, the reality is that the pace of technological and social change has moved faster than the pace of regulatory change. Many governments also seem to be facing growing pressure from existing service providers (many with vested interests) keen to hold back new start-ups and disruptors.

On the one hand, this means that — while most governments want to take a strategic approach to managing new technologies — many are stuck in a tactical loop of discovery and regulation. But, at the same time, we are also starting to see new tools and new regulatory structures being developed among early public sector adopters.

Over the coming year, we expect to see governments focus on creating regulatory frameworks that are flexible and durable in the face of technological change. The most successful, in our view, will be the ones that are able to recognize the need to find the right balance between control and innovation, rather than choosing one over the other.



Trend 2:

Data drives
operational
efficiency

As the world becomes more adept at turning data into insights, massive opportunities will emerge for infrastructure owners, operators and planners. Indeed, over the coming year, we expect to see more and more resources go towards uncovering the insights that will enable unprecedented efficiency across the infrastructure life cycle.

Operators will be using data and analytics to unlock operational efficiencies — increasing productivity, extending asset life spans and reducing operating and maintenance costs. Planners will use data and analytics to not only create much stronger alignment between supply and demand, but also to improve the overall effectiveness of the planning process. Regulators will be using data and analytics to better govern and oversee infrastructure delivery. And investors will use it to assess the value and resilience of their investments.

As ‘rule of thumb’ gives way to evidence-based decision-making and infrastructure players become more analytics-savvy, we also expect to see decision-makers place much greater value on the insights they can gather from predictive analytics.

There is already a significant number of organizations that are able to predict maintenance and operational issues before they become bigger problems. One mobile network operator now says they are able to foresee outages 7 days before they occur; the organization is not only preventing outages from happening (thereby protecting their brand and their revenues), they are also saving on operational costs by ensuring they are conducting the right maintenance at precisely the right time to keep their assets performing optimally.

As we suggested in last year’s *Emerging Trends*, governments will likely need to take a lead role in encouraging and facilitating data and analytics within the infrastructure sector, particularly with respect to planning.

In part, this will require government to start opening up and better curating their data so that owners and operators can uncover more valuable insights. And that will force authorities to find a balance between the desire to improve analytics and the need to regulate the use of data (particularly when it comes to safety, security and privacy). However, in the longer-term, we believe that concerns about privacy will abate as the societal value of data becomes better understood and better means of protecting anonymity are developed.

Over the coming decade, we expect this trend to only increase in importance. In part, this is because we are only now starting to scratch the surface of what the data can tell us; better data and better analytics capabilities will surely unlock insights we never anticipated. But it is also because cultures are changing; decision-makers are starting to put greater trust in their analytics rather than being forced to rely on past practice and gut feel.

Data-driven efficiency is not sexy stuff; investments into enhanced data and analytics likely won’t command any photo ops or grab any headlines. But we believe that it will almost certainly unlock massive value for infrastructure owners, operators and — most importantly — the end users.

An aerial photograph of a long, curved bridge spanning across a body of water. The bridge has multiple lanes and is supported by numerous white pillars. A yellow bus is visible on the bridge. The text 'Trend 3: The challenges of megaprojects are magnified' is overlaid on the left side of the image.

Trend 3:

The challenges of
megaprojects are
magnified



Over the past few years, we have seen more megaprojects, of greater scale and complexity than ever before, being proposed and progressed. High-profile examples of the last year include the new bridge linking Hong Kong to Macau and Zhuhai, Thailand's Eastern Economic Corridor, Australia's Inland Rail project and the Dubai Solar Park (this is the world's largest single-site solar installation to which more than US\$4.3 billion of private investment has been committed).

As megaprojects become larger and more complex, new lessons and challenges are emerging. In particular, it has become clear that cross-border projects require unprecedented levels of collaboration between governments. Few governments are interested in having the rules of engagement dictated to them; everyone is looking for a win-win situation.

Over the past year, we have also seen continuing issues related to the politicization of megaprojects. In some markets, we have witnessed megaprojects being sacrificed on the political pyre as populist candidates turn existing projects into political platforms (Mexico's new President recently halted a US\$13 billion airport project that was already under construction). In other cases, fiscal prudence and concerns about project transparency have led to the cancellation of key endeavors.

Capacity is also rapidly becoming a challenge. The reality is that there are very few major domestic construction companies in any market with the size and experience to successfully deliver megaprojects. We are currently seeing this in Australia, where the country is investing in a portfolio of giant infrastructure projects, many valued at more than US\$2 billion.

This means that some project owners are being forced to choose between paying more for a consortium of experienced local companies, taking a risk by accepting inexperienced players or bringing in foreign competitors; a difficult balance.

Perhaps not surprisingly, capability is also becoming a problem, particularly at the management level. Indeed, as projects become bigger and bigger, it is becoming increasingly difficult to find individuals with experience managing projects of such massive size and complexity.

As projects get bigger and more complex, they are becoming inherently more risky. That makes it increasingly difficult for project promoters to keep their nerve when things start to go wrong. In this environment, we expect to see project owners find a new thirst for benchmarking, analyzing performance and learning lessons from other successful projects globally as they seek to defend projects against political and financial pressures.

Our view is that, given all these constraints, we may be rapidly approaching the effective limits of project size and complexity unless new approaches to project delivery are developed.

A woman with short dark hair, wearing a dark blazer, is shown in profile from the waist up, looking down at a tablet computer she is holding with both hands. The background is a blurred city skyline at night, with various lights and buildings, creating a bokeh effect. The overall color palette is dark with highlights of purple, blue, and orange from the city lights.

Trend 4:

Eyes shift to
emerging market
opportunities

As competition for investment opportunities in developed markets increases, we are seeing a growing stream of infrastructure players looking to emerging markets for new opportunities — and better yields and margins.

Consider, for example, how multilateral agencies — largely led by the World Bank — are actively seeking to play a key role in facilitating investment in emerging market infrastructure by promoting the use of ‘blended finance’, where development funding and private finance are combined to increase the flow of investment into emerging markets infrastructure.

This is just one aspect of what we see as an increasing, and important, focus on improving the ‘bankability’ of emerging market opportunities by creating more rigor in the ways projects are prioritized, selected, developed (by undertaking more robust technical and financial feasibility analysis), ‘de-risked’ and procured.

However, as the flow of bankable opportunities increases and new players enter these markets, they will need to understand the risk and reward balance of the projects they take on. Local knowledge is key, not only to understanding the formal rules and regulations but also the business and political context. There is no doubt that there is great opportunity, but there is also significant risk for the uninformed or unwary. Selecting the right business partners to work with will be a critical success factor for new entrants.

This year, we expect to see infrastructure players start to place greater emphasis on exploring emerging market opportunities. And with more focus being placed on properly selecting, preparing and delivering projects, we should also see project volumes rise. Ultimately, this should lead to better infrastructure, higher quality of life and improved global competitiveness in those markets. A welcome step towards greater global equality.



Trend 5:

Embracing the
evidence



Over the past year, we have seen governments take a much more analytical and evidence-based approach to the way they plan and prioritize their infrastructure investment.

In part, this is being driven by increased data availability and analytical capabilities, which are allowing authorities to conduct much more effective and informative scenario planning (see [Trend 2](#) for more on this). But it is also being catalyzed by an increased recognition that technologies, models and citizen/user/customer expectations are rapidly changing (more on this in [Trend 9](#)).

All over the world we are starting to see a much more analytical, data-driven, evidence-based and technocratic approach to infrastructure planning, prioritization and development. And that is enabling infrastructure authorities to not only make better decisions, but also create stronger consensus in society to support those decisions.

Canada, for example, has recently published its first Core Public Infrastructure Survey, a comprehensive inventory of the country's assets, providing a definitive statement of the condition as well as the extent of the nation's infrastructure.

Others are using technology to help understand how their decisions will influence the built environment. Singapore is currently working on a project to create a digital twin of the entire city state. KPMG member firms have worked with authorities to create 'activity- and agent-based models' that collate hundreds of data sources to produce a minute-by-minute spatial representation of movement within a specific region, thereby allowing those authorities to understand the impacts and interdependencies of their decisions.

However, while some governments have already made significant progress moving towards evidence-based decision-making processes, we believe there is still significant scope for the wider application of data and analytics within the infrastructure planning and prioritization process.

Over the coming year, we expect to see infrastructure authorities and planners move towards more holistic and evidence-based decision-making processes. And that, in turn, will allow governments to take a much more informed approach to delivering on society's needs and expectations.



Trend 6:

Sustainability goes mainstream

When people first started talking about the UN's Sustainable Development Goals (SDGs) ahead of the Rio+20 conference in 2012, it might have been seen in some circles as a pet project of environmentalists and development specialists. While many agreed the goals were laudable and visionary, questions soon arose as to whether any measure could significantly influence the broader economic, social and political agenda.

Today, however, it seems that the SDGs (and the principles they represent) have become widely recognized by not only the development community, but by the private sector and broader civil society. Indeed, we are seeing governments starting to evaluate their policies against delivery of the SDGs; businesses increasingly see sustainability as a board-level priority; and investors are starting to direct their money towards companies deemed to be acting sustainably.

In part, the pressure to embrace sustainability has been catalyzed by the public's desire for a sustainable future. Our view suggests that, as the moral question broadens, it has gained much greater legitimacy with the full breadth of society; citizens want their infrastructure, cars, homes and brands to be a force for good. Our parents and grandparents would be proud.

But it has also been driven up the agenda by a growing recognition of the risks that a lack of sustainable-thinking can bring. A recent report by the UN's Intergovernmental Panel on Climate Change,¹ which suggests that countries are failing to reduce global warming, should create a renewed sense of urgency.

¹ <https://www.ipcc.ch/sr15/>

To be clear, this is not just about environmental impact and global warming; today's definition of sustainability encompasses everything from financial and funding sustainability through to operational and technological sustainability. It is about understanding the impact on local communities and future asset users. And it is about ensuring that the benefits of infrastructure decisions are being measured and weighed against their potential sustainability impact (thereby also helping to head off unwanted confrontations with activists). Like pulling on a loose thread in a sweater, a tug in one seemingly isolated area will eventually be felt everywhere.

Simply put, the SDGs have provided society with a broader and more contextualized definition of sustainability and that, in turn, is helping influence the way average people view the challenge.

Against this backdrop and supported by continuing economic growth, we are seeing infrastructure authorities, planners, developers and operators start to take a much more critical view on the sustainability of their assets.

Yet, while progress on the sustainability agenda is clearly being made, we expect the coming year to bring more public pressure and scrutiny on the sustainability of infrastructure planning, delivery, maintenance and funding as attitudes around the globe continue to shift.



Trend 7:

Progress trumps
divisiveness

It's been a great year for pessimists. Political divisiveness is on the rise. Societies are fracturing. Multilateral trade agreements are flailing. And once-unbreakable alliances are falling to pieces. Uncertainty reigns.

Yet, even while media reports suggest that global agreements are becoming harder to achieve, our view of the markets indicates that progress is being made beyond the headlines. The passage of the remodeled Trans-Pacific Partnership shows that — even absent the support of some of the major powers — increased certainty can be achieved in global trade. The ongoing efforts to improve the Paris Climate Accord indicates that collaboration on major issues is still possible at a global level. The uncertainty may be less certain.

We see significant signs that multinational collaboration and globalization is still alive and well. Proof of this is easy to find — it is in the continued work on the Nord Stream pipeline (even in the face of ongoing tensions between Russia and Europe), the completion of the Western Europe-Western China Expressway running from St. Petersburg in Russia to the Yellow Sea in China, and countless other multinational projects currently underway.

It's below the noise of international politics that the greatest progress is being made. Indeed, even with (or maybe despite) all of the global convulsions, we see many societies driving

ahead with their infrastructure agendas at the subnational level. And that is allowing a nascent sense of purpose to emerge as local public and private organizations start to take matters into their own hands.

Over the coming year, we expect to see infrastructure players of all types — investors, developers, operators, service providers and contractors — reassess their long-term strategies in order to diversify their footprints and spread their risks while also moving towards those markets that continue to make progress on their infrastructure agendas.

Some, as we noted in [Trend 4](#), are already hard at work building their emerging market capabilities — both operational and strategic — so they can take an active role in shaping the new world order. Others are simply trying to understand how this environment of disruption will impact their current business and existing expansion and growth plans.

We remain optimistic that — despite current social and political gyrations — the world will continue to coalesce around a common sense of purpose, enabled by new technologies, sustainable development goals and a shift towards social self-empowerment. The world order may be shifting, but we are confident that the desire for progress will ultimately trump the current environment of divisiveness.



Trend 8:

Competition for
new technologies
heats up



One of the amazing things about today's technology environment is that new ideas are not confined to one geography or sector.

Take renewables, for example. We are seeing a massive pipeline of renewable projects emerge around the world as the price of solar and wind turbines continues to fall, and as (most) governments target decarbonization as a policy priority. Yet, while the technologies being leveraged are largely the same in every market, the approach often differs.

In Europe and the West, we have seen growing competition for renewables assets from solar farms to offshore wind auctions. In some cases, bidders for assets seem to be betting that the economics of renewables will improve significantly, which, in turn, is pushing down the reported cost per kilowatt generated. However, as Europe's governments move away from feed-in tariffs and towards power-purchase agreements, the opportunities for margins and above-market returns are diminishing.

In Asia, on the other hand, the competition for renewables is just getting started. By 2025, Taiwan hopes to increase the share of renewables to 20 percent, including 20 gigawatts (GW) of solar and 5.5 GW of offshore wind power; Korea plans to develop at least 20 GW of renewables and Japan has 18 GW in the pipeline. And that's just the developed Asian markets — most developing markets, including Indonesia and Vietnam, are also promoting a range of potential renewables opportunities to foreign investors, developers and operators.

Similarly, the competition around electric vehicles is also heating up. Manufacturers are competing to create the best technologies; cities are competing to create encouraging environments for electric cars; even different sectors (aerospace, automotive, shipping and mass transit, for example) are competing to move away from traditional combustion engines.

One unexpected outcome of this diversity of approaches to technological change may see emerging markets leapfrog the mature markets. There are numerous examples of jurisdictions — like India, Malaysia and Egypt — that, unencumbered by legacy assets and outdated regulation, are rapidly moving forward with the adoption of new technologies like solar. Yet in the West, governments continue to struggle, bogged down trying to maintain old infrastructure networks that everyone knows need replacing.

Over the coming year, we expect to see the competition around new technologies intensify as players continue to look for new opportunities to improve their services, products and revenues. And one sobering feature is that historic leadership means nothing in this new environment (in fact, it is often the incumbents that struggle the most to adapt to new technologies and ideas). The winners are just as likely to be found in the start-ups of the developing markets as they are in the leaders of the developed world.



Trend 9:

The customer
becomes king

An aerial photograph of a city street with several digital overlays. A large blue square in the center contains the word 'CAMERA' in reverse. A dashed white line runs diagonally across the street. There are several small rectangular boxes and a grid pattern overlaid on the image. People are walking on the street, and a car is visible in the bottom right corner.

One particular effect of some new technologies is that they are enabling citizens to interact with infrastructure in new and unexpected ways. And that is forcing infrastructure planners and providers to rethink their role.

Consider, for example, how navigation apps like Waze are not only showing consumers the fastest route to their destinations (thereby changing traffic patterns) — they are also influencing ridership patterns on public transit and in carpool lanes.

The popularity of ride-sharing models indicates that many consumers would rather take a point-to-point journey (at the right price point) than use a set-route mode (like buses). The shift towards virtual working, live-work environments and online shopping suggests that consumers may be less focused on central business districts and more focused on access to good information and communication technology networks.

Customer demand for real-time information and insights indicates that access to data is quickly becoming just as important to customers as access to physical services. So, too, is access to peripheral services and retail options (though not if it comes at the expense of excellence in the core service).

Governments, planners, investors and stakeholders are recognizing that consumer expectations and needs are changing. And that means their traditional assumptions about how consumers use their infrastructure also need to change.

Thankfully, new technologies and approaches are allowing infrastructure planners and owners to achieve unprecedented insight into customer expectations and patterns. As we noted in [Trend 2](#), we expect to see infrastructure owners and operators start to build their data and analytics capabilities in order to uncover new insights about user/customer patterns and expectations. In other cases, technologies are being used to digitize the infrastructure experience.

This year, we expect consumers to seek a larger voice in their infrastructure options. That will require governments to focus more clearly on understanding actual user choice — whether that be their transportation route, time of energy consumption or health needs, for example.

Indeed, we believe that future infrastructure plans will need to be informed by real-time and predictive customer insights rather than historical patterns and expert opinion. Ultimately, this should lead to a massive democratization of infrastructure planning; those that recognize this fact early and embrace it will reap the benefits.



Trend 10:

Interdependence
creates opportunities



Gone are the days where infrastructure could be planned in distinct silos. In today's environment, it is the interdependency of infrastructure that is creating the greatest opportunities (and, for some, risks).

Consider, for example, how the introduction of electric vehicles will impact road, transit, power and distribution networks. Or how navigation apps are encouraging integration between public and private transit options. Or how the introduction of 5G networks will change the way services (such as healthcare) are delivered.

Infrastructure planners who want to improve capacity and capability in one area will need to think much more critically about how other areas must be adapted to achieve their desired outcomes. It's no use encouraging the adoption of electric vehicles if the existing electrical grid isn't capable of distributing enough power to charge the cars themselves. There's no point in rolling out a high-definition, e-health service if there isn't enough mobile capacity to deliver the service to remote customers.

The challenge, however, is that few governments are structured in a way that allows infrastructure planners and owners to minimize the risks and maximize the interdependencies. For the most part, planning is still conducted in silos; budgets are still allocated by functional departments; regulation is still largely focused on individual technologies and sectors.

As we noted in last year's *Emerging Trends* report, infrastructure authorities have started to think much more holistically and flexibly about how they plan, design and deliver needed assets. And that means understanding where current and future interdependencies exist and how they can be maximized (or the risks minimized) to flex with future developments and increasing demands for sustainability.

This year, we expect to see some of the world's more progressive governments put more effort into creating much stronger integration between their functions and capabilities in order to provide authorities with the flexibility they need to properly manage and — if necessary — modulate the growing areas of interdependence. On the execution front, we also expect to see more jurisdictions move towards developing infrastructure agencies similar to those found in places like the UK, Australia and Canada.

To be clear, the need for increased flexibility is not an excuse for infrastructure authorities to forsake long-term planning. Quite the opposite; over the coming year, we expect to see infrastructure planners take the steps necessary to start considering multiple long-term plans, supported by robust scenario-planning capabilities, as a way to maximize the growing interdependence of infrastructure without leaving everything to chance.

Bookshelf

Emerging Trends in Infrastructure



The 2018 trends report

In 2018, the Emerging Trends report identified how technology, politics and pricing models, among others, will shape the future of infrastructure.



The 2017 trends report

In 2017, the Emerging Trends report looked at the shift towards more responsive leadership. As political agendas and social expectations change, and power shifts, technology has disrupted everything.

Insight magazine: The Global Infrastructure magazine



Insight No. 11: #InfraConnect

This edition discusses the value of connections we make in a world where traditional infrastructure is no more.



Insight No. 10: #InfraTech is here

This edition offers valuable insights on the impact of technology on the world of infrastructure.

To access the listed publications, visit: kpmg.com/infrastructure or email us at: infrastructure@kpmg.com

Global Construction Survey series



Make it, or break it: Reimagining governance, people and technology in the construction industry

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Building a technology advantage

The 2016 Global Construction Survey reviews how the industry can harness the potential of technology to improve the performance of major projects.

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Meeting the market: Australia's infrastructure boom drives smarter procurement models

Australia finds smarter ways to structure mega deals, offering lessons for procurement teams around the world, whatever market conditions they face.



Embracing drones. Making the most of the third dimension

It's only been a few years since drones first started being mass-produced. Here are five ways cities can leverage drones today.



KPMG'S Global Infrastructure practice

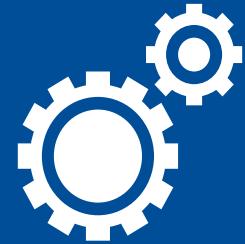
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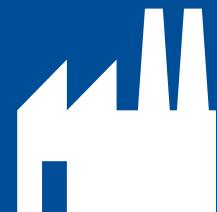
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