

London 2018 Summit: Major project delivery and digital transformation

Outcomes Report
December 2018



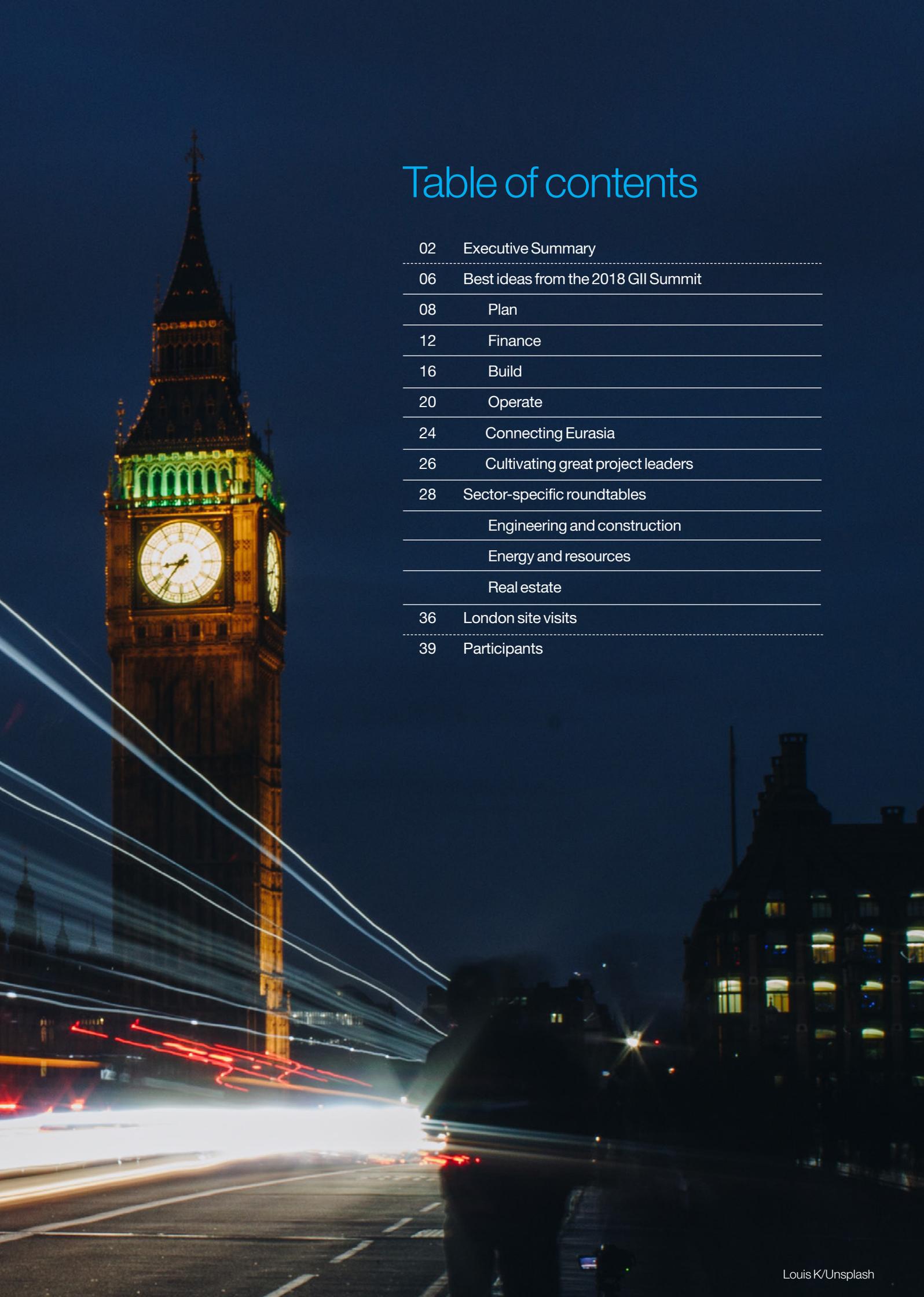


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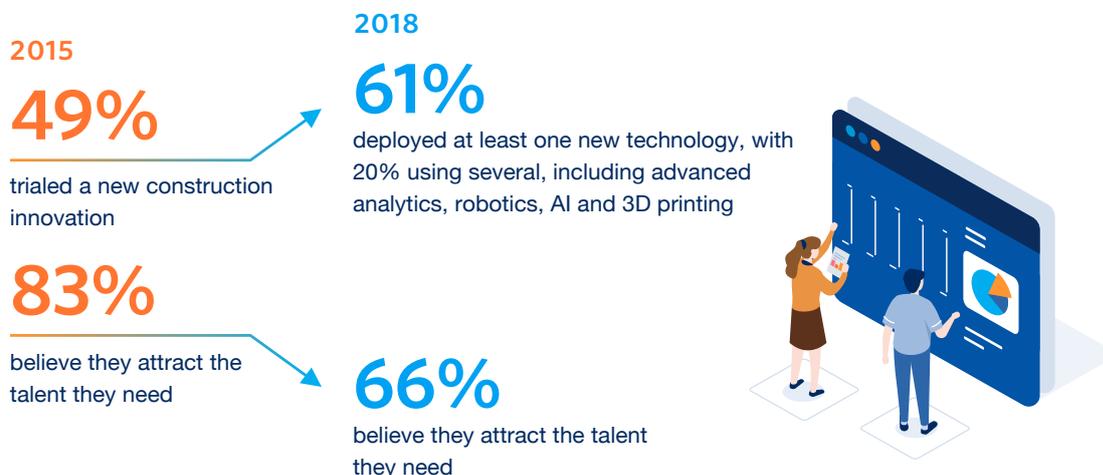
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Executive Summary

The Global Infrastructure Initiative was established in 2012 for two primary reasons: to create a forum for global leaders across the value chain to exchange ideas as well as to identify ways to improve infrastructure delivery and get more out of existing assets. Since its inception, it has evolved from one summit every 18 months into a global community that comes together at roundtables and site visits throughout the year and shares its perspectives in our Voices on Infrastructure publication.

Over the past six years, the infrastructure industry itself has experienced significant change. From 2012 to 2018, the number of major projects that broke ground grew by 77 percent, and the average project value increased by nearly 19 percent. When we convened our first summit in Turkey in 2012, one session was dedicated to digitization. At the 2018 summit in London, it was a primary theme, and talk of disruption and technology permeated nearly every discussion. Most summit participants (85 percent) responding to our most recent pre-summit survey have developed a digital transformation strategy.

The industry has increased adoption of technology, generating talent and recruitment challenges



Source: GII Pre-Summit Survey

We have highlighted the most prominent ideas for collaboration in the following sections. We welcome input, ideas, and feedback on how to pursue these.

Seize the digital opportunity

The summit is organized in accordance with the four stages of the project lifecycle: plan, finance, build, and operate. However, participants in each of these segments reached the same conclusion: the industry must improve its current processes, tools, capabilities and operations to capture the benefits of digitization, automation, the IoT, and analytics. This requires taking an end-to-end perspective across the lifecycle of a large asset.

RECOMMENDATION

Summit participants specifically identified two actions to help the industry come together:

- 1** Develop a single, global platform to share data on digital best practices that is open and accessible to all players in the industry.
- 2** Create an industry-level group that sets data and technology standards to unlock opportunities presented by the Internet of Things (IoT), analytics, and artificial intelligence.

Develop and invest in future-focused definitions of success

Similarly, the dialogue across all four summit pillars surfaced a need for changes to how we design projects, define their success, and invest in the long-term. Mobility is becoming increasingly autonomous, connected, electrified, and shared. And, emerging technologies are advancing faster than any one project can keep up. Analyzing potential future states in planning processes; designing and building flexible assets that can serve multiple uses; and identifying diverse revenue streams over an asset's lifecycle will be critical to ensuring infrastructure projects deliver the intended benefits—economic, environmental, and social.

Of the survey respondents, 69 percent have changed their long-term planning approach because of these forces, and 80 percent of those said that total lifecycle costs and future usability assessments are more prominent or frequently considered in investment decisions. The increased use of data and analytics to support decision making will help optimize existing assets and further refine project selection and design. The use of interoperable, modular components will unlock the opportunity to be more flexible over the course of an asset's life.

Use collaborative contracts that set expectations beyond financial incentives

Increased use of collaborative contracting models was a prominent theme at the 2017 summit in Singapore, and there was robust discussion in London about how those models can help align all stakeholders and establish outcome-focused measures of progress that consider the impacts on end users. It will be important that collaborative contracts include appropriate risk-sharing, set clear expectations, establish a problem-solving mentality, and offer financial incentives for each stakeholder. Such contracts will also be critical in reconfiguring the supply chain in a world with increasingly industrialized and prefabricated components.



RECOMMENDATION

One recommendation emerging from the summit was to establish industry working groups for a sustained and concerted exploration of collaborative models in specific geographies.

Attract and develop the workforce to evolve with industry needs

New skill sets are required in every phase and by every actor involved in infrastructure projects. While 100 percent of survey respondents who have undertaken digital transformations cited processes and systems as the focus, only 36 percent also focused on talent management and 27 percent on corporate culture. The experience of other industries shows that without a focus on organizational structures and talent, digital transformations are not likely to succeed in the long term.

One idea that emerged from the summit was recognizing that every organization carries responsibility for addressing these skill gaps. Apprenticeship programs can be a powerful tool, but organizations need to consider them an opportunity to up-skill the industry at large rather than just a chance to build their individual talent pipelines.

Importantly, there was widespread recognition that gender and ethnic diversity matters. McKinsey research shows that setting diversity and inclusion priorities and tracking progress is critical in attracting and retaining diverse talent at all levels of an organization.

We are committed to collaborating with the GII community on these efforts and are considering several new initiatives. We welcome your thoughts on how we can continue to foster more diversity and inclusion.



We hope the GII community will join us in pursuing these ideas. Through potential working groups, roundtables, and site visits over the next 18 months, we aim to further catalyze the transformation that is underway. As progress will only be achieved if all stakeholders act, we ask that all GII participants commit to implement at least one of the ideas before we reconvene in Montreal in 2020.

We sincerely thank our partners: Bentley Systems, Clifford Chance, Spencer Stuart, and Trimble. We also acknowledge our institutional partner the UK Infrastructure and Projects Authority, and our media partner the *Financial Times*. Without their collective support, the 2018 GII Summit would not have been possible.

We thank those who attended the 2018 GII Summit for their energy and insights. We look forward to staying in touch—and to continuing the conversation. 🌐

We'd like to hear from you if you would like to get involved in any of the recommended activities or if any of these ideas inspired changes in your organization. We also welcome recommendations on areas to focus on at future roundtables or disruptive projects or practices to consider for site visits. Please send your updates, ideas, or suggestions to info@giiconnect.com.

Best ideas from the 2018 GII Summit

The goal of GII is to identify themes, insights, and practical actions that can be applied by stakeholders across the value chain and diverse asset classes. Progress is a collective effort, and our hope is that the leaders who joined us in London — and the thousands of others throughout the GII community — will use these ideas as they develop their own strategies to navigate the change ahead.

We also invite industry leaders to join us in pursuing new, collaborative efforts that will help catalyze a more innovative and productive future for the industry. We look forward to engaging with the GII community and ask that everyone commits to implementing at least one of these ideas before we reconvene in Montreal in 2020.

Here are the highlights from the 2018 Summit, followed by an analysis of each.

PLAN

- Innovate early in planning processes and design for the future
- Digitize and automate processes and systems
- Prioritize capability building and recruiting new talent
- Invest in resilient and climate-smart infrastructure

FINANCE

- Refine business plans and forecasts using data analytics
- Build flexible assets to capture a range of funding sources over time
- Include diverse revenue sources in financing plans
- Build and broaden investors' in-house digital expertise

BUILD

- Scale the use of interoperable and modular components
- Measure progress against a well-defined, outcome-focused business case
- Use real-time management data to enable early identification of project issues
- Adopt collaborative contracts that incorporate risk sharing and clear requirements

OPERATE

- Adopt a user-centric view
- Use technology to break down barriers between assets and systems
- Consider regulatory and procurement changes to set the conditions for innovation
- Plan for changes in mobility as the biggest disruptor across all types of infrastructure

Cross-cutting sessions

- Build a pipeline of talented and diverse project leaders to set critical major projects up for success over the long term
- Minimize risk to attract the private and multi-lateral financing needed to close Asia's \$8 trillion infrastructure investment gap 



Photo courtesy of Heathrow

PLAN

An outcome-focused approach and experimentation with new ways of working can enhance project planning.

While much attention is given to the cost overruns and schedule delays that occur in the delivery phase of major projects, a more strategic, outcomes-focused effort in the planning phase can pay dividends. For example, a transportation project might identify a target number of passengers to move each hour. Choosing the right project objectives can help keep a project on track and improve the use of an asset over the course of its operations. Importantly, the planning phase should include sustainability and resiliency considerations as needs are growing and investment appears to be following suit.

Innovate early in planning processes and design for the future

Projects frequently lack a short, crisp articulation of objectives, including environmental, social, and economic outcomes. And the long-term nature of major project construction often means that original concepts could be outdated by the time a project reaches commissioning. This irregularity is exacerbated by rapid advances in technology and changing user behaviors. Moreover, public-sector owners often face the challenge of balancing specific objectives with

a need to satisfy multiple stakeholders—sometimes with divergent interests—to maintain support for a major project. It can be a struggle to communicate benefits when the public focus is on time and cost alone.

Participants at GII identified several keys to improving how the industry can structure major projects for success:

- **Define outcome-focused metrics of success** before developing a project concept.
- **Incorporate full life-cycle costs** in initial planning and procurement decisions.
- **Design assets that can serve multiple uses** in the immediate term, such as parking garages that can serve as cold-storage facilities, while also incorporating flexibility for future needs.
- **Disrupt traditional government-run planning processes** with competitive formats, such as challenge funds, and involve contractors earlier in the process to provide creative ideas.
- **Communicate projects' benefits through new visualization platforms**—like augmented and virtual reality—to go beyond a cost-benefit analysis and secure stakeholder buy-in.

“There are some models where the contractor comes in early and helps with better risk identification. Power plants do that, oil and gas wants it, infrastructure isn’t having enough of this conversation yet.”

—Bruce Grewcock, Chairman and CEO, Peter Kiewit Sons’

Digitize and automate systems and processes: the future of engineering is centered on unlocking digital

Technology and digitization of design and engineering processes are beginning to disrupt—and stand to significantly improve—how the industry works today. This will impact all aspects, from the common business model based on billable hours, to the core design tools used.

Contractors and owners can seize this opportunity by doing the following:

- **Improve risk management through the digitization of processes.** Project leadership could see near-real-time progress across projects through automated tools and feeds, allowing earlier identification of issues and mitigation, even in pre-construction project phases. While design houses may be concerned about how digitizing their core offerings will disrupt their business model, first-movers have recognized the significant opportunity to de-risk their work, which will become a competitive advantage. For example, 5D building information modeling (BIM) and virtual reality help identify problems during the engineering phase before breaking ground.

- **Use data and standardized digital processes to make insight-driven decisions.** Advanced analytics and scenario modeling can help owners identify several alternative options in the early stages of project conception. For example, one power company estimated that it saved \$35 million in prevented downtime using digital twins. Cloud computing also means that every project and site, no matter how small, can be digitized at a low cost—so everyone can reap the potential benefits.
- **Increase use of on-site technologies in the equipment-planning process.** Sensors were first used to track people (for safety) and products (for quality and schedule), but today data from equipment sensors should be applied regularly to improve planning and scheduling processes.
- **Develop a value proposition to recruit data scientists.** Talent is at a premium when it comes to data scientists, and the industry is competing with major technology players. One suggestion was to connect societal and economic benefits to infrastructure jobs to attract younger technology professionals. One participant noted that this hiring can also be done incrementally: “You don’t need hundreds of these people; one, two, or three great data scientists could make a huge difference to your business.”



Prioritize capability building and recruiting new talent

As every industry undergoing digital transformation has experienced, the changes in processes and systems will demand new skills and entirely new roles in many cases. The digitization of core engineering tasks mean that more time can be spent anticipating and mitigating issues and risks, so engineers will need to increasingly move from being discipline specialists to project integrators. Owners and contractors can no longer think about holding digital talent in their IT functions alone; they must be integrated throughout project teams.

Beyond the project teams, owners need to consider the skills that are required at the top of their project organizations to effectively manage major projects. Project leaders should be empowered to manage change. They must also establish a culture that encourages the use of such technology and provides contractors with incentives to bring forward innovative ideas.

Invest in resilient and climate-smart infrastructure

Over the past decade, climate change and storm events have cost the world nearly \$2 trillion and affected nearly four billion people. Projects around the world face the challenge of building and protecting infrastructure that can withstand several climate- and weather-impact scenarios that could unfold because of global warming. The industry is certainly making progress, such as with the use of sustainability ratings and the assignment of sustainability grading to potential investments, but there are no standards for defining or evaluating resilience in a similar manner. While it would be difficult, participants agreed that an established body and universally understood metrics—such as the ratings agency that offers AAA ratings to investors—could help prioritize climate-smart infrastructure measures and put best practices in place.

However, any global effort needs to be grounded at the local level. Regional and local governments are best placed to take an integrated view on how a climate or weather event will affect a community. For example, they should take a comprehensive view at how a storm could damage not just a power station but the access road and bridges critical to repair crews as well.

“Weather events do not consider which department has responsibility for different assets.”

—Claire Perry, Minister of State, UK Department for Business, Energy and Industrial Strategy

Given the infrastructure investment gaps facing the world today, private capital is becoming more critical to make the incremental investments in green or sustainable infrastructure. Financiers can help unlock sustainable investment by structuring deals to make them investor-friendly. This is particularly promising in emerging economies, and there has been significant progress in Africa.

In developed economies with massive, established infrastructure, investment is more about spurring the use of new technologies and ways of building. The government can consider regulatory structures that do not “pick winners” and instead open the market up for the most innovative and beneficial technologies to win out. For instance, governments have instituted renewable power auctions to help create markets for offshore wind developments. Public agencies can also partner with the private sector on specific projects; for example, a commercial district and its waterfront real estate tenants can invest in flood defenses, reducing the burden on the taxpayer. 



FINANCE

Technology and data analytics are transforming project investment trends and opportunities.

Refine business plans and forecasts using data analytics

Data have always been at the core of projecting future revenues and risks for infrastructure projects. Today, more than ever, we have richer data and better, more accessible tools to capture and analyze it. Investors can use these data pools and tools to examine certain aspects of infrastructure opportunities (such as demand forecasts, maintenance schedules, and operating volumes) and improve their assessments.

Analytics can improve site selection and ensure that project design can meet the more accurate estimates of future capacity and service needs. Also, more accurate models of greenfield projects or expansions can decrease risk for both investors and governments; they may also result in lower capital and operating costs and the ability to push a greater number of projects through the pipeline.

For example, when assessing the revenue risks related to an urban transport system, an investor can build a model that integrates analyses of rider travel patterns, consumer preferences, and data sets supporting predictions on where people are likely to live, work, and play over the next 20 years. That model can also show government sponsors and citizens—who may well be the transport system’s financiers—the extent to which that project will likely reduce travel time and congestion. This in turn can lead to more accurate predictions of economic benefits.

“The recycling of existing infrastructure brownfield assets that need enough capital infusion that they’re almost greenfield could be a sweet spot for investors. [For owners], really identifying risk, mitigating it, pricing it and putting it into the project package up front will make it more attractive for equity investors.”

—Laurie Mahon, Vice Chair, Global Investment Banking, CIBC World Markets

Data analytics may also help identify projects that are no longer viable due to shifting demographics or consumer patterns. Indeed, analytics may reveal some longer-term projects that have been in planning for years but no longer have a strong business case or economic development rationale.

To seize this opportunity, project sponsors—including private investors and government funders—can require data analytics to be integrated into project origination and planning. Public and private infrastructure financiers can lead the way. They should also work with sponsors to make these tools available so the modeling and potential outcomes can be transparently shared with stakeholders. Importantly, they can help build support for projects by working with governments to provide clear and supported assessments of the economic and social benefits.

Build flexible assets to capture a range of funding sources over time

Infrastructure is generally viewed as among the most permanent single-use investments. Much of the infrastructure being built today is meant to provide exactly the same set of services for 30 years or longer. The assumptions are that, indefinitely, airports will continue to support planes and passengers, parking lots will still house cars, and highways will serve commuters who need to travel from suburbs into city centers and back home again.

But are those fair assumptions? Technology is changing mobility—how we get around, where we go, and how we power our transport systems. Furthermore, population growth and urbanization are triggering the repurposing of already-built environments and are demanding more from infrastructure assets.

These trends make it more likely than ever that much of the infrastructure financed today could look very different 30 years from now. The rapidly changing needs of society necessitate additional infrastructure services for different groups of users. For example, many greenfield roads are designed with expansion potential and with rights of way for fiber and power lines. However, roads authorities should now be thinking about flexible designs that allow for rapid lane direction changes, express lanes, adaptive exits, in-road electrification, and even the option to allow for accommodating rail and other types of mass transit as the population grows.



Owners of major civic buildings intended as government office space or courthouses should assess the potential for their buildings to also house retail and commercial tenants, to function as an event space, and to net-produce rather than use energy. Their rooftops and basements could serve as parking and service centers for flexible car services, autonomous vehicles, and airborne vehicles and drones.

Accommodating the need for flexible infrastructure will require sponsors, planners, and users to invest in assessing the most likely future trends, deploy data and analytics tools to assess potential and risks, and then integrate flexibility into the financing business case.

Building materials, design, and technologies need continued innovation to integrate energy into infrastructure and operate it more efficiently. Investors need to be well-versed in these technologies and willing to invest in their deployment—even if there is some risk. Sponsors and governments need to consider changes to their project procurement processes to reward infrastructure developers and investors that propose flexible solutions with longer-term sustainable business cases.

Given the rate of technological progress and evolution, technology is no longer the primary limiting factor in capitalizing on the opportunities offered by big data and advanced analytics.

The change management process and collaboration with diverse stakeholders are the main hindrances.

Include diverse revenue sources in financing plans

Traditional public-sector funding models for infrastructure will not meet the world's infrastructure needs. But users of infrastructure services cannot be expected to finance the high-costs of complex transport, water, and utility systems alone. High user fees and rates often have the effect of driving users away to alternative routes and distributed services. They can also make some infrastructure services unaffordable for lower income users. Additional revenue sources must be integrated into the financing plan for infrastructure whenever possible to make projects bankable and politically acceptable.

Additionally, the trends compelling the need for flexible infrastructure will reinforce the likelihood that infrastructure assets of the future have multiple revenue streams. Established models of transport-oriented development, for instance, in which rail and bus stations and airports are financed partially by integrating real estate development and retail revenues into the base-case financing model, are becoming the norm. They are also now being extended to a wider range of infrastructure assets such as ports, universities, civic centers, bridges, and roads.

The monetization of data generated by users on an infrastructure asset is still at early stages but will ultimately be a part of any infrastructure assets customer and financing strategy. Integrating diverse revenue streams with unique drivers and risks presents challenges to the traditional model of project financing, but it also opens new capital sources with different risk and reward profiles. Importantly, it creates new opportunities for the public and private sector to work together to finance more infrastructure faster.

Build and broaden investors' in-house digital expertise

These new models for infrastructure finance all have one thing in common: they will require public and private infrastructure financiers to integrate new capabilities alongside their traditional investing expertise. Given how essential data analytics is becoming to origination and due diligence, industry first movers are hiring in-house data analytics professionals. Others need to follow suit to remain competitive. Furthermore, as they look to secure new opportunities, many investors will find that success will depend on their ability to bring design expertise as well as familiarity and comfort with new revenue streams. 

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BUILD

Disruption of project delivery is underway. Who is best positioned to take the lead and reap the benefits?

While talk of disruption to the industry is not new, this year, participants agreed that the industry has reached an inflection point, with increasing evidence that change is underway.

There are three prominent catalysts for this change. First, widespread recognition of the industry's low levels of productivity and digitization make it fertile ground to approach things differently. Second, countless technologies are already changing the way the industry operates. This includes the use of sensors and the Internet of Things to unleash predictive analytics, project lifecycle management tools integrated into building information modeling (BIM), digital twins, and the use of mixed, augmented, and virtual reality at various stages of the project lifecycle. Finally, the next generation of workers has been raised on interactions with smart devices or on screens; they are not going to accept the current work practices, and this dissatisfaction will propel change.

The question for many is whether the disruption will be led by traditional industry players or if technology companies who have shown interest in investing in the industry will take the lead.

Incumbents need to think hard about how to harness these trends rather than risk having others move in.

Scale the use of interoperable and modular components, particularly in densely populated areas

Modular construction can help increase productivity, improve quality given the controlled environment, reduce construction times, and attract new members to the workforce who would not otherwise work in construction. In densely populated areas, use of modular and prefabricated components can also reduce the burden on the neighboring public by lessening traffic congestion, as well as noise and dust pollution.

“I think that modular has the highest likelihood of the new technologies of transforming how construction will be delivered.”

— Dan McQuade, President, AECOM Construction Services (former)

To realize the full potential of this disruption, the industry will require a new operating model across the construction supply chain that incorporates modularization and prefabrication, technologies such as 3D printing and digital twins, and collaborative contracts. Industry players will need to adopt a production-style approach with standardized and interoperable modules across asset classes, while also maintaining the ability to customize projects. They will also need to more sharply focus on end-users’ needs and invest in upskilling the employees of organizations that are critical to the supply chain. Success will require all stakeholders, including regulators, public and private owners, engineering and construction companies, technology providers, and suppliers to align on new ways of working.



Measure progress against a well-defined, outcome-focused business case

Projects are currently defined as successful based on whether they are delivered on time and on budget. While participants did not underplay the importance of these criteria, the industry at times loses sight of the critical outcomes a given asset will provide. For example, a 10-year project that is delayed by one year often faces intense public scrutiny. However, it is rare that we celebrate when that same project ultimately reduces average commute time by 50 percent and lowers air-polluting emissions. The primary goal of infrastructure is to deliver long-term environmental, economic, and social benefits. By focusing solely on the cost and schedule implications during design and construction, project owners risk making decisions that are not in the interest of delivering those outcomes. Therefore, the true benefits of the project can be overlooked and underdelivered.

“Procurement decisions should not be made in isolation. Determine the real value of the final asset; only then can you begin to interpret whether or not it’s the correct cost you’ve allocated.”

—Ann Bentley, Global Board Director, Rider Levett Bucknall UK

Use real-time management data to enable early identification of project issues

The performance of major projects can be improved. When we asked participants for their views on the biggest cause of major project failure, 33 percent said poor stakeholder alignment, followed by a lack of owner or sponsor capabilities (at 19 percent) and inadequate risk planning (at 18 percent). These factors contribute to the well-recognized fact that too many projects suffer from budget overruns or suffer schedule delays.

Many agree that projects would benefit from improved transparency and clear management data, which would allow project leaders and owners to understand performance at a granular level and recognize when a project is in distress. To help overcome this issue, project owners should develop well-defined business cases at the outset. It is then the role of project leaders to regularly revisit the business case with the project team, reinforce shared goals, and measure success against the desired outcomes. Project leaders need to quickly establish a clear vision—this will foster a collaborative and problem-solving environment to help a multidisciplinary team work together. Owners and contractors should also look to augment their project teams with agile-savvy leaders who can integrate across functions and technical disciplines, allowing them to more quickly identify and resolve issues.

“The answer is staring us in the face. Every other industry identified the potential for disruption 30 or 40 years ago. Technology is breaking down some of the challenges peculiar to construction.”

—Chris Shephard, Vice President, Construction Solutions, Trimble

Adopt collaborative contracts that incorporate risk sharing and clear requirements

Changes in procurement and contracting models are critical to a more collaborative approach to projects. This theme is not new, but its widespread implementation has not been achieved. While there are promising examples of this in the private sector, for example in mining or oil and gas, in the public sector it is an enduring challenge. All parties involved must first set challenging yet realistic objectives up front and then establish what “win-win” really means for everyone. And to avoid hidden or surprise costs, there is also an opportunity to develop transparent systems for project budgets with joint ownership of contingencies—benefiting owners, investors, and contractors.

33%

of GII 2018 participants said more stakeholder alignment is the biggest cause of major project failure

46%

said win-win incentives in contracts will have the largest impact on improving owner-contractor relationships

Participants emphasized that monetary-only collaborative contracting attempts will not work. Fair risk sharing, clearly defined requirements, and established principles of collaboration can be even more important than the financial aspects of the contract. Such a shift to understanding a project’s behavioral aspects are demonstrated by an increasing number of owners using psychometric tests—that is, aptitude questionnaires or interviews—during contractor bid evaluations.

“If you are going to design win-win incentives, they have to be real and credible.”

—Cressida Hogg, Chairman, Landsec

Finally, project owners can consider changes to the procurement and contracting process that enable contractors to invest more in research and development. When there is shared risk between contractors and owners and the right financials in place, experience demonstrates that the owner-contractor team is more likely to develop new and innovative solutions. 

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Dan Roizer/Unsplash

OPERATE

Infrastructure assets must be flexible and able to adapt to emerging technologies and user expectations over the course of operations.

Adopt a user-centric view of infrastructure

Governments, owners, and developers still often view infrastructure as isolated physical assets and distinct projects. This contrasts with businesses and citizens—or the customers—who experience infrastructure as a background enabler in their daily lives, from their commutes to ubiquitous internet connectivity. Importantly, these customers have increasingly high expectations of flexibility, convenience and overall quality of life. To keep up with demands and catalyze greater economic growth, owners and developers should take a more user-centric view.

Consider user-centric airport planning, which optimizes for an airport's capacity and also for public and private transportation routes into that airport, accommodating passengers and freight as well as airport employees. As owners assess how to get the best use out of their assets and maximize revenues, it is important to think about broader trends. For example, a rail station might

evaluate evolving work and travel behaviors and decide to repurpose underutilized space to build a co-working area. Such thinking should also carry over into the evaluation and prioritization of an owner's capital portfolio; in the airport scenario, an owner might cancel plans for a new parking garage and instead establish a partnership with a ride-sharing provider.

When companies and owners optimize their own position in the value chain, benefits are small and fragmented. A more systemic approach is needed. Simply put, we can unlock significant value by breaking down barriers between asset classes. Infrastructure organizations can take steps to structure themselves to break down siloes and be more user-centric. For example, the Scottish government now has a cabinet secretary with responsibility for transport, infrastructure, and connectivity – hence putting user-centricity at the heart of infrastructure decision-making.

Use technology to break down barriers between assets and systems

Technology will enable users to optimize the operation of both individual assets and of systems of assets. There was robust discussion throughout GII about the potential for digital twin technology to optimize all aspects of a project. Participants agreed that developing digital twins in the design phase, which can allow for much more targeted and efficient maintenance, is a must and should be augmented by the digital twin of brownfield assets. As adoption of digital twins increases, there is an opportunity to incorporate environmental, social, and economic considerations, alongside physical specifications, allowing owners to understand the full scope of potential outcomes.

For example, digital twins can allow building operators to identify and switch out unreliable air handling units and improve efficiency or to update elevator programming to adapt to changes in building occupancy.

“The definition of infrastructure is changing, and digital transformation will create convergence of assets.”

—Gregory Hodkinson, Chairman, Arup

Technology also offers an opportunity to take a more systematic approach across assets. For example, traffic data can be linked to interactive road signs to temporarily increase road capacity (such as by opening additional lanes) in areas of congestion. Sharing data between assets depends on accomplishing digital alignment at an engineering level. Both the public and private sectors will need to prioritize interoperability for connecting different technologies, models, and data sources to effectively enable automated digital workflows. Greg Bentley, CEO of Bentley Systems, gave an example of how his organization is catalyzing these types of immersive

connections and fostering collaboration between projects and asset types by delivering its digital twin web services through an open-source library.

With the pace that technology is advancing, it will be important that owners plan and allow for adequate time for systems integration before commissioning projects, particularly of major long-term ones.

Consider regulatory and procurement changes to set the conditions for innovation

The shift in infrastructure usage is raising complex challenges for the public sector. For example, the increased prevalence of home-working and low-cost home delivery is causing increases in local congestion and air pollution from delivery trucks. These are issues that no single provider can solve and that the public sector can take a leading role in addressing.

First, local and national governments can lead the debate and act as a guiding mind on the future of infrastructure. For example, cities can develop mobility strategies, rather than just a transportation strategy. At the national level, governments are considering plans to substitute revenues from fuel-excite duty as electric vehicles replace traditional vehicles.

Second, the public sector can consider making bold moves to help shape the future of infrastructure—for example, specifying the production of digital twins in all public projects. Active discussion among GII participants revolved around the opportunity to introduce regulations that could help rationalize last-mile deliveries in city centers.

Third, the public sector has an opportunity to take on a larger role of integrating and distributing information in a way that individual asset owners cannot. For example, the public sector can aggregate data between asset types to allow transport providers to optimize journey times, better plan maintenance closures, and even define the optimum location for new facilities.

“I am primarily in the mobility business, not the asset-building business.”

—Jens Holmboe, Director General, Danish Road Directorate

Plan for changes in mobility as the biggest disruptor across all types of infrastructure

Time and again, participants raised the changing nature of mobility as the biggest disruptor across asset classes. Owners, operators, contractors, investors, and governments should examine how changes in levels of electrification, automation, and connectivity will touch every part of their business.

The implications of mobility on commuting trends and car ownership are well-documented, but GII participants also explored some of the less obvious consequences that organizations should consider. For residential developers, autonomous vehicles can greatly increase mobility for senior citizens and may inform housing planning for this growing segment. For example, underground parking garages that have traditionally been part of multi-family building design could become obsolete. For emergency services providers, more battery-powered vehicles on the road is likely to mean more electrical fires, requiring new skills and equipment. For road builders, autonomous vehicles could allow greater traffic density and more optimization of road geometry as speeds become more predictable, potentially freeing up significant land. For power distribution companies, local networks can be designed to harness electric vehicles for use as storage units when not being driven. 🌐



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Bosphorus Bridge in Istanbul

Muhur/Getty Images

Connecting Eurasia

Minimizing risk will be critical to attracting the private and multi-lateral financing needed to close Asia's \$8 trillion infrastructure investment gap.

The opportunity to create more efficient connections between European and Asian economies could help spur global economic growth, and infrastructure development will be a critical enabler. Furthermore, sound investment in Asian infrastructure will be necessary to meet global climate change objectives.

McKinsey research finds that across Asia, excluding China, there is \$10 trillion of infrastructure investment needed, but only \$1.6 trillion of projects in the pipeline. This leaves the region with more than \$8 trillion of unfunded infrastructure needs. Capital from the private sector and multilateral development banks (MDBs), including the Asian Infrastructure Investment Bank (AIIB), will be necessary to close the investment gap.

“We are looking for projects that are financially sustainable, environmentally responsible and socially acceptable.”

—Sir Danny Alexander, Vice President and Corporate Secretary, AIB

The private sector and MDBs can collaborate with national governments to help develop pipelines of bankable projects. In well-designed public–private partnerships (PPPs), the private-sector partner will often invest for 20 to 30 years to help ensure operating assets deliver the intended environmental, social, and economic benefits.

However, important factors must be in place to help minimize risks and attract private and multilateral funding and financing, including:

- Strict environmental, social, and anticorruption policies and transparent systems to monitor adherence
- Long-term debt sustainability of the host nation
- Regulatory and political stability and sustained project support
- Financial sustainability throughout the asset’s lifecycle backed by a detailed business case

“The private sector, together with the MDBs who can take developing market risks, should come up with ways to make it easier for governments to deliver the enormous pipeline of projects needed in emerging markets for the betterment of society and GDP growth. We all have a responsibility to make this work.”

—Nick Wong, Partner, Clifford Chance

Standardized frameworks can help increase the number of PPPs by providing transparent and consistent guidance on key processes (such as procurement) and risk allocation. Another approach is to set up governance boards on major projects with global representation that provides the right mix of insights and experience as well as a level of detachment from local politics.

Finally, the capacity of local institutions to manage and deliver the projects is critical. The AIB and other MDBs can play a critical role in Asia by working with local project owners to build the capacity of their teams to improve project selection, design, and delivery. 



Cultivating great project leaders

Successful delivery of critical infrastructure is reliant on a pipeline of talented and diverse project leaders.

As projects become larger and more complex, project leadership can be one of the most influential factors in a project's success. Effective major project leaders are defined by their ability to master a combination of practical judgment, political ability, and wisdom—in addition to their thorough grasp of technicalities, core project management systems, and processes. For long-term major projects, it is also important there be continuity in strong leadership.

“Great leadership comes from living the values.”

— Terry Morgan, Chairman, Crossrail and HS2

The infrastructure industry is facing labor shortages, a skills gap, and aging workforce in many parts of the globe. The successful delivery of major projects is critical to keep pace with



projected economic growth, so it is imperative that owners and contractors act now to build pipelines of talented, diverse project leaders. The size and long-term nature of major projects create a tremendous opportunity to build these pipelines and create socially inclusive hiring programs. Specific actions include:

- Establish apprenticeships with specific diversity targets and demand the same from the supply chain
- Create openings, such as data scientists and user-experience specialists, to attract people who would not have originally pursued a job in infrastructure and engineering
- Ensure current project leaders act as role models and mentors
- Invest in development and training that is rooted in the organization's values and that integrates emotional intelligence with behavioral science. [🌐](#)





Sector-specific roundtables

The GII Summit hosted three sector-specific roundtables on engineering and construction, real estate and energy and resources. Highlights from the roundtables are summarized below.

Engineering and construction: Beyond modular—from projects to products

The challenge of low productivity in the construction industry has been well documented. To catalyze significant productivity improvements, the industry should seize the opportunity to move toward a manufacturing-style production approach. For example, some in the industry are already taking lessons from the automotive industry and streamlining the on-site assembly process. Others have moved to an off-site manufacturing model producing full modular units.

Engineering and Construction (E&C) roundtable participants had the opportunity to hear from just a few of these leaders: Mace's Jump Factory, which can build a fitted-out floor in 55 hours on a

constrained site in London; Ambar in Brazil, which has already built more than 75,000 homes through its “design, supply, assemble, live” process; and Uber, which has been a pioneer in its customer-centric view and ability to evolve and scale quickly.

While not all players in construction are well positioned for off-site manufacturing, certain segments of the industry will see significant improvement. Roundtable participants explored how this manufacturing-style approach could dramatically improve project planning and delivery in three sectors: airport, rail, and real estate. While each asset class has its unique considerations, participants identified four common areas of focus. All stakeholders—owners, contractors, suppliers, and regulators—will need to agree to new ways of working together.

1. **Increased customer centricity.** Project owners need to consider assets with the end users’ experience in mind. This customer-centric focus must be clearly articulated to everyone within the value chain to establish clear project requirements. For example, the use of modular construction in real estate should deliver sufficient customization for the end customer while still retaining the productivity benefits of standardization. Likewise, airport operators need to consider the experience customers look for as it relates to retail and dining, which are primary revenue drivers.
2. **Standardization and interoperability of modules among and across asset classes.** Within modular construction, one of the biggest challenges for suppliers is ensuring consistent demand so the manufacturing facility maintains sufficiently high utilization levels. Project owners are concerned that modular suppliers may have to close operations during a project because they don’t have a strong enough revenue stream. A critical step to overcoming these issues is to create greater interoperability between owners and suppliers. An industry-wide agreement on the interoperability of modules would allow greater flexibility for suppliers to provide modules across a series of asset classes, while owners would have greater robustness in their supply base. This sort of standardization could also help improve user experiences. For example, a standard security layout or boarding system may result in a better experience for passengers.

Design and architecture will certainly create the desired variety in the look, feel, and experience of each asset, but participants agreed that tremendous strides can be made in the industry by convening working groups to establish standards for the core “building blocks” that allow for interoperability.

3. **Continued need to improve productivity and efficient delivery.** Currently, the case for modular construction is often marginal. Cost benefits today can vary from a 20-percent cost reduction to a more common comparable cost—or even a cost premium compared with on-site construction. For adoption of modular construction to really take off, modular companies will need to incorporate best practices that enable them to fully realize cost benefits.



First, companies should industrialize design to allow mass customization to balance standardization and flexibility. Standardization will maximize the use of automated equipment, but flexibility will ensure a range of products and therefore demand on the factory.

Second, they need to invest in digitization, data strategies, and automation. They should also consider how to incorporate other technologies (such as 3D printing) that can also deliver productivity benefits. Third, investing in and upskilling the supply chain will be critical to increasing use of just-in-time delivery and building information modeling (BIM) for coordination between services.

4. [Scaled procurement, moving from project- to portfolio-level purchasing.](#) The full cost and productivity benefits of modular construction can only be achieved if there is a consistent project pipeline. Projects identified and procured as a portfolio create demand confidence for suppliers. Project owners, particularly in the public sector, should consider opportunities to move toward a portfolio approach to procurement and project management to reap the cost and time benefits. A successful example of this is the Pennsylvania “500 bridges in 500 days project,” in which the use of standardized design and modular construction allowed the ambitious and extensive project to be delivered on time and on budget. 🌐

Energy and resources: Driving productivity through digital transformation and innovative project leadership

In the energy and resources sectors, a new wave of major projects is approaching. There was widespread acknowledgement from participants that these megaprojects, among the most complex and costly on the planet, will have to:

- embrace new technology-enabled ways of working to ensure safe and productive project delivery,
- understand how best to use this technology to operate these assets once constructed, and
- consider how to balance the demand for high capability megaproject leaders with the comparatively meager supply of these leaders (particularly within the skill set that constitutes what McKinsey calls the “Art of Project Leadership.”)

Under this broad umbrella of topics, roundtable participants considered the following questions: what role will engineering, procurement, and construction contractors (EPCs) play in adopting the digitization of construction, and how will this affect the competitive landscape? What is the root cause for a lack of a SAP-like industry standard for digitizing construction? How can we best teach people the elements that constitute the “Art of Project Leadership?”

Highlights of the discussion include:

The age of the digital twin is upon us.

Energy and resources assets often require optimization across highly complex processes with nonlinear relationships between inputs and outputs. The ability to effectively simulate, optimize, and schedule these processes in a nimble, pragmatic, and digital way will improve operations dramatically. It is a question of when, and not if, the industry will embrace digital twins. Two opportunities for widespread adoption stand out in particular—forecasting optimization in liquefied natural gas (LNG) production and simulating power plant energy efficiency.

Despite higher rates of digitization in operations, construction and project delivery still lag—but this will change soon.

In contracting, it is not uncommon that companies are “too busy” and operate on too tight a margin to recruit the right talent and truly adopt digitization. Any EPCs that continue down this path will soon find themselves unable to compete globally. Owners are generally more progressive than EPCs when it comes to digital adoption—for example, owners have led in the use of mobile technology in operational assets—and



they must drive the step change through levers such as outcome-based contracts that include or require use of digital tools.

Increased industry collaboration will generate mutual benefits for owners and contractors.

EPCs are consistently striving for new ways to deliver high quality, simple, and cost-effective solutions, supporting project execution through economies of scale and fit-for-purpose solutions. Given the high repeatability of assets within energy and resources, the “majors” have a role to play in aligning on collaboration standards among them. Technology providers also have a role to play in standardization and collaboration—making data open source will support project delivery globally and counteract the age-old problem of the data-free construction site. For instance, it can create transparency on safety impediments and field team productivity at the task level.

Capable and experienced project leaders are a rare breed; this paucity will influence the growth of energy and resources sector.

Apprenticeship is important, as is structured training for the project leaders of the future. The culture of the industry needs to allow higher levels of experimentation and risk taking. Fundamentally, the right mind-set trumps the right background, so organizations should look to develop talent quickly and embed the right mind-set in all emergent leaders: open, collaborative, values-driven, and ready to take full ownership of outcomes. One idea that surfaced during the roundtable discussion was to build project simulators that would allow teams to test themselves against various scenarios, evaluate their responses, and identify skills that need to be developed to improve outcomes in a real-life situation. 🌐

Real estate: The future of real estate

The global real estate market has reached an inflection point, with the changing demands from customers and emerging technologies having profound impacts across real estate asset classes and the project lifecycle. The roundtable explored the critical issues of:

- Understanding market forces creating opportunities and challenges in real estate investment today
- Anticipating millennials' behavior in residential, office and retail real estate
- Embracing new technologies in construction and property development
- Addressing the affordable housing challenge
- Preparing for smart cities and districts of the future

Changing consumer preferences are disrupting demand for traditional retail real estate, while opening new opportunities elsewhere

Across consumer categories, millennial consumers expect to make 50 to 75 percent of their purchases online, according to new research from McKinsey & Company. This growth in online retail continues to have a profound impact on demand for “traditional” retail assets, but is also creating new growth opportunities. For example, 50 percent of time spent in malls is now on entertaining and dining, with only 30 percent on shopping. This creates significant revenue streams for retailers who focus on creating and curating an environment where shoppers want to stay, eat, and play.

Customer-centric office space does not stop at flexibility

New entrants such as WeWork have shifted customer expectations on experience, quality, and flexibility of office space, forcing incumbents to shift from a focus on square metres to customer experience. A customer-centric focus could mean moving from the traditional reception desk to a concierge-style welcome service, or providing a variety of zones with different functionalities and moods within one floorplate. And although the demand for flexibility is growing – research indicates that up to 25 percent of office space will be a flexible solution by 2020 – industry leaders still expect to see strong demand for traditional long-term leases as large corporate customers still need the stability afforded by such arrangements.

Incumbent developers are making the shift to new operating models, particularly in emerging markets

There are new entrants making significant progress in the [real estate] industry, from the largest global technology companies to venture capital firm Fifth Wall that invests specifically in real estate technology. The trends in retail and commercial real estate are most rapid in emerging markets, where developing countries are “leapfrogging” traditional structures to embrace new models. Incumbents are responding with fundamental shifts in their business models: for example, Vanke, one of the largest real estate developers in China, now conducts

acquisition, delivery, and operation in a single online environment. They are also investing in digital skills, with a team of more than 700 technology specialists, and use social media platforms to track consumer patterns and adjust their offerings. Leaders in developed markets will need to make similar changes or risk losing ground to the new entrants.

The public and private sectors must work together to deliver quality, affordable housing at scale

Around the world, countries are facing a shortage in affordable housing. This is, first and foremost, a social imperative. But it is also an economic imperative: a shortage of affordable housing in the right places acts as a brake on economic growth, and both the public and private sector must take an active role in developing the solution. The public sector can improve the supply of land in the right locations, by both relaxing planning regulations where appropriate and by freeing up useable land that has not been developed for some time. The private sector must use new technologies, new materials, and new construction techniques or consider modular and offsite systems of construction, including both buildings and the utilities that serve those buildings, to reduce build costs, shorten time to market, and improve quality. As the industry overall shifts to greater use of modular and flexible building space, it may also help unlock housing supply. Today we have a massive oversupply of commercial square footage and loss of big-box stores. The potential for future spaces like these to be adapted from retail to housing with relative ease could have significant benefits.

Disruptive technologies will create significant value for developers across construction and operations

Technology is changing the real estate business at every stage of an asset's life, and the companies that do not invest now risk being left behind. The construction process is slowly moving towards a production system, driven by digitization and modularization. This creates significant opportunities for developers. First, time to market will decrease because digital and modular will help shrink construction time and increase predictability. Second, moving to a production system will create procurement efficiencies, as contractors standardize building elements and move to global sourcing arrangements. Third, digitization will allow contractors to optimize the ecosystem. Data on usage patterns will be analyzed and overlaid on a digital twin of a building to continuously optimize operations and provide insights to building occupants to help optimize their use of the space. For example, occupancy patterns can be used to adjust the time at which heating systems fire up. Similarly, desk usage rates can be analyzed by developers to optimize layouts of future buildings.

Technology is allowing us to reimagine cities for a better quality of life

The "Smart City" is a concept that has been around for some time, but we are reaching a point where technology is now allowing us to optimize cities to promote better living. Smart Cities overlay a technology layer on the bricks-and-mortar infrastructure layer to link assets and improve connectivity. For example, modular building systems allow us to repurpose and reconfigure city blocks as usage patterns change. Similarly, smart signage and lighting means



roads can be repurposed and prioritized for pedestrians, as mobility patterns change. Machine learning can be applied to zoning parameters and building configurations, capturing data on demographics, population density, economic trends, and weather patterns, and cycling through millions of permutations of location, orientation, height, form, and materials to optimize the early stage design of a new city block. 🌐

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London site visits

While in London, GII participants had the opportunity to go behind the scenes at some of London's most complex and innovative major projects. This included visiting the following sites:

Battersea Power Station: One of central London's largest and eagerly anticipated urban regeneration projects, the £9 billion project will deliver thousands of new homes, offices, restaurants, retail space, and cultural venues. It will also consist of 18 acres of public space and major infrastructure improvements, including a new London Underground station.

Crossrail: As Europe's largest infrastructure project, Crossrail will link London economic centers. GII participants visited the site of the future Canary Wharf station, which will connect it to the City of London, the West End, and Heathrow Airport. The project is the first of its kind in the United Kingdom to develop a strategy and process for enabling innovation throughout the course of the megaproject.

London Bridge station: The London Bridge station rehabilitation increased capacity to 90 million passengers per year. The station remained operational during construction, and the project was completed on time. It also significantly expanded the throughput, enabling several more

trains per hour to travel through the station. Participants heard about how the project team learned as it went and continually applied lessons learned to increase efficiency.

Queen Elizabeth Olympic Park: Spread across 560 acres of parklands, Queen Elizabeth Olympic Park (QEOP) is home to landscaped gardens, historic waterways, famous sporting venues, and a vibrant arts and events program. Following the 18-month transformation program of the London 2012 Olympic Park, QEOP opened in April 2014 and is still transforming—it will soon provide additional homes, access to jobs and apprenticeships, and a culture and education district.



Thames Tideway Tunnel: The 16 mi (25 km) sewer tunnel is being constructed to prevent an average of 20 million tons of untreated sewage discharge from entering the River Thames annually. The project will upgrade London’s sewage system to cope with the city’s demands well into the 22nd century. A highly complex project, the tunnel is being built from three main construction drive sites and will require the use of 24 construction sites, 11 of which are located along the river bank.

Transport for London Network Management Control Centre: Transport for London (TfL) is the integrated transport body that runs nearly all the transport in London, operating from two control centers in one location. Participants had the opportunity to see firsthand how TfL manages the interface between highly automated systems and its human intelligence to deal with challenges to the system and support 31 million daily journeys. 

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Participants

Over 200 world leaders in infrastructure and capital projects joined us in London from Oct 29–31, 2018 to discuss new solutions and move the global infrastructure industry forward.

Pratik Agarwal — Group Chief Executive Officer, Sterlite Power

Philip Aiken — Chairman, Balfour Beatty

Saleh Al Ateeqi — President & CEO, Kuwait Investment Office

Al Jajeh — Executive Board Member & CFO, Cumming

Abdullah Al-Attayah — Deputy President, Qatari Diar Real Estate Investment Company

Talal Al-Dhiyebi — Chief Executive Officer, Aldar Properties

Danny Alexander — Vice-President & Corporate Secretary, Asian Infrastructure Investment Bank

Jose Rene Gregory Almendras — President & CEO, AC Infrastructure

Dev Amratia — Chief Executive Officer, nPlan

Rosemarie Andolino — CEO & President, Manchester Airports Group USA

Jose Eduardo Antonio — Chairman & CEO, Century Properties Group

John Armitt — Chairman, National Infrastructure Commission

Naaman Atallah — Chief Executive Officer, Piramal Realty

David Atkins — Chief Executive, Hammerson

Hadi Badri — Chief Strategy Officer, EMAAR Properties

Roger Bailey — Chief Technical Officer, Thames Tideway

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We help clients improve on-time and on-budget delivery of major projects and get the most out of existing capital assets. Working alongside owners, developers, contractors and financiers, we have experience across all markets, asset classes, and stages of the project lifecycle. McKinsey provides our clients with a unique combination of strategic advisers, practitioners with deep sector and market knowledge, and senior technical experts with decades of industry experience.

Over the past five years, we have delivered impact in more than 3,000 engagements, including work on 150 megaprojects collectively valued at more than \$1 trillion. Our unique ability to partner with our clients and drive fundamental change is rooted in our independent perspective, alignment with client goals, a deep commitment to innovation and impact, and the depth and breadth of our expertise and experience.

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Global Infrastructure Initiative

Since 2012, McKinsey & Company's Global Infrastructure Initiative (GII) has convened many of the world's most senior leaders in infrastructure and capital projects to identify ways to improve the delivery of new infrastructure and to get more out of existing assets. Our approach has been to stimulate change by building a community of global leaders who can exchange ideas and find practical solutions to improve how we plan, finance, build, and operate infrastructure and large capital projects.

Over the years, GII has hosted five global summits, dozens of regional roundtables, and innovation site visits to explore some of the industry's most exciting advances. The best insights and practices from around the world are featured in our *Voices on Infrastructure* publication. Our intent is to create a platform that inspires senior leaders to drive change to help close the infrastructure gap, promote economic growth, and contribute to more resilient and secure communities.

globalinfrastructureinitiative.com



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