

Rethinking Infrastructure: Voices from the Global Infrastructure Initiative

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**GLOBAL
INFRASTRUCTURE
INITIATIVE**

By McKinsey & Company

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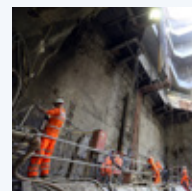
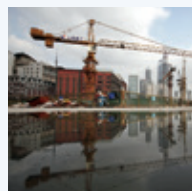
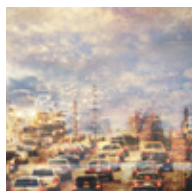
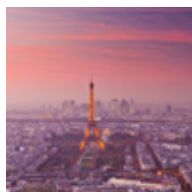
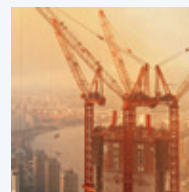
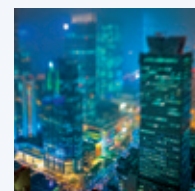
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Introduction

Established in 2012, the Global Infrastructure Initiative (GII) seeks to bring together leaders and thinkers from all disciplines related to infrastructure. We ask them to challenge the conventional wisdom, and to inform and inspire those who are tasked with meeting the world's growing need for housing, transport, and energy.

In this expanded edition of *Rethinking Infrastructure*, we have added the voices of participants who attended the GII in Rio in May 2014 to those who went to Istanbul in 2012. With 25 articles (14 of them published for the first time), we hope that this publication will stimulate conversation among the sector's leading CEOs, government leaders, entrepreneurs, and academics.

Drawing on the work of both conferences, this collection explores six themes:

- setting the vision
- winning public support
- securing investment
- improving productivity
- harnessing the power of digital technologies
- meeting the needs of emerging economies

The McKinsey Global Institute has estimated that between 2013 and 2030 the world needs to spend \$57 trillion on infrastructure to fulfill global GDP projections. The problem is not just the scale of the investment but the difficulty of spending it well. The stories of projects in which costs have been greatly underestimated are legion. The redevelopment at New York's World Trade Center, for example, is nearly \$3 billion over budget, and counting. Of the \$9 trillion

in annual infrastructure spending, an estimated 40 percent is not optimally spent due to bottlenecks, lack of innovation in delivery mechanisms, and market failures. GII seeks to show how to do better.

Section 1: Setting the vision

The first article in this section addresses the crucial question of how to create cities that work for their citizens. This is more important than ever because more than half the world now lives in cities, and that figure is growing literally by the hour. Based on an analysis of dozens of cities and case studies, four McKinsey authors examine how cities can deploy their competitive advantages to achieve “smart growth.”

The next two pieces look at particular definitions of success. Judith Rodin, president of The Rockefeller Foundation and author of *The Resilience Dividend: Being Strong in a World Where Things Go Wrong* (PublicAffairs, 2014), argues that “we need to change the mind-set from ‘keeping all bad things out’ to creating new kinds of capacity” that can absorb unpredictable events and incorporate the ability to “fail safely.”

Then, Virginia Greiman, the former risk manager for Boston's “Big Dig,” suggests that the definition of success should include broader goals such as sustainability and economic development, not just whether a project is completed on time and on budget.

To conclude the section, former US Secretary of State Madeleine Albright discusses the

idea that infrastructure is both a process and a foundation: it “forms the basis for social stability, human rights, freedom, and equality.”

Section 2: Winning public support

In each of these articles, the emphasis is on why, and how, infrastructure providers can make the case to the public. In the first article, McKinsey’s Dominic Maxwell, Julian Mills, and Stuart Shilson begin by showing how leaders can learn from industries that have mastered the art of connecting with consumers. Next, London’s deputy mayor for transport, Isabel Dedring, argues that before putting a shovel into the ground, the public needs to be engaged, seriously and sincerely. Doing so, she says, ultimately saves time and money. And that matters, considering that London has a number of major projects in the works: the £15 billion Crossrail project, £1 billion in bicycle infrastructure, and the potential for a new £25 billion Crossrail 2 line.

For mega-events, such as the Olympic Games, public support in many countries seems to be declining, notes German Olympian Wolfgang Maennig in the interview that closes this section. It may be time for a new approach to the Games, one that requires fewer big investments.

Section 3: Securing investment

Once infrastructure proposals win public consent, financing and ownership issues must be resolved. Six articles explore these challenges.

In the section’s opening article, McKinsey’s Mike Kerlin sets the stage. He notes that it is not just the amount of money needed that is challenging

but also how to raise and spend it. The next four articles examine narrower financing issues. In the article that follows, Frédéric Blanc-Brude of the EDHEC–Risk Institute takes a close look at how to match investment demand for new infrastructure with the supply of capital from institutional investors. Privatization, he writes, is not the only—or necessarily the best—option. In the next article, Thierry Deau and Julien Touati of Meridiam, a private-equity firm that specializes in infrastructure, discuss the potential of public–private partnerships.

Arif Naqvi, founder and group chief executive of the Abraaj Group, another private-equity firm, examines how to evaluate the potential of energy-infrastructure projects in emerging markets. The opportunities are substantial for the careful investor, he writes in the next article; the key is to identify which markets “have transformed their investment environment,” to improve regulatory and risk management.

US Secretary of Transportation Anthony Foxx closes the section by candidly describing difficulties in the United States in delivering infrastructure, and then suggesting what can be done. The scale of the task is awesome: “America has 100,000 bridges old enough to qualify for Medicare,” he writes.

Section 4: Improving productivity

The fourth set of articles addresses how to deliver better, less costly infrastructure. In the first one, McKinsey’s Martin Hjerpe, Nicklas Garemo, and Jan Mischke estimate that governments could raise infrastructure productivity by \$1 trillion a year through improved project selection, streamlined delivery, and making the most of existing investments.

Uwe Krueger, CEO of Atkins, a design, engineering, and project-management consultancy, describes in the next piece how those principles can be made concrete. Looking at major projects in London, Malaysia, and Qatar, he shows that imagination combined with management can lead to great cities.

McKinsey's Yakov Sergienko suggests an alternative approach in the following article. Using the example of a single European city, he shows how "quick fixes" noticeably improved its traffic flows.

Finally, two experts offer a view from the trenches on productivity. Lee McIntire, former chairman of CH2M HILL, discusses creative ways to close the funding gap. Moreover, he notes, "Not every project is a great project."

And in another interview, CEO Zhang Yue details how China's Broad Group completed a 30-story structure in 15 days. The group has bigger

ambitions: it seeks to build Sky City, a 208-story structure, with 90 percent of the workload completed off-site and incorporating new standards in energy efficiency.

Section 5: Harnessing the power of digital technologies

Infrastructure is not immune from the revolutionary power of digital technologies. McKinsey's Carl-Stefan Neumann describes in the first article how big data can improve forecasting, reliability, and efficiency, and offers real-life examples that make the case.

In the next article, MIT's Matthew Claudel and Carlo Ratti look into the future to consider a specific example. The driverless car, they say, could transform cities and contribute to an 80 percent reduction of cars on the road.

An interview with Siemens' Roland Busch concludes the section. He argues that the challenge is not about big data but relevant data—defining the



business problem, then finding the data needed to solve it.

Section 6: Meeting the needs of emerging economies

The collection ends with a look at infrastructure in emerging markets. China, for obvious reasons, gets particular attention. It is urbanizing faster than any country in history and on a breathtaking scale: by 2020, China aims to integrate 100 million rural migrant workers into urban life and urbanize another 100 million people in its central and western regions.

The scale of the undertaking is laid out in the first article, by Xiaodong Ming, deputy director of the planning department of China's National Development and Reform Commission. He discusses his country's values and priorities as it undertakes this journey toward "people-centered urbanization." Among them: better buildings, integrated transport systems, and environmental sustainability.

In the next article, Zuo Kun of China Development Bank Capital argues that China's model of financing infrastructure through government debt is no longer sustainable. Instead, China should work with the private sector to explore market-based finance options. This might also help to improve the quality

of new projects. At the same time, China's own construction companies should seek to raise their game and compete internationally. That would give "made in China" a whole new meaning.

Next, Peter Dawson, CFO of engineering-and-construction giant Bechtel, discusses some of the roadblocks in developing countries, including the difficulty in finding adequate financing and establishing public-private partnerships. Finally, in the closing interview, John Rice, vice chairman of GE, describes how the company is responding to expectations that it train and develop people, as well as support local markets and suppliers.



The common thread of these 25 features is that infrastructure planners and providers are responding to some of the most significant challenges on earth: urbanization, development, population growth, and climate change. At the same time, the industry faces challenges of its own, such as public support, financing, ownership, and design.

Through the Global Infrastructure Initiative, McKinsey aims to explore these challenges—and play a part in addressing the most pressing issues. 



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Unlocking the future:

The keys to making cities great

Effective urban leaders focus on doing three things well.

**Shannon Bouton,
Jay Dearborn,
Yakov Sergienko, and
Jonathan Woetzel,**
McKinsey & Company

More than half the world lives in cities, and that figure is likely to increase to 60 percent by 2030, adding 1.4 billion more people than today. The rush to urban centers, particularly in emerging economies, is driven by a desire for a better life with more opportunities—as economies start to centralize in cities, so do people. The McKinsey Global Institute (MGI) has estimated that between now and 2025, the world's urban population will grow by 65 million people a year, or almost 179,000 every day.¹ Meeting the needs of this changing demographic will be challenging. What has to happen to make a good city? Or a great one?

Those are urgent questions. Because cities are where the future is, urban environments need to evolve to match human aspirations. To consider

how to do this, MGI interviewed a wide range of urban leaders and experts and researched in depth dozens of cities in Asia, Europe, the Middle East, North America, and South America. Some of the cities we looked at are certainly considered great; others have achieved notable results on specific topics.

It is worth noting that cities are dynamic environments; they are always works in progress. As conditions change, so must cities. Today's status as a great city does not guarantee tomorrow's. In a sense, the leading characteristic of both great and improving cities is an ingrained sense of dissatisfaction: there is always room for improvement. And greatness is all about the individual trajectory, not emulation.

Given this dynamic, we have identified three things that effective urban leaders do well. These principles apply widely, regardless of economic conditions or geography.

1. Achieve smart growth. All cities need economic growth for their residents to earn a livelihood and enjoy a good quality of life. Smart growth is about finding the best way to do that sustainably.

Good economic strategy attracts investment. Great strategy identifies and attracts the best growth prospects. But how do you do this? Tax breaks may be necessary, but they are not sufficient. What is more important is to figure out the city's competitive advantages and then construct a winning offer to businesses that also makes economic sense for the city. For example, cities can support businesses by connecting them to distinctive talent and critical business resources. Some cities in the American Southeast, for example, attracted foreign carmakers not only because of lower labor costs but by pointing to specific strengths: talent, proximity to centers of innovation, and good transport. As part of the package, targeted public investment can be useful. The US state of Georgia built a job-training facility for would-be autoworkers; South Carolina has established an apprenticeship program in cooperation with manufacturers. In a different context, Dubai has created the infrastructure to make itself the world's largest port, as well as an international business and tourist center.

Once a city determines what it wants to be known for, one way to approach economic development is to take the attitude that the business community as a whole is a client and that economic development is about making that client successful. Bogotá does so by providing a one-stop shop for investors, including help with permits and training. And in Rio de Janeiro, as one official

put it, "Our main question is how can we, the city, serve them well?"

Another critical element is to plan for change. Successful cities anticipate how economic growth will influence the changing needs of the city. Environmental management should be integrated into the plan; this means developing an agenda that uses a variety of policies—such as regulations, zoning laws, market mechanisms, and incentives—to set environmental goals and standards. It is better (and cheaper) to deal with green issues, such as air quality and land and water use, before they become problems. All too many cities have had to take expensive remedial action to fix problems that could have been prevented.

Traffic congestion, for example, is not only time consuming, frustrating, and ups the cost of doing business, but the resulting air pollution also damages residents' health. Sometimes cities can make significant improvements just by using current infrastructure better. Singapore's congestion system has proved that pricing can reduce traffic and improve its flow. High-density development—building up, rather than out—is also a valuable strategy. In effect, it uses land more intensively, and land is one resource that cannot be grown.

2. Do more with less. There may not be a single city anywhere that believes it has enough money to accomplish all it wants and needs to do. To deal with budget pressures, cities need to make every effort to collect, manage, and spend their resources effectively. São Paulo has increased value-added-tax revenues not by raising the rate but by improving tax collection; since 2007, it has offered a rebate on sales tax paid by consumers who send in their paper receipts. This has helped reduce underreporting by stores.

High-performing cities assess and manage expenses well—what in business terms would be called “cost efficiency”—in good times and bad. Several specific actions have proved successful: for instance, outsourcing administration to lower-cost centers emphasizing strategic procurement, and using zero-based budgeting (in which the budget is built from scratch and every line item must be approved).

In addition, great city leaders accept that not every service, from information services to park maintenance, needs to be provided directly by government personnel, and they acknowledge that the mandate for government changes over time. Although authorities may be wary of giving up control, well-designed public–private partnerships have proved capable of delivering infrastructure and services at lower cost and higher quality. The key is to define concrete, measurable goals using cost-benefit analysis and rigorous performance metrics. Britain has done this with road-building partnerships, establishing high-level guidance and setting out the conditions under which toll roads can be built. Regardless of where the money is coming from, there is no substitute for good governance and investment accountability—that is, the ranking, design, delivery, and management of capital investments. This may sound obvious, but it is not nearly as common as it should be. MGI has noted that, in some countries, half or more of electricity is lost in transmission and distribution. Reducing those losses is a lot cheaper than building new power plants. MGI estimates that as much as \$400 billion a year could be saved just by speeding up permitting and by structuring projects to encourage time and cost savings.² One example of how this can work in practice comes from San Francisco. The city created a capital-oversight body to hold developers and other city entities accountable for delivering

on the investments. Among other things, they are required to make available to the public annual development reports and ten-year master plans.

Technology can be a game changer. The right data can be analyzed to help increase revenues, lower capital spending, and improve services. This can be as simple as using sensors to adjust street lighting depending on ambient-light conditions—which results in lower costs and no loss of quality. To take another example, New York City is using data on clogged basins to identify which restaurants might be illegally dumping grease. In site visits, with the support of data, inspectors were right 95 percent of the time, leading to better time management, fewer clogged basins, and more revenue (from the collection of fines). And Bucheon City in South Korea makes real-time traffic information available, allowing drivers to choose the least congested route and improving traffic flow.

3. Win support for change. This is, of course, easier said than done. Established business, community, and political interests might prefer (and fiercely defend) the status quo. City leaders need to be persistent and resilient; if they can deliver fast, positive, and visible results, they can build support for more change. Doing this requires high-performing civil servants who are seen to be accountable for their work. Singapore, which has one of the world’s most highly regarded civil services, benchmarks public-sector pay against equivalent pay in the private sector so that it can compete for top talent. Compensation and promotion are based on merit, not longevity, and the city-state promotes public service as a high-status and well-compensated career choice.


Even the most skilled and motivated city workers, however, need guidance to be effective.

Outstanding city leaders have a coherent vision that includes not only an idea of where they want to go but also of how their history can inform that journey. They build on their values and knowledge of the priority issues affecting their city to inspire constituencies. Seoul's Park Won-soon, a former labor activist, is committed to making his city more open and democratic, broadcasting almost every meeting over the Internet. Former New York City mayor Michael Bloomberg once noticed that he got three different answers to a question on who should be picking up garbage. In response, he set up a dedicated phone line so residents needed to make only one call to report any kind of issue in the city.

This vision can be personal and to a certain extent must be; mayors need to be committed, even passionate, about where they want to take their cities. But it also needs to be a vision that stakeholders can make their own. Consensus with the local population and business community can help to improve transparency, information, communication, and partnerships. "Listen to the neighborhoods." That's what the late Thomas Menino, mayor of Boston from 1993 to 2014, once told McKinsey. "Make people believe and understand that you are making their lives

better."³ One technique is to experiment with pilot projects to demonstrate success (or failure), soften opposition, and work out any difficulties before deciding whether to roll out an effort more broadly. That is what Curitiba's three-time mayor, Jaime Lerner, did with the Brazilian city's bus-rapid-transit plan. The Rede Integrada de Transporte began in one neighborhood; it now covers the whole city, and other municipalities have copied the system.

Cities are essential to global economic growth and productivity. They are where most of the world's population live, work, and play, and they are important to everyone else, too. They are the world's economic engine, consuming the majority of global power and resources, while generating 80 percent of GDP and 70 percent of greenhouse-gas emissions.

Making cities great is the critical infrastructure challenge of this century. 

¹ For more, see *How to make a city great*, McKinsey Global Institute, September 2013, on mckinsey.com.

² For more, see *Infrastructure productivity: How to save \$1 trillion a year*, McKinsey Global Institute, January 2013, on mckinsey.com.

³ *How to make a city great*.



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Infrastructure and the resilience dividend

Even the best planning can't always stave off an infrastructure failure when a major disruption hits. But building in resilience can help infrastructure withstand shocks or fail safely.

Judith Rodin,
president,
The Rockefeller Foundation

In the days after Superstorm Sandy, which left unprecedented damage across New York and New Jersey, government officials and urban planners were surprised to find an exception to the devastation: Arverne by the Sea, a 308-acre housing development on the Rockaway Peninsula a few miles south of John F. Kennedy International Airport, had weathered the storm almost completely unscathed. Arverne's local supermarket—and the electricity to power it—was functioning within days of the storm, while nearby communities went without either for weeks.

It wasn't just good luck. The project's developers had taken the possibility of a storm as powerful as Sandy seriously and factored the impact of

climate change and rising sea levels into their planning and infrastructure development. From energy-absorbing boardwalks and storm-water systems to underground electric lines, Arverne by the Sea was built to fail more safely and rebound more quickly.

In a century when shocks like Sandy would seem to be growing fiercer and increasingly routine, we need to build more developments like Arverne by the Sea, with resilient infrastructure integrated into the design and planning of not just houses but entire cities. And we need to act quickly. In less than 30 years, more than six billion people will call a city home, two billion more than today, putting more strains on existing infrastructure

and more people in the way of rising coastal waters and increasing weather events.

But to ensure that cities can imagine, finance, and plan the infrastructure needs of tomorrow, we need to change the mind-set around infrastructure from “keeping all bad things out” to creating new kinds of capacity to respond to the challenges that will inevitably come.

The first step is to move away from responding only to the last disaster and instead anticipate future threats and changes. In 2010, for example, designers in Portland, Oregon, revisited their plans for a light-rail bridge spanning the Willamette River to ensure it could withstand higher and more rapid waters. These were costly changes, but now the bridge will be ready for whatever may come and stands as the first transportation project in Oregon’s history to be conceived and planned with future storms and weather-related incidents in mind.

No matter how much we plan for and predict major disruptions, however, infrastructure failure is sometimes unavoidable given the increasing severity of shocks and stresses to our systems. Thus the second step is to build in mechanisms for infrastructure to fail safely, minimizing the disruption that can ripple across systems. We saw this need in New York City during Superstorm Sandy. The electric grid was too networked, so when one part of the system went down in a fantastic explosion, the entire lower half of Manhattan went with it. As a cochair of the New York State 2100 Commission, our recommendations to New York governor Andrew Cuomo included smart-grid technology, which is designed to decouple and delink parts of the electric grid. Now, the local utility

Consolidated Edison is installing this kind of technology, including smart switches, which can isolate areas where a disruption occurs and limit widespread failure during future outages.

The third step to adopting more resilient capacity is to expand the expectation of who pays for infrastructure. Traditionally, this has been viewed as solely the realm of government. But the resilience of a business, and indeed an entire sector, is intertwined with the resilience of its community. The private sector has a clear interest and responsibility to put skin in the game.

One way to attract more private-sector capital is through infrastructure banks, like the one Mayor Rahm Emanuel has implemented in Chicago. Farther west, a partnership of government, community, business, and nonprofit groups from Washington, Oregon, California, and British Columbia has established the West Coast Infrastructure Exchange, aimed at strengthening financing for public–private projects that cross jurisdictions. The Rockefeller Foundation has supported both initiatives.

Another way is to better integrate infrastructure projects for public good with the needs of the private sector. To this end, we teamed up with the White House, the US Conference of Mayors, and innovators in the private sector to fund an initiative called RE.invest, which is supporting eight US cities to establish a new form of public–private partnerships that will help them package portfolios of investments aimed at building more resilient infrastructure. With the help of leading engineering, law, and finance firms, the cities will be able to use public resources more efficiently to leverage private investments—for example, in better storm-water infrastructure.

In this way, infrastructure investments can achieve multiple wins, or what we call the “resilience dividend.” Simply stated, this means financing, planning, and implementing solutions that help cities, systems, institutions, and people rebound more quickly from disaster if and when it hits and help spur economic development, job creation, environmental sustainability, and social cohesion between shocks. For example, the effort to create and maintain green infrastructure will necessarily spur the expansion of education and employment opportunities for a new generation of highly skilled workers.

To help more cities realize the resilience dividend, The Rockefeller Foundation launched the 100 Resilient Cities Centennial Challenge in 2013. Some 400 cities applied to become one of the first

to be selected, showing a clear appetite for these solutions. The cities will receive access to a suite of services and support to develop a resilience plan and hire a chief resilience officer to implement it. Infrastructure will be a central component, and the foundation’s platform will help cities access private-sector financing for resilience-infrastructure projects as part of their strategy.

If the recent series of disasters, from superstorms to typhoons to earthquakes, has a lining, it’s not silver, but gray and green—the colors of the infrastructure that must be built and supported in order to weather the shocks and stresses of this century. By changing our mind-sets, we can ensure that the survival of Arverne by the Sea is no longer an exception to the rule, but a harbinger of things to come. [o](#)



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Evaluating megaprojects:

What constitutes success?

Megaprojects always face challenges, but looking only at cost and timing may not be the only way to judge their success.

Virginia A. Greiman,
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projects and planning,
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Megaprojects will always struggle with unforeseen events, regulatory requirements, technical difficulties, financial constraints, and politics. The costs—at least \$1 billion—of megaprojects are high. The complexity is increased by the fact that there are many different stakeholders, including owners, managers, sponsors, and local communities, and they all have different perspectives. Moreover, delays and budget overruns are, admittedly, the norm rather than the exception. As a result, many megaprojects are remembered more for these issues than the lasting good they produce.

Defining success is complicated. It might seem straightforward to consider projects successful

that come in on time and on budget, but what if the finished venture doesn't solve the problem it was meant to? If a high-speed rail system meets its time and budget commitments, for example, but cannot attract the ridership necessary to alleviate traffic congestion and improve air quality, it is still a failure.

On the other hand, comprehensive research has found that projects that are both late and costly can still be considered successful if they deliver what is promised and if associated socioeconomic benefits are accounted for. Usually, however, such benefits are not even identified. For example, Boston's Big Dig—a complex plan that rerouted an interstate and built a bridge, a tunnel, and a

greenway—was a source of enormous frustration and controversy because it took many more years and many more billions of dollars than projected to finish. Now that it is done, though, residents and visitors are enjoying the benefits of dramatically reduced travel time, as well as improved waterfront access, wildlife conservation, new and expanded parks, and increased business development. Boston is a better place because of the Big Dig.

This is not to say cost and schedule do not matter; of course they do. Like everyone associated with the Big Dig, I wish it had gone more smoothly and less expensively. But its history also hints at another point: sponsors need to do a better job of assessing and then communicating the benefits a project will deliver.

Project-management success versus megaproject success

There is a difference, in short, between successful project management and successful projects. Project-management success has traditionally been defined as meeting scope, schedule, and cost-compliance requirements. These three factors constitute what is known as the “iron triangle” and are the traditional benchmarks used to evaluate most projects. There are additional attributes, however, such as socioeconomic improvements, technological innovation, and improved environmental conditions that could and should be part of the equation in determining whether a project is a success.

In recent years, “comprehensive benefits assessment” has been used to attract financing for big public projects and to build community support. This term means that all benefits, tangible and intangible, are taken into consideration in assessing a project’s justification. Intangibles include skill development, alleviation of poverty,

knowledge sharing, and institution building. Undertaking a comprehensive benefits assessment is becoming the norm for determining the likely long-term success of projects and influencing decisions about priorities and resource allocation. I believe that all projects should incorporate a comprehensive assessment from the start and develop practices to implement and measure these benefits. For example, the worth of technological improvements can be measured by the increased value of the intellectual-property portfolio.

There are different ways to measure these benefits. One method is to do qualitative and quantitative analysis of project and industry data, including stakeholder surveys, screening, and observation. Typically, there is a base-case cost-benefit analysis to which investment alternatives are compared. The analysis addresses these questions: What additional benefits will accrue if this alternative is chosen? And what additional costs will it incur? The objective is to translate the effects of an investment into monetary terms and to account for the fact that benefits play out over a long period while capital costs mostly arise up front.

The World Bank Group, for example, seeks to link infrastructure-development projects to job creation, environmental improvements, and poverty reduction. From that point of view, a road becomes more than a means to get from point A to point B; it is a way to help the poor, and this benefit should be taken into account when considering whether to build. In the developing world, a number of studies point to a significant impact of roads on poverty reduction because of their effect on economic growth. A 1.0 percent increase in road investment is associated with a 0.3 percent drop in poverty incidence over five years.¹

Evaluated comprehensively, many large-scale projects deliver benefits above and beyond what was originally planned or even imagined. The original environmental assessment of the Big Dig focused on the economic and environmental benefits of alleviating traffic congestion. The Central Artery, which it replaced, was built to carry 75,000 vehicles a day and was instead supporting 190,000. As the project evolved, new opportunities arose and additional benefits became part of the thinking:

- 1 innovative engineering, infrastructure, and technological advancements
- 2 integration of isolated neighborhoods and transportation systems
- 3 creation of a new island park from a mountain of decaying garbage
- 4 redeveloped landfills and the expansion of the shellfish and wildlife population between Boston and Long Island²
- 5 economic-development opportunities benefiting small- and minority-owned businesses in particular³

The Big Dig also established the nation's first innovation and advancements program; the program shared the knowledge gained from the project with transportation practitioners around the world. Since the Big Dig, this kind of knowledge transfer has been incorporated into every large-scale project that receives federal funding and is also required under many state statutes and regulations.⁴ Finally, while no one has yet counted up the benefits in monetary terms, the technological advancements that the Big Dig pioneered, such as environmentally enhancing context-sensitive design, safety-incentive programs, innovative ground-freezing techniques, and the largest use of urban slurry-wall modules, are now being used in other projects around the world.⁵

The sustainability imperative

Sustainability normally refers to environmental practices. In megaprojects, a broader definition, including concepts of economic, social, and institutional sustainability, is appropriate.⁶ The San Francisco–Oakland Bay Bridge, which

Other factors must be incorporated into the project's cost-benefit analysis. There needs to be a framework to help governments—and the public—understand the larger benefits of a project and to include the impact of economic and social development.

was damaged during the 1989 earthquake and reopened in 2013, was \$5 billion over budget and took ten years longer than originally projected. But the bridge was built to last for 150 years—much longer than the typical 50 years of service—and to withstand earthquakes and seismic activity of the highest magnitude. Both factors will support substantial savings down the line.⁷

Although determining the bottom line on the Bay Bridge as constructed is difficult, the point is that cost and schedule are not the only ways to judge success. Other factors must be incorporated into the project's cost-benefit analysis.⁸ There needs to be a framework to help governments—and the public—understand the larger benefits of a project and to include the impact of economic and social development in the final analysis.

That doesn't mean that residents will be less irritated at the daily disruptions of projects that never seem to end. But perhaps, looking at the bigger picture, they will consider them worth the trouble. ○

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⁶ H. T. Dimitriou, E. J. Ward, and P. G. Wright, *Lessons for Decision-Makers: An Analysis of Selected International Large-Scale Transport Infrastructure Project*, OMEGA Project 2, OMEGA Centre and Volvo Research and Educational Foundations, Bartlett School of Planning, University College, London, December 2012, omegacentre.bartlett.ucl.ac.uk.

⁷ "ABCs of bridge renewal," TR News, Transportation Research Board of the National Academy of Sciences, January–February, 2014, trb.org.

⁸ James Laird, Peter Mackie, and John Nellthorp, *Where to Use Cost Effectiveness Techniques Rather Than Cost Benefit Analysis*, World Bank Group, 2005, worldbank.org.



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Building societies:

An interview with Madeleine Albright

Infrastructure is about much more than cement, says the former US secretary of state and chair of the Albright Stonebridge Group.

Norah Ferry,
McKinsey & Company

Madeleine Albright is well known for her work in international relations, geopolitics, and systems of government. In recent years, the former US secretary of state has turned her attention to a new field—infrastructure—in her role as chair of global strategy group Albright Stonebridge Group and Albright Capital Management, an investment strategy firm that focuses on emerging markets. In this interview with McKinsey, Albright discusses how infrastructure can provide the foundation for stable and prosperous societies.

McKinsey: *Why are you interested in infrastructure?*

Madeleine Albright: At its most fundamental level, when infrastructure is well planned, designed and built, it provides the physical framework for a modern, healthy, and prosperous society. Whether we're talking about telecommunications, transportation, power and water, or public buildings such as schools and hospitals, infrastructure touches every aspect of the way we live. I have a saying that infrastructure is about a lot more than cement. What that means is that infrastructure is an integral component of the system of society. It allows us to communicate, to move people and goods, and to improve our quality of life by propelling research, education, and

commerce. In short, it enables the transformation of individual ideas into action.

McKinsey: *How do you connect your work on infrastructure with some of the other topics for which you are well known?*

Madeleine Albright: Infrastructure is central to most of the issues that I have always cared about—whether I was working in the public sector, as a professor, or now as chair of the Albright Stonebridge Group—because it forms the basis for social stability, human rights, freedom, and equality. It can play a critical role in either exacerbating or reducing the gap between the rich and the poor. And the quality of infrastructure is also very important, because it's not just about building something. Infrastructure that advances a society involves extensive planning and is built in the right place for the right purpose. I continue to enlarge my definition of infrastructure; it is the framework and basis for many aspects of domestic and foreign policy.

McKinsey: *What kind of questions—or challenges—does infrastructure raise in developing economies versus developed ones?*

Madeleine Albright: The fundamental rationale is the same in both developed and developing economies. Being able to build a road, bridge, or school unlocks enormous economic and social potential in developing countries, and also in developed countries. Because, as we all know, infrastructure is not limited to a single event. It is a process that you have to keep working on and perfecting—with respect to planning, financing, operating, and maintaining. This is certainly true in the United States, where our bridges and roads are aging and need repair.

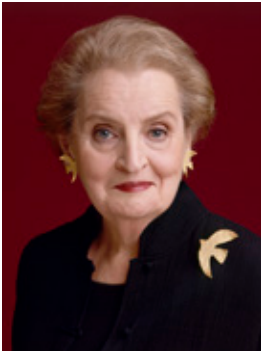
As international travel and trade among countries continues to grow, certain types of infrastructure—ports and airports, for example—are becoming more important in both developing and developed economies.

But obviously there are differences. I think there is a different emphasis regarding where you want to put your money and what types of projects you pursue. In developing economies where so many needs are still not met—some of the most basic human needs—infrastructure priorities and projects will differ. We also see more opportunities to build completely new infrastructure, and in some cases, new cities, in developing economies, which present an opportunity to incorporate the latest thinking in socially and environmentally sustainable design. In some cases, developing economies actually have an advantage because they can learn from what has come before and “leapfrog” outdated solutions that make up so much of the built environment in the developed world. We can see a good example of this in the rapid adoption of cell phones in developing countries, which has circumvented the need for stringing traditional telephone wires. There are similar opportunities for leapfrogging in clean energy, efficient urban mobility, and other areas.

McKinsey: *Yet rallying public support for infrastructure projects can be difficult. Can you articulate the communication challenge?*

Madeleine Albright: Part of the difficulty lies in the fact that you are building for the future, not today. Getting buy-in from citizens who are paying their taxes now or from investors, who are looking for assurances of project viability and stability, is challenging, particularly when

Madeleine Albright



Vital statistics

Born in
Czechoslovakia, 1937

3 daughters

Education

MA, PhD, Columbia
University, Department
of Public Law
and Government

BA, political science,
Wellesley College

Career highlights
**Albright Stonebridge
Group**
(2001–present)
Chair

**US Department
of State**
(1997–2001)
Secretary of state

United Nations
(1993–97)
US permanent
representative

**Center for
National Policy**
(1989–92)
President

**White House National
Security Council**
(1978–81)
Member of staff

Fast facts
Received the Presidential
Medal of Freedom,
the highest US civilian
honor, in 2012

Has written five books,
including *Prague Winter:
A Personal Story of
Remembrance and War,
1937–1948* (Harper, 2012)
and *Madam Secretary:
A Memoir* (Miramax, 2003)

Is chair of the National
Democratic Institute

Serves as professor in the
practice of diplomacy
at Georgetown University

Speaks Czech, French,
Polish, and Russian

a project may not be operational for five to ten years. Still, I think we can do more to communicate with the public about the importance of infrastructure.

In our excitement over a project and what it might deliver, we sometimes overlook the softer side of infrastructure development. So we have to ask questions: What exactly are we building and why? How much does the larger community know about this project? Have their views and concerns been taken into account in the planning phases? Taking the time to think about those messages and to have open discussions with the public about a

project before it begins is very important. This may sound very basic, but it doesn’t always happen.

I will give you an example. A few years ago, we visited neighborhoods in a capital city in Africa for a project related to legal empowerment of the poor. When we spoke with people, the first question they asked was whether we were associated with the people who brought the wells. And then they told us how, one day, these strangers came in and said that the water the neighborhood had been using for many years was not clean. And they unveiled new wells. But the citizens didn’t understand why they couldn’t continue

using the same water source they had always relied on, like their parents had before them. And they resented this intrusion into their way of life. I think this illustrates why it is important to communicate with people as early as possible and to ensure that communication remains ongoing throughout a project.

Last, I think that you have to have confidence in your citizens, and the exchange of information builds respect and signals that you have confidence in one another. It forms the foundation for a successful infrastructure project—one that brings people together, rather than dividing them.

McKinsey: *How do you think about the roles of the public sector and the private sector in infrastructure?*

Madeleine Albright: The roles differ a bit in each society, but generally speaking, you need a government—whether it is a national or local government—to bring structure and rigor to the infrastructure process. In general, the public sector is responsible for ensuring, through both carrots and sticks, that infrastructure is developed in a way that is consistent with the best

interests and top priorities of the larger society. In urban planning, for example, the public sector plays a crucial role in developing the long-term plan and in thinking about laws to protect certain historic neighborhoods.

The public sector usually has role in the financing, when public finances or assets are involved. And as I said, infrastructure is more than cement, so there is a regulatory aspect where the public sector may have to play a critical role, especially if you are talking about the environment and natural resources.

In many cases, the private sector provides the actual labor to build and maintain infrastructure, and sometimes it is very specialized labor. We were in Istanbul for the 2012 Global Infrastructure Initiative conference, and I kept thinking: Can you imagine what it must be like to build a railway tunnel under the Bosphorus? So, infrastructure projects require a lot of people with specialized training and expertise and often the public sector doesn't have these people in house. Obviously the private sector can also play a critical role in financing and long-term planning.

You have to have confidence in your citizens, and the exchange of information builds respect and signals that you have confidence in one another.

McKinsey: *Does government have to demonstrate a certain level of stability and quality to attract and safeguard infrastructure investments?*

Madeleine Albright: I think this is a little bit of a chicken-and-egg question. Governance is based on people who actually know what is going on around them, and are supportive of it. And yet the public sector has to operate ahead of where the people are. Theoretically, the public sector is there to lead. And so, for example, if you have to move people and develop a different kind of community, I think it is very important to try to explain why it was necessary and how they are the beneficiaries of it.

Infrastructure projects can have positive effects and improve people's confidence in their government, which means that they are willing to pay taxes and see what the government comes up with. But the truth is that before a major infrastructure project can be undertaken, the government has to demonstrate

sufficient administrative capabilities, be able to prevent corruption, and demonstrate social stability, so that the planning process actually attracts investors.

Governance is a virtuous circle, if it works right. It is this exchange where the people have faith that their government is operating on their behalf. To earn that support, governments have to show that they are acting in the people's best interest, rather than on behalf of some elite group. The most effective governing structures have this exchange of confidence between the public sector and its citizens.

McKinsey: *How difficult is this confidence to achieve, particularly at a time when government coffers are under strain?*

Madeleine Albright: I spend a great deal of time working on this, and it is hard. We are living in a period in which there is not a lot of confidence in institutions because they have not delivered for their citizens. One of the topics I talk about



a lot is whether political development or economic development comes first. The truth is, they go together, because government has to deliver. I have this saying that people want to vote, but they also want to eat. So there has to be an incentive for having an elected government—what is the government going to do to improve the lives of its citizens. And that is why, for me, infrastructure is such a broad subject. You can build a road, but is it capable of making sure that the crops make their way into the city, so that urban markets have something to sell and people have food to eat? Government has to think about the broader effects of infrastructure development. We all do. The minute you decide that infrastructure is more than cement, you see it is pretty much everything.

McKinsey: *As you said, the effects of infrastructure reverberate everywhere. What can be done to address the environmental impact of infrastructure?*

Madeleine Albright: First, I think the challenge for engineers and builders is greater than ever,

given the volatility we are witnessing in the natural environment. It requires foresight, and we must think about what might happen not only in 10 years but also in 20, 30, and 40 years. And we all have a part to play in thinking about the environmental and social effects of the infrastructure process. You can build the most architecturally stunning city in the world, but will it matter if the traffic is impossible and the smog is so overpowering that you can't look out the window and enjoy the view?

One of the reasons I look forward to the Global Infrastructure Initiative is that we have the opportunity to discuss all of these topics—the challenges and opportunities that infrastructure presents. The conference gathers very different people with unique specialties and interests—everyone from the environmental engineer to the city official—and it underscores how dependent we are on one another. To address these issues and develop sustainable infrastructure that unifies communities, we have to work together. [O](#)



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Making the consumer case for major infrastructure

Infrastructure leaders who are looking to win public support for new projects can learn from industries that understand their customers.

**Dominic Maxwell,
Julian Mills,
and Stuart Shilson,**
McKinsey & Company

In the world of Twitter and citizen campaigns, of strained budgets and competing needs, infrastructure decisions will always be hard fought. But how are they won, and how should they be decided? Not just with technical arguments to the elite but with hearts-and-minds appeals to the public and a deep understanding of citizens' and customers' needs.

Infrastructure leaders who are considering new investments and looking to win public support can learn from their peers in consumer-focused industries, companies that define themselves—and live or die—by their ability to understand customers and to adapt quickly and precisely to emerging trends and preferences.

Incumbent operators, too, can apply these techniques. Holding a monopoly position, as they often do, makes it easy to pay little attention to the consumer. We are in an industry of hard hats and operational focus more than focus groups and customer segmentation.

But in the long term, returns from infrastructure always depend on the end customer who pays the bills. True, there will be regulation and political context, but ultimately, the best strategy for regulation and for stakeholder management, and the right strategy for the country, is a strategy centered on meeting the needs of consumers and citizens.

For example, Thames Water, a UK private utility company that provides water and waste treatment for 15 million customers in London and the Thames Valley, has prices strictly set by an independent, technical regulator. Its formally stated vision, though, is that “if customers had a choice, they would choose Thames Water.”

A strong focus on the customer does not mean every investment should go ahead, and the counterarguments on cost or local impact should sometimes be decisive. It does, though, mean that infrastructure planners and proponents should prepare the right facts and conduct the right research.

How can we refocus on the customer? From serving some of the largest companies in consumer goods and infrastructure, we suggest three steps:

- **First, think positive.** The best consumer companies are focused and disciplined about their brands’ positive value proposition and core emotional appeal, but the same is not always true for those making the case for infrastructure.
- **Second, think big by considering “catalytic” benefits to the economy.** Catalytic benefits are part of the standard framework of economic assessment and include broad impact on trade, investment, and industrial clusters. They are also part of a hearts-and-minds strategy that appeals to a far wider contingent. By speaking to the core of what a benefit does and feels like, they speak to issues of identity and pride.
- **Third, keep talking.** Consumer and retail companies make use of constant feedback from

their consumers through purchases, but the insights from systematic analysis of social media and “generated data” such as Google searches are valuable, and are also continuing to increase. To understand the conversation that they are in the midst of, infrastructure companies and planners should mine these insights.

Think positive

As mentioned, the first step for infrastructure companies is to think positive, learning from customer research in consumer-goods companies to deeply understand the specific, positive, and emotionally resonant appeal of their project. In many ways, consumer-goods companies have always known how to do this. Coca-Cola’s “brand emotion” is happiness and moments together, and each advertisement and brand presentation offers a variation on that theme. Its 2010 World Cup theme song, “Wavin’ Flag,” had more than 20 different variations appealing to different regions, but all played on the brand’s core emotion, happiness.

Similarly, stories of national progress and development, as well as the broader national narrative, are rife in advertisements for consumer goods in much of the developed world. Recurrent themes include unstoppable modernism (“now is our time”) and national destiny.

Beyond consumer-goods companies, research and writing on the power of emotion in thinking has exploded in recent years. Neuroscientists such as Antonio Damasio have helped us understand that emotion underlies, rather than opposes, reason. In politics, Drew Westen’s *The Political Brain* (PublicAffairs, 2007) popularized the argument that emotion, not reason, dictates individuals’ political decisions. From behavioral

economics, Daniel Kahneman's *Thinking, Fast and Slow* (Farrar, Straus and Giroux, 2011) argued that we are governed by a “fast and intuitive” system of thinking as well as a deliberative, logical system.

Those who believe that new transport and other infrastructure investments are crucial for a country's long-term future should be equally clear about their projects' positive value proposition and emotional brand.

The key to doing so is to ruthlessly prioritize and clarify which emotion is at stake. Is it national pride, national competitiveness, hope for the future, family and security, or something else? No retail proposition can win on every dimension—on price, quality, and convenience—and successful retail companies typically excel on just one or two dimensions of the “retail pentagon” (comprising price, range, service, experience, and convenience) and carefully map their strengths against competitors. Similarly, no infrastructure proposition can win on all points. With no message discipline, there is no message.

Beyond this, though, foundational research on the “motivation hygiene” theory or “dual factor” theory has long shown that while many preferences, often including avoidance of irritations, must meet a “hygiene” level, or minimum bar, they have no further energizing power once met. Motivating factors have continuing force.¹ Finding and emphasizing them is vital for success.

Think big

Building an emotionally compelling story around infrastructure is possible. In fact, it is common for politicians, who build their case from words rather than numbers.

When Governor Arnold Schwarzenegger made the case for high-speed rail in California, he said, “The faster we move economic goods—that's economic power, and this is why all over the world they are building high-speed rail”—appealing in one sentence to catalytic benefits, regional pride in economic power, and competitiveness with the rest of the world.² And when Russian President Vladimir Putin made the case for high-speed rail from Moscow to Kazan and Yekaterinburg, he said, “[Our funds] should be directed to projects that will change the face of the country and open up new prospects for development.”³

To do the same, to move from time savings or convenience to local and national pride, infrastructure leaders need to think big—and count big, quantifying the benefits that make this case.

There is a standard framework for cost-benefit analysis of major infrastructure investments, used by most major governments. It starts with the direct benefits for users and producers, including the monetary value of time savings and convenience. It then moves on to the multiplier effects, as money cascades from till to till, creating additional wealth. Finally, it tallies the catalytic impacts on underlying productivity.

But the theory almost invariably exceeds the practice, and the catalytic benefits are often ignored. Finding ways to expand the conversation and the measurements beyond the direct and multiplier effects to include the catalytic impacts is crucial to counting the full benefits of infrastructure.

For example, when the UK government quantified the case for expanding Heathrow airport in 2009, catalytic benefits were simply excluded.

The official assessment included a long list of potential catalytic benefits for “firms...enjoying the same broad location,” for “deeper markets,” for firms “reliant on air transport,” and for “the UK’s ability to compete in international markets.” At the end of this list, though, came the anti-climactic line that “it might be very difficult to quantify such benefits....[h]ence no estimate of wider economic benefits is included.”⁴

Similarly, there are few, if any, quantitative assessments of the catalytic benefits of some of the world’s biggest infrastructure projects, including the recently discussed California high-speed rail and Moscow–Yekaterinburg high-speed rail, and the EastLink toll road in Melbourne, Australia.

It is easy to see why. Many of the impacts are highly specific to context, prone to complicated feedback loops and tipping points, and unpredictable. As the evaluation of the United Kingdom’s high-speed rail conceded, “There is no ‘off the shelf’ methodology that is widely used in UK transport appraisal to assess the complex issues of productivity, trade, and regional economic competitiveness.”⁵

And yet the catalytic impacts—the wider economic benefits—can be enormous, changing the outcomes of cost-benefit analyses and transforming the prospects for hearts and minds. With one major piece of infrastructure on which we worked, the catalytic benefits were as big as the direct and multiplier effects combined. Intuitively, that makes sense: What would the economy of New York be without its subway system, or Memphis without its airport? An existing infrastructure asset can be fundamental to a regional economy, and a new infrastructure asset can transform one.

Infrastructure leaders can succeed at thinking big—at bringing to debates and analyses the full benefits of their project, including the catalytic ones, in three ways:

- **First, by pinning down causation with enough precision to be persuasive.** Would an airport increase exports? Prove it. The standard of evidence is constantly rising, and simple comparisons on cross-tabulations are no longer enough when sophisticated econometrics can answer the question more convincingly.



To move from time savings or convenience to local and national pride, infrastructure leaders need to think big—and count big, quantifying the benefits that make this case.

- **Second, by paying proper attention to space.** Infrastructure is intrinsically place specific, so analysis has to escape from the national, regional, or local to the level of individual business clusters and even individual companies. Thanks to the proliferation of data, clusters can now be mapped at a company-by-company, industry-by-industry, and street-by-street level. Doing so allows the benefits of infrastructure to be pinned down and quantified, allows those clusters to be mobilized as allies, and brings the argument alive for citizens. For example, Heathrow airport identified the aviation-using clusters in its region, including IT, and secured endorsements from Microsoft, BlackBerry, FM Global, and Electronic Arts.⁶
- **Third, by paying proper attention to time, with rigorous benchmarks.** Opponents of infrastructure projects will often suggest an alternative plan or location. Finding the nearest equivalent projects that match along the dimensions of geography, assets, and political context can be illuminating. Heathrow expansion, again, faced alternative proposals for a new airport in the Thames Estuary, with discussions of Heathrow's closure and redevelopment as a contribution

to the cost and source of alternative employment. They were able to point out that the old Hong Kong International Airport, with skyscrapers lined up to the airport fence, has been empty more than 15 years and is still undeveloped, and Denver International Airport took 22 years to complete; that Battersea Power Station, on the bank of the River Thames and moments from superprime real estate in London's Chelsea neighborhood, has taken more than 33 years to develop; and that Bankside Power Station took 19 years to be reopened as the Tate Modern.⁷ These projects helped change the perception about what the closure of Heathrow would mean for the local area.

Once identified and quantified, the catalytic benefits also need to be expressed in a way that means something to the ordinary user and citizen—translating it, in effect, from net present values and monetized equivalents to jobs, house prices, foreign investments, and industrial clusters, to create a compelling and tangible vision.

Keep talking

The third lesson for infrastructure leaders is to keep talking to consumers, as consumer companies do—developing a constant dialogue

beyond mere purchases. Once the message is developed and the appeal is pitched with suitable resonance, it needs to be continually fine-tuned and adjusted. The “brand personality” of the infrastructure project is often attacked and needs to be monitored and defended; continual conversation allows the infrastructure company to provide better service to users, ameliorate local impact, and generate greater loyalty.

And, as with consumer companies, infrastructure companies can increasingly draw more information from social media—from blogs, Twitter feeds, Facebook feeds, and search data. Buzz volume, for example, shows which arguments are “winning” and when conversation spikes, based on the number of messages, tweets, and blog posts. Sentiment analyses use algorithms to determine if social-media postings are positive, negative, or neutral. Accuracy is greater than 70 percent, and with smaller samples or more resources can be combined with manual analysis. “Word clouds” show relative prominence of ideas, measuring the frequency of occurrence of particular words. And detailed, systematic (and human) reviews of material can reveal a gap between the arguments that motivate social-media users

and how local or other groups express them to policy makers. Making full use of tools such as these, infrastructure leaders can start to understand more directly what the public may object to and how to address it.



Infrastructure investments can transform lives, regions, and nations. Without public support and a clear consensus audible from the cacophony of claims, interests, and beliefs, new investment is impossible. By thinking positively, thinking big, and continuing to talk, those interested in new infrastructure can stay focused on the needs of consumers, and win and keep public support. ○

¹ See Frederick Herzberg, “The motivation-hygiene concept and problems of manpower,” *Personnel Administrator*, January–February, 1964.

² “California Governor Arnold Schwarzenegger addresses our HSR conference,” US High Speed Rail Association, November 15, 2010, ushsr.com.

³ “JSC High-Speed Rail Lines,” 2014, eng.hsrail.ru.

⁴ *Adding Capacity at Heathrow Airport: Impact Assessment*, UK Department for Transport, January 15, 2009, nationalarchives.gov.uk.

⁵ *High Speed Two (HS2) Limited: HS2 Regional Economic Impacts*, UK Department for Transport, September 2013, kpmg.com.

⁶ *Heathrow: best placed for Britain*, Heathrow Airport, June 2013, heathrowairport.com.

⁷ Ibid.



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E before I: Why engagement needs to come first in planning infrastructure

Consulting stakeholders before digging makes for better, cheaper projects.

Isabel Dedring,
deputy mayor for
transport, London

When it comes to delivering essential infrastructure, experts tend to discuss what are perceived as the difficult issues, such as planning, financing, and construction techniques. Engaging with stakeholders and the public is not always mentioned—and if it is, it's way down the list. That job often gets farmed out to a public-affairs firm that may or may not have expertise in the specific subject.

Engagement is emphatically not a fringe issue. Across the world, failure to consult before digging has delayed or undermined projects that businesses and governments have set their hearts on building. Once the public gets wind of the plans, it's back to the drawing board. The

result is that deadlines are missed and costs rise. Sometimes, the plans are scuttled entirely. For example, a new airport at Notre-Dame-des-Landes in France has failed to move forward amid strong opposition from lobby groups.

The rise of social media has complicated matters, transforming the way much of the public gets its information. Without effective engagement, negative perceptions of a new project can spread quickly, even without help from traditional media. A citizen-led Internet campaign forced the British government to scrap plans for nationwide road pricing in 2007 and 2008. Social media is forcing everyone to think hard about how they inform the public—and increasing the risks of failing to do so.

As London's deputy mayor for transport, I have learned this firsthand. London has more than eight million people, all of whom seem to have strong opinions about our infrastructure plans. Every decision, from the £15 billion Crossrail project to extend and improve rail travel to the repainting of a local road junction, is a matter of intense public interest. We hear from stakeholders and lobby groups of all kinds—and we listen to them. As we seek to make our money go further, these discussions must be an early and integral part of project development.

This is about far more than appeasing the critics; there is real insight and benefit to be gained. Consider London's planned £1 billion in investment in cycling infrastructure. The number of Londoners cycling to work has more than doubled in the past decade, and the mayor of London, Boris Johnson, is a high-profile cyclist. People therefore expected city authorities to deliver policies to make cycling safer and easier. And we are doing so. But instead of developing a strategy and hoping that cyclists would be grateful, we worked with residents to craft one from the bottom up.

Using social media, we reached out to influential cycling bloggers and commentators; together we came to a consensus that the city needed to undertake major upgrades to physical infrastructure to make cycling safer and more attractive. On that basis, we put together a program of action that we presented to London's 32 boroughs for formal consultation. The result is a bigger program of investment in cycling over the next decade in London than in the rest of the United Kingdom combined. Measures such as a new east–west “Crossrail for the bike”—a dedicated cycle route and a network of joined-up, direct, dedicated cycle

lanes—are being established. By 2015, we will be spending £145 million a year on cycling, or around £18 per person in London. By 2023, that figure is set to reach £913 million, more than three times the previously planned amount.

Early engagement can also work for larger-scale, higher-cost programs. As we did with cycling, we consulted early and often to develop London's road strategy. We put together a road task force with a wide variety of stakeholders, from truckers and motorists' groups to businesses and cycling and walking groups. Despite their different (and sometimes competing) interests, members of the task force agreed on a £30 billion action plan over the next 20 years. The consultation actually helped to break the logjam of policy constraints, proving that wide engagement does not mean sacrificing clarity of purpose.

Our biggest transport project is Crossrail; in fact, this is the biggest construction project in Europe. Crossrail is designed to transform rail travel in Britain's southeast and will include more than 60 miles of new track and ten new stations. Two-thirds of the funding comes from the public sector, and half of that is from the central government. Given budget constraints, future megaprojects will not be able to rely on such high levels of public funding. Here again, better engagement can help.

The mayor has proposed the Crossrail 2 project, a new railway (with an estimated cost of £12 billion) connecting southwest to northeast London through the center. The stated goal is that “at least half of the project's cost can be paid for through private, or non-Exchequer, sources,” and the Crossrail 2 task force has identified ways to do so.¹ For example, by talking to businesses and property developers, we have been able to

fine-tune the route to take advantage of areas where land values are expected to rise the most. That increases the potential revenue stream provided by contributions from developers; they can be asked to contribute grant funding toward the cost of constructing nearby stations on the basis that a new station will increase the potential and value of their holdings. By engaging early, then, we put ourselves in a position to accrue substantial additional financial benefits.

There is still a lot to learn about how to make the most of opportunities from engagement. One area we are looking at is how to manage demand to make better use of existing infrastructure assets. We have already begun giving transport users better information about peak demand times—for instance, creating heat maps of demand at London Underground stations so that people

can plan their trips better by avoiding congestion. The data are interactive in the sense that passengers can use them to change how they travel. Deeper engagement, in the form of harnessing the viral potential and the capabilities of social media, will be at the heart of meeting this and other challenges. People respond to online engagement; so far, however, public authorities have not mastered when and how to engage digitally.

London has an ambitious 20-year pipeline of transport projects. By putting engagement at the heart of policy, we believe we will deliver better projects, tighter budgets, and clearer benefits. ○

¹ *Funding Crossrail 2: A Report from London First's Crossrail 2 Task Force*, London First, 2014, londonfirst.co.uk.



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Should the Olympics be shrunk?

An interview with Wolfgang Maennig

Olympian Wolfgang Maennig argues that it's time to reconsider ambitions for infrastructure when it comes to mega-events.

Rik Kirkland,
McKinsey & Company

Wolfgang Maennig, an economics professor at the University of Hamburg, focuses his research on real estate, transport, and sports economics. In this interview, he sat down with McKinsey's Rik Kirkland to discuss the nature of mega-events and to suggest a new approach to Olympic bids.

McKinsey: *One of the things you study is the economics of “mega-events.” What is a mega-event?*

Wolfgang Maennig: There are several ways to define it. One is by the number of participants. A second is by the number of spectators worldwide. Another is by impact. There's no consensus. But certainly things such as the Olympics, the World Cup, and maybe the Henley Regatta and Wimbledon are mega-events.

McKinsey: *What is the relationship between infrastructure and mega-events such as the Olympics?*

Wolfgang Maennig: It's time to greatly rethink the ambitions toward infrastructure connected with the Olympic Games. If you look back to the classical Greek Olympics, there was no idea of urban revitalization associated with the Olympic Games.

I think the mess started in 1992 when Barcelona, in a clever way, was able to attract a lot of money from the Spanish government and from the European Union to stage the Summer Olympics. The Barcelona authorities used the money to refurbish the city, and they did it very well.

But the problem is that, since then, cities are not applying for the Olympics because they want to have the best athletes in their city or because they want to be part of an Olympic experience but because they think they can press the national authorities to get money for infrastructure projects they otherwise would not have. In addition to that, the Olympic Games bidding process nowadays is like an auction, so that each city is overbidding the next—more and larger stadiums, a bigger airport, bigger staging, bigger streets, bigger railroad stations, and so on.

In the beginning, the International Olympic Committee (IOC) and the World Cup leaders liked it because if you spend a lot of money on the Olympics or the World Cup, it means that you have a decent impact, a legacy. Now, however, the IOC is noticing more public resistance in the host and potential bidding cities.

For example, for the Winter Olympics of 2022, right now, there are only bids from China and Kazakhstan. Poland and Sweden actually withdrew their bids because of lack of public support, and Austria, Germany, and Switzerland all considered bidding but pulled out for the same reason. After being encouraged to bid by Thomas Bach, president of the IOC, Norway also withdrew, citing the lack of public support for the expense. The Olympics and the World Cup are among the most attractive brands in the world, and their leaders are worried their reputation is getting damaged because of the criticism.

McKinsey: *Does hosting mega-events help the economy?*

Wolfgang Maennig: There have been a number of studies using statistical data from the host cities and host countries. As always in academics,

you find a range of opinions. But the overwhelming majority of these studies say that there are no significant effects from mega-events on income, employment, tax income, tourism, and so on. There might be other benefits, such as more medals for the host nation, a feel-good factor for the population, and a better reputation for the host city. But the positive “core” economic effects cannot be proved.

McKinsey: Should the process of bidding and choosing such events be different?

Wolfgang Maennig: Oh, definitely. It’s not only that we have to reduce the demand for infrastructure. It’s more fundamental. In my home city of Berlin, there was a public poll recently. Residents were complaining about increasing rents. So the public administration proposed building some 4,700 flats of affordable housing on a disused airfield in the middle of the city. In the poll, most Berliners rejected the plan.

There might have been several reasons, but I am sure one of them is that it might have been the wrong persons who proposed it. We have to accept that the credibility of the elites—and I am part of one elite group—has suffered in the past decade, and especially in the past five years. That’s true for athletes. It’s true for politicians. It’s true for economic and financial leaders. It’s true for all kinds of elites. So, we have to admit that although we think we know better, we cannot just propose a project and expect people to accept it. They don’t believe anymore that we know better. People think that they are at least as well educated as, let’s say, their political leaders. In fact, I would say that a large percentage of Berliners think they are more clever than the politicians. That might be true for other parts of the world as well.

Wolfgang Maennig



Vital statistics

Born in Berlin,
February 12, 1960

Married, with 2 children

Education

Habilitation, Technical
University of Berlin, 1991

PhD, economics, Technical
University of Berlin, 1985

Career highlights

University of Hamburg
(1992–present)

Professor of economics

ESCP Europe

(1991–95)

Professor of economics

Fast facts

Served as a visiting
professor at the University
of California, Berkeley
(2014), Massachusetts
Institute of Technology
(2014), Federal University
of Rio de Janeiro (2007),

and University of
Stellenbosch (2006).

Received the Olympic
Order in 2000 for
his contributions to
the Olympics

Was a member of the
eight-man crew that
won a gold medal in
rowing at the Seoul
Olympics in 1988; also
competed in the 1984
Olympics and has advised
German authorities
on several bids for large
sporting events

So if I urge Berlin to go for an Olympic bid, I think we should start with a web-based participation process where the people could write down what a Berlin Olympic concept could look like. Then there will be a Delphi process—some ordering of what would be thousands of suggestions. It would all be transparent. And then you have a second round of involvement. We'll come up with a concept with many new ideas.

I think that would be an innovative and different kind of Olympic bid. For example, I'm sure there would be a proposal not to build anything new. We might propose instead to use the Olympic swimming pool Berlin constructed for the 2000 Olympic bid. According to the capacity requirements of the International Swimming

Federation (ISF), this arena is too small, so the ISF might resist.

But I'm quite convinced that many other competitors would follow the proposal not to build a new swimming arena, too. This would really make sense for the Olympics, because it has become a rat race for bigger and bigger infrastructure. The federations would have to adjust to the needs of the Olympic cities and not the other way around. Historically, remember, some of the early Olympics in the modern era were just part of, or parallel to, big international exhibitions. That was the case for Paris in 1900, St. Louis in 1904, and London in 1908. There was little or no new construction for those Olympic Games. ○



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Making the most of a wealth of infrastructure finance

Spending money, not raising it, is the biggest problem when it comes to financing infrastructure.

**Tyler Duvall,
Alastair Green,
and Mike Kerlin,**
McKinsey & Company

The world will need to spend almost \$57 trillion on new infrastructure over the next 15 years, according to the McKinsey Global Institute. That's an enormous sum, but contrary to popular belief, there is no shortage of capital; in fact, there will be more than enough as both governments and investors increase their focus on infrastructure.

The past five years, for example, have seen a steady rise in the number of institutional investors allocating assets to infrastructure, as well as the establishment of infrastructure as an asset class in its own right. At the same time, thanks to an increased appetite for direct investing by limited partners and the entrance onto the scene of giant sovereign-wealth funds, more money is in play. Meanwhile, multilateral and development-finance

institutions are stepping up their efforts. The pool of capital available is deep. Across infrastructure funds, institutional investors, public treasuries, development banks, commercial banks, corporations, and even retail investors, we estimate that more than \$5 trillion a year is available for infrastructure investment.

While capital is, of course, necessary, it is not sufficient to ensure success. The money has to be focused on the right projects and then spent judiciously. Here are five principles that can help infrastructure providers make good choices.

1. Establish realistic revenue streams to encourage private financing.

There are two primary sources of revenue for

investors in infrastructure. The first is public funds and the other is revenue streams in the form of charges, such as tolls, paid by end users. Historically, government has assumed most of the burden, particularly in emerging markets. But the scale of infrastructure required makes attracting private investment critical.

To do so, projects in difficult-to-finance areas such as roads and water should take their cue from telecommunications. This sector manages to attract investors even in capital-poor countries because it offers a clear return on investment and predictable cash flows. In many cases, particularly in developing countries, people have become accustomed to paying little or nothing for water or roads. But they do, of course, derive benefits, economic and otherwise, from such projects; moreover, there needs to be a way to pay for maintenance. If charging users offers a realistic prospect of covering capital or operating costs, then doing so makes sense, assuming this arrangement makes provisions for low-income users, ensuring they are not overburdened.

To replicate the telecoms model for other kinds of infrastructure, governments should ensure that charges reflect the economic costs. Even a well-structured project will fail to attract private financing if prices are set too low; in that case, the public sector will be forced to cover all the costs.

The roads sector illustrates the difficulty of setting appropriate prices. Drivers in many countries are unaccustomed to paying for using roads and therefore resist such efforts; for example, violence and mass boycotts arose in response to efforts to introduce charges for heavy-goods vehicles in France and urban tolls in South Africa's Gauteng Province. Moreover, persuading treasury departments to set aside toll revenues for road improvements is difficult. Tolls can be insufficient,

and there is always a temptation to divert them elsewhere. Because of these factors, we expect around half of all proposed road projects to go unfinanced and thus unbuilt in the years ahead. That adds costs with respect to congestion and the difficulty of moving goods.

The same is also true of wastewater; the beneficiaries of sewage systems, meaning everyone, often do not contribute to the cost of cleaning up the water. This is particularly true of developing markets, due to the inability to impose and collect charges. In too many cases, that means wastewater is left to pollute the landscape or, worse, seep back into the water supply. However unpopular doing so may be, governments need to set prices for such projects so that investors can earn a reasonable financial return. Otherwise, the systems will not get built.

Once governments have structured projects to provide stable and appropriate revenue streams, they can begin to figure out which ones to do first. Setting priorities is important, particularly in developing countries that have severe fiscal constraints. South Africa's National Development Plan contains dozens of road, port, and rail projects, including both public and private financing. Its Department of Public Enterprises has flagged several components, including a new coal terminal and a container port, for private investment. These represent investments that would be attractive to private firms.

One way of making investments attractive is to package smaller projects together; pooling project revenues and risks in this way can attract major investors who might otherwise see the individual projects as too small to bother with. The Metropolitan Waterworks and Sewerage System in Manila used this approach to partition and privatize its two water-service areas. The 1997

privatization resulted not only in significantly improved access for the city's population, but also in healthy local-currency returns for the corporate owners of the Manila Water Company.

2. Focus on finding the right types of capital.

Having a lot of capital available for infrastructure doesn't mean the right type of money will be there. Privately financed infrastructure projects require both debt and equity to manage risks and satisfy debt investors, who typically take the lion's share of project costs. We forecast Brazil to have a surplus of debt for infrastructure in coming years but a shortfall in equity financing, due to public indebtedness, a devaluing currency, and highly leveraged corporate balance sheets. And Brazil is not alone. Consequently, many projects will fail to find financing simply because there isn't enough equity to attract the debt required to complete the transaction.

Development banks can help to fill the equity gap, and in fact, many are scaling up their commitments. For example, the World Bank Group's International Finance Corporation

invests more than \$1 billion per year in infrastructure equity and has increased its firepower in recent years by launching a global infrastructure equity fund alongside private-sector investors. In October 2013, the effort successfully completed a \$1.2 billion fund-raising, well above the \$1 billion target.

Capital is also flowing from nontraditional sources. Some countries require their mandatory pension funds to invest part of their resources domestically. This has helped generate a pool of resources suitable for domestic infrastructure investing. In the small town of Glynncoch, Wales, local crowdsourcing finances construction of a new community center without formal government support. Eliminating the legal barriers to crowdsourcing could ensure that personal, not just institutional, capital can help to build the future.

3. Encourage investors to consider emerging markets and greenfield assets.

A sophisticated understanding of countries, regions, and projects is necessary to match capital from investors, developers, and government sponsors alike with the infrastructure projects

Eliminating the legal barriers to crowdsourcing could ensure that personal, not just institutional, capital can help to build the future.



that need it. Simply put, investors need to deal with each emerging market individually and to harness local knowledge on the way.

That may sound obvious, but it needs to be said. The fact is, many investors (or their limited partners) restrict themselves to Organisation of Economic Co-operation and Development (OECD) or investment-grade countries. Others will not take on “greenfield assets”—new-build infrastructure projects where investors must take on the risk of development and construction. Instead, they prefer to focus on already-built brownfield assets. But as more money flows into brownfield OECD markets (industry data provider Preqin has estimated that the number of institutional investors in the sector more than doubled between 2011 and 2014), heightened competition is placing pressure on returns. Although measuring precise changes in such investments is difficult, many institutional investors with long track records are looking beyond brownfield OECD infrastructure assets in response to rising prices.

Investors who want to consider these types of opportunities should be aware that doing so could mean taking calculated risks in emerging markets; adopting a country-by-country approach to risk assessment is important. In addition, those investors would first need to ensure that limited-partner agreements allow them the flexibility to invest in what may be considered riskier countries, as long as these markets meet certain criteria.

For instance, if investors consider a country like Croatia, they would find that although the three major rating agencies rate the country as subinvestment grade, Croatia has an attractive public–private partnership (PPP) regime. The Economist Intelligence Unit rates it well ahead of its peers in southern Europe in many ways, and it has a more favorable legal and regulatory profile than a number of countries that do better at attracting capital. Infrastructure projects in countries like Croatia that fall just outside investment grade (rated BB+ through BB– by Standard & Poor’s) account for \$4 trillion of infrastructure needs over the next five years.

Smart investors will deploy a variety of tactics—such as assessing the risk profiles of potential investments and partnering with local sponsors and development-finance institutions—in order to pursue high-growth projects where fewer players are at the bidding table.

4. Realize value from cash-generating assets.

Many governments, particularly in developing markets, are missing the chance to tap a viable source of cash in the form of generating value from existing assets. The world’s infrastructure stock is valued at an estimated \$48 trillion. Some of these assets are already profitable, while others could turn a profit if operations improved and subsidies declined. There are examples at hand. Greece’s government recently agreed to sell a network of 14 regional

airports to a consortium, and in 2013, the Brazilian government sold for nearly \$800 million a 30-year concession to operate Confin Airport in the state of Minas Gerais.

Reforming or privatizing state-owned infrastructure presents challenges, of course. An asset may operate at a loss, have a difficult labor situation, or need to be untangled from other businesses unsuitable for privatization. Despite these complexities, purchasing these assets can yield greater returns from selling assets or turning money-losing assets into profitable ones. For example, Jordan's Queen Alia Airport once required a government subsidy to operate; a private-sector operator not only has invested in its expansion but also makes enough money to pay fees back to the government.

5. Deepen partnerships among infrastructure-finance players.

The infrastructure-finance market is plagued by a lack of information. Governments and businesses aren't in the habit of sharing best practices or benchmarks with each other, much less the details of what went wrong (or even right). Governments, investors, developers, and operators alike would benefit from sharing more information and in more structured ways. Many governments recognize that developers can be a valuable source of ideas—for example, about which projects would have the best economic returns or how to attract private investment. Early evaluation of project plans can help prospective bidders warn governments if the project looks unviable.

One way to take advantage of the ideas and expertise of private-sector developers is to allow them to submit unsolicited proposals for infrastructure projects to government. Brazil and Colombia, which are two of the busiest and most promising infrastructure markets in South America, all accept such proposals. Other entities are seeking to open new channels of communication. For example, the Port Authority of New York and New Jersey has invited private investors and developers to share their perspectives on how to develop the region's infrastructure. Tanzania's government uses "delivery labs" of public, private, and social-sector experts to set infrastructure-investment plans. Chile has developed a way of evaluating PPP projects that rewards developers for proposing low-cost solutions to national-infrastructure problems. As each of these approaches becomes successful, private players become more comfortable and more willing to participate, and the public sector becomes more willing to pay attention.

It's common today to hear that too much capital is chasing too few infrastructure assets. But the problem is not a lack of worthy projects; it's a lack of expertise and, perhaps, daring. Investment opportunities need to be appraised and prepared properly, and investors need to educate themselves. Marrying investors to assets will require more effort, more innovation, and more thoughtfulness on the part of government and business, but this is vital in order to ensure that there is sufficient investment in infrastructure to support global growth. ○



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Making a better match between institutional investors and infrastructure investments

Matching up infrastructure projects and institutional investors is difficult. Better knowledge of how infrastructure assets will behave and new ways to monitor performance can help.

Frédéric Blanc-Brude,
research director,
EDHEC-Risk Institute

Why is it so difficult to match long-term money with long-term investment projects such as new infrastructure? Policy makers have certainly made a priority of the search for new ways to finance long-term growth.¹ At the same time, institutional investors have recognized the need for alternative long-term instruments to help meet long-term commitments such as pension payouts or insurance policies. Yet matching investment demand (for new infrastructure) and supply (from institutional investors) remains elusive.

Simply put, better matchmaking requires creating new knowledge about the expected behavior of underlying infrastructure assets and portfolios. Infrastructure investing today is not yet a relevant

asset-allocation question for institutional investors, and until it becomes one, the relative size of their investment in infrastructure will remain marginal.

There are several reasons why matching up institutional investors and infrastructure projects is difficult:

- The *first generation of infrastructure-investment products* was not well suited to long-term investors' needs and has prompted a backlash among the largest investors.
- More important, a *knowledge deficit* about what "investing in infrastructure" actually means prevents investors from examining such long-term investment decisions at the relevant strategic asset-allocation level.² This gap also

tends to reinforce the view among regulators that infrastructure investment is highly risky.

- Needed *performance monitoring* is lacking.

In fact, long-term investment in unlisted and highly illiquid assets like infrastructure projects significantly increases investors' demand for performance monitoring in ways that the private-equity and debt sectors have been unable to respond to so far. The task is to overcome a substantial collective-action problem to standardize reporting and improve benchmarking.

The infrastructure story so far

Investing long term in illiquid infrastructure assets is a strategic asset-allocation decision. Ideally, investors should make it based on an investment benchmark that allows them to take a robust view on the expected performance of such investments. However, such benchmarks do not exist for infrastructure assets. The paucity of relevant data and the absence of a clear definition of what is meant by “infrastructure” mean that only remote proxies can be used as benchmarks. Moreover, the kind of reporting that private-equity managers typically use, focusing on internal rates of return and investment multiples, is fundamentally inadequate for the purpose of benchmarking investments in an asset-allocation context.

In the absence of adequate investment benchmarks, investors' growing interest in infrastructure assets stems from what we call the “infrastructure-investment narrative.”³ The notion is that infrastructure assets uniquely combine the following characteristics:

- low price elasticity of demand, therefore low correlation with the business cycle
- monopoly power, hence pricing power, hence an inflation hedge

- predictable and substantial free cash flow
- attractive risk-adjusted cash yield, available over long periods
- the opportunity to invest in unlisted assets

In other words, infrastructure investment *implies*:

- improved diversification
- better liability hedging
- less volatility than capital-market valuations

The narrative is itself a model in that it describes the characteristics of the average infrastructure project. It is also a benchmark (albeit one that does not rely on any empirical observations) upon which investors must rely to form their expectations about such investments, and thus make allocation decisions.

However, this infrastructure-investment story has not so far proved easy to buy. First, most free cash flow in infrastructure projects goes to debt instruments (predictable cash flows tend to lead to significant balance-sheet leverage), and few infrastructure-debt investment solutions existed until very recently.

Another reason is that gaining exposure to infrastructure equity has been mostly limited to two routes: the so-called listed infrastructure and unlisted private-equity funds, or “infrastructure funds,” the immense majority of which are clones of leveraged-buyout funds with similar investment time frames, fee structures, and use of fund-level leverage. As we at EDHEC have pointed out,⁴ in our opinion, neither listed nor unlisted infrastructure-equity products have delivered the “narrative” suggested above (exhibit).

A knowledge deficit

It should surprise no one that the disconnect between the investment narrative and the

Exhibit

Research findings about the performance of infrastructure equity show listed and unlisted products have not followed the narrative.

Expected behavior	Listed infrastructure	Unlisted infrastructure private-equity funds
Low risk	No	No
Low correlation with business cycle	No	No
Long term	No	Exits after 5–7 years
Excess returns	No	Yes, but fund-level leverage
Limited drawdown	No	No (credit cycle)
Inflation protection	No	No

Source: Frédéric Blanc-Brude, *Towards Efficient Benchmarks for Infrastructure Equity Investments*, EDHEC-Risk Institute, Jan 2013, edhec-risk.com

observed performance of available investment products occurs because there is little clarity about what “infrastructure investment” means in the first place. The definition of the underlying asset often remains vague and is subject to considerations about “real” assets and assumptions about the characteristics of firms in certain sectors. As a result, descriptions of the infrastructure sector often employ a series of industrial classifications such as utilities, transport, energy, water, public buildings, and so on, but no widely agreed-on definition. Observers and practitioners alike rely on the proverbial wisdom that they shall know it when they see it.

Lacking a clear definition of what “infrastructure” actually is, it’s also not surprising that no clear picture emerges from the evidence on the performance of existing infrastructure-related investments. These strategies do not stem from well-identified mechanisms at the underlying level corresponding to remunerated risk factors.

They are simply ad hoc asset-selection schemes in the listed and unlisted spaces.

Since investors remain largely ignorant about how infrastructure equity and debt portfolios might behave, it is virtually impossible to understand infrastructure investment from a strategic asset-allocation standpoint. Assembling the necessary ingredients to take a long-term view on infrastructure investing requires the ability to document expected returns, risk measures, and correlations. That can only start with a clear and well-accepted definition of underlying assets and a transparent proposal about the investment strategy, including the use of leverage and the effective number of bets that a portfolio of infrastructure assets can be expected to correspond to.⁵

In effect, meeting investors’ needs for better knowledge of the performance of infrastructure assets and investment strategies determines the

extent to which they are able to invest in such assets. Moreover, the absence of knowledge about performance also leads to a regulatory dead end: when faced with unknown quantities, prudential regulation penalizes long-term unlisted bets, further distorting allocation decisions.⁶

Of course, this lack of knowledge about the performance of infrastructure assets is not new. It was also not a particular problem as long as investing in long-term unlisted assets played a minor role in the (relatively small) alternative investment allocations that large institutional investors made. Until recently, most of them did not invest in alternatives at all.

However, once investors consider making substantial allocations to infrastructure investment, ranging from a few percentage points to almost a fifth of their assets in some cases, the absence of better knowledge about long-term unlisted investments becomes an impediment to new investment. This partly explains why investors have remained mostly on the sidelines rather than making greater forays into the infrastructure sector.⁷

Wanted: Long-term performance monitoring

What we know about the long-term behavior of illiquid assets is likely to evolve and improve. As a result, long-term investors need more than just a benchmark to make their initial asset-allocation decisions; they also need to be able to monitor performance in order to continuously update and enhance their knowledge. Long-term

investors tend to be more active shareholders and require greater monitoring. However, in the case of infrastructure investment, the failure to deliver adequate performance measurement and monitoring has led to an unfortunate retreat from the delegated-investment model.

Wide-ranging academic research documents how investors' demand for firm monitoring is an increasing function of their investment horizon.⁸ But if long-term equity investors tend to be active shareholders, they are also passive investors whose asset-allocation decisions require forming long-term expectations about risk and returns—that is, investment benchmarks. In the case of frequently traded assets, market prices provide the basis for forming these expectations. In effect, private monitoring efforts by large block holders contribute to market efficiency, since these efforts also benefit other stockholders. In turn, the market also provides monitoring benefits to long-term investors by processing information that is not available privately.⁹

Likewise, investing in infrequently traded assets requires a long investment horizon. But without the feedback of market prices, forming long-term expectations about risk and returns is less straightforward. It follows that investing in unlisted equities like infrastructure further increases investors' demand for monitoring. As with listed firms, a long-term investment horizon creates incentives to monitor performance to preserve or improve shareholder value, but the illiquid nature of unlisted firms creates a second motive for monitoring: investment benchmarking.



Investing in unlisted, illiquid firms with a long-term horizon also requires specialist knowledge and should typically lead investors to delegate this process to investment managers. Unfortunately, the current delegated model of private-equity investment mostly fails to respond to investors' monitoring needs. This is most apparent with the kind of performance reporting offered by private-equity managers.

For example, two associate professors at the Saïd Business School in Oxford and HEC Paris, respectively, propose a comprehensive critique of the performance monitoring of typical private-equity funds.¹⁰ They show that pooling individual investments and internal rates of return (IRRs) for funds creates misleading results, because IRRs cannot be averaged; IRRs are grossly inadequate for the purpose of asset allocation.

With private-equity managers unable to deliver satisfactory performance measurement and monitoring, a number of large institutional investors have ceased to delegate their investments in unlisted firms. Instead, they have brought in-house the function of acquiring and managing infrequently traded assets such as infrastructure. Canadian pension funds, a few large European pension funds, and sovereign-wealth funds are leading this trend of investing directly in illiquid assets.

Bringing investment and monitoring functions in-house is not necessarily an improvement, however. Delegating monitoring tasks to a specialist agent should boost efficiency. But a number of large investors have decided to exit delegated private equity altogether because information asymmetries between investors and managers can be so large that the benefits

of delegation go unrealized. Nevertheless, bringing the function in-house creates other costs. In particular, it can be difficult to create a well-diversified portfolio of large illiquid assets such as infrastructure-project equity.¹¹ Investors are now engaged in individual project selection even though they still haven't answered the asset-allocation question. Moreover, this approach is only available to very large investors that can bear the full cost of deal sourcing and the ongoing management of their portfolio companies.

Faced with a retreat by such large accounts as the Canadian pension industry, why are private-equity managers not offering to improve their monitoring and reporting so that investors can benefit from delegation while making well-informed asset-allocation choices? In effect, some managers are already evolving toward new private-equity models that allow investors to gain the kind of longer-term exposure they require. Moreover, the tendency for institutional investors to create large or very large unlisted equity allocations is a recent development; the need to monitor and benchmark performance has only recently become more pressing.

The failure of the private-equity industry to provide satisfactory monitoring for large investors is also a problem of collective action. Most of the necessary information is private. Dissemination and data collection, when it exists, is ad hoc and relies on existing practices instead of promoting data collection according to the requirements of robust asset-pricing methods. Private-equity managers could be more transparent and aim to provide performance measures that are more relevant to long-term investors. Taken individually, however, not one has access to enough information to answer the private-equity asset-allocation question.

Direct investment in infrastructure projects is not a panacea for institutional investors, even large ones.

Clearly, there is a role to play for policy makers and academics in overcoming this collective-action problem and supporting the standardization of data collection and the creation of adequate investment benchmarks for the purposes of long-term investing in unlisted assets. Without such improvements, it will remain considerably more difficult for long-term investors to make allocations to infrastructure-related products.

The way forward

Effectively and efficiently matching up long-term institutional investors with long-term illiquid infrastructure assets will require two actions that must work in concert: preserving the benefits of delegation to a specialist manager who can act on behalf of an active asset owner, and enforcing sufficient long-term performance monitoring and benchmarking to allow a passive investment stance, which can be justified as a strategic asset allocation.

Direct investment in infrastructure projects is not a panacea for institutional investors, even large ones. Instead, the benefits of delegation should prove significant if the information asymmetry between investors and managers can be reduced by creating new knowledge to inform investors' asset-allocation decisions.

We propose a step-by-step road map to help resolve the question of how relevant to investors infrastructure investment can be. Our approach requires a multistakeholder effort to reveal the characteristics of infrastructure assets at the underlying and portfolio levels and reduce existing information asymmetries between investors and managers. This road map has eight elements:

1. Definition. The first step on the road to relevant infrastructure-investment solutions for institutional investors is an unambiguous definition of the underlying instrument, as a financial asset.

2. Valuation and risk-measurement methodology. With a clear and well-accepted definition of underlying instruments, it is possible to develop adequate valuation and risk-measurement methodologies that take into account infrequent trading. By "adequate" we mean that such methodologies should rely on the rigorous use of asset-pricing theory and statistical techniques to derive the necessary input data, while also aiming for parsimony and realism when it comes to data collection. The proposed methodologies should lead to the definition of the minimum data requirement, which is necessary to derive robust return and risk estimates.



3. Data-collection requirements. While ensuring theoretical robustness is paramount to the reliability of performance measurement, a trade-off exists with the requirement to collect real-world data from market participants. In particular, proposed methodologies should aim to minimize the number of inputs in order to limit the number of parameter-estimation errors. Adequate models should also focus on using known data points that are already collected and monitored or could be collected easily. In all cases, data requirements should be derived from the theoretical framework, not the other way around. In turn, whether the necessary data already exist or not, this process will also inform the standardization of investment-data collection and reporting.

4. Reporting standards. Standardizing infrastructure-investment data collection should enable the emergence of an industry-wide reporting standard that investors and regulators alike can recognize. Such a reporting standard would increase transparency between investors and managers, who would now be mandated to invest in a well-defined type of instrument and commit to report enough relevant data for investors to benefit from their specialized monitoring.

5. Investment benchmarks. The investment profile of the underlying assets spans expected returns, risk, and market correlations. Once these have

been documented as well as the existing data allow, it is possible to design investment benchmarks to reflect the performance of a given strategy (for example, maximum Sharpe Ratio) for a given investment horizon.


6. Investment solutions. These investment benchmarks can serve as the basis for the development of various standard or tailored investment solutions by the industry, including different types of funds with explicit horizons and risk profiles.

7. Regulation. The robust performance benchmarking of unlisted infrastructure equity portfolios also has direct regulatory implications for risk-based prudential frameworks like Solvency II, the directive codifying EU insurance regulation. For example, the benchmarking should permit calibrating a dedicated unlisted infrastructure submodule in the context of the Solvency II standard formula, or usefully informing investors' internal risk models.

8. Public procurement. Finally, documenting the financial performance of unlisted infrastructure is relevant for the design of public-infrastructure tenders and contracts. It is the opportunity for the public sector to involve investors early in the design of public-infrastructure contracts with a measure of investment performance that has been validated academically and recognized by industry.

At EDHEC, we have begun following this road map. In our publications, both recent and upcoming, we propose a number of solutions to make infrastructure investment more relevant to institutional investors. As a first step, we suggest that well-defined underlying instruments can be found in project-finance debt and equity, which embody many of the aspects of the infrastructure-investment narrative and can be modeled and calibrated.¹² We also develop valuation and risk-measurement

methodologies for project-finance equity and debt that are consistent with modern asset-pricing theory, while relying on standardized data inputs that are as succinct as possible and that can be easily collected.¹³

The EDHEC-Risk Institute will continue to implement these steps with its partners over the coming years, including the creation of infrastructure debt and equity investment benchmarks. 

¹ Long-term investment in infrastructure was a key topic during the 2013 Russian presidency of the G20 and was high on the agenda of the 2014 Australian presidency.

² Numerous research papers have demonstrated the primacy of asset allocation in investment management. Asset-allocation decisions explain most of the variability of investment outcomes. See William F. Sharpe, "Asset allocation: Management style and performance measurement," *Journal of Portfolio Management*, 1992, pp. 7–19; Michael J. Brennan, Ronald Lagnado, and Eduardo S. Schwartz, "Strategic asset allocation," *Journal of Economic Dynamics and Control*, 1997, Volume 21, pp. 1377–1403; and Roger G. Ibbotson and Paul D. Kaplan, "Does asset-allocation policy explain 40, 90, or 100 percent of performance? Authors' response," *Financial Analysts Journal*, 2000, Volume 56, pp. 16–19.

³ See Frédéric Blanc-Brude, *Towards Efficient Benchmarks for Infrastructure Equity Investments*, EDHEC-Risk Institute, January 2013, edhec-risk.com.

⁴ Ibid.

⁵ See Noël Amenc, Felix Goltz, and Ashish Lodh, *Alternative Equity Beta Benchmarks*, EDHEC-Risk Institute, August 2012, edhec-risk.com.

⁶ The current debate about the role of long-term investment in Solvency II, the directive that codifies EU insurance regulation, illustrates this point. See Frédéric Blanc-Brude and Omneia R. H. Ismail, *Response to EIOPA's Consultation on Standard Formula Design and Calibration for Certain Long Term Investments*, EDHEC-Risk Institute, 2013, edhec-risk.com.

⁷ For example, Australia may be a pioneering market for infrastructure investment, but Australian super funds only invest 3 percent of their assets in infrastructure.

⁸ See Andrei Shleifer and Robert W. Vishny, "Large shareholders and corporate control," *Journal of Political Economy*, 1986, pp. 461–88; Nemmara K. Chidambaram and Kose John, "Relationship investing: Large shareholder monitoring with managerial cooperation," New York University working paper, NYU Stern School of Business Research Paper Series, FIN-98-044, November 1998, stern.nyu.edu; Xia Chen, Jarrad Harford, and Kai Li, "Monitoring: Which institutions matter?," *Journal of Financial Economics*, 2007, Volume 86, pp. 279–305; Elyas Elyasiani and Jingyi Jia, "Institutional ownership stability and BHC performance," *Journal of Banking & Finance*, 2008, Volume 32, pp. 1767–81, and "Distribution of institutional ownership and corporate firm performance," *Journal of Banking & Finance*, 2010, Volume 32, pp. 606–20; and Najah Attig et al., "Institutional investment horizon and investment–cash flow sensitivity," *Journal of Banking & Finance*, 2012, Volume 36, pp. 1164–80, edhec-risk.com.

⁹ See Bengt Holmström and Jean Tirole, "Market liquidity and performance monitoring," *Journal of Political Economy*, 1993, pp. 678–709.

¹⁰ See Oliver Gottschalg and Ludovic Phalippou, "The performance of private-equity funds," *Review of Financial Studies*, 2009, Volume 22, pp. 1747–76.

¹¹ See Blanc-Brude, *Towards Efficient Benchmarks*.

¹² See Frédéric Blanc-Brude and Omneia R. H. Ismail, *Who is Afraid of Construction Risk? Portfolio Construction with Infrastructure Debt*, EDHEC-Risk Institute, 2013, edhec-risk.com, and Blanc-Brude, *Towards Efficient Benchmarks*.

¹³ See Frédéric Blanc-Brude and Omneia R. H. Ismail, *Valuation and Risk Measurement of Unlisted Infrastructure Equity Investments and Valuation and Credit Risk of Illiquid Infrastructure Debt Instruments*, EDHEC-Risk Institute, 2014, edhec-risk.com.



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Using PPPs to fund critical greenfield infrastructure projects

For institutional investors and government agencies, greenfield infrastructure projects are ripe with opportunity. By structuring them as public-private partnerships, both parties have better chance of meeting their individual goals.

Thierry Déau,
CEO and founding
partner, Meridiam

Julien Touati,
corporate-development
director and investment
director, Meridiam

The global infrastructure funding gap is now widely acknowledged: approximately \$57 trillion must be invested in infrastructure to maintain GDP growth through 2030, according to the McKinsey Global Institute.¹ The World Bank Group has offered similar estimates.² Given the long life span of most infrastructure assets—from 15 to more than 100 years—a higher share of global savings will have to be allocated to infrastructure in coming years. The fast-growing savings managed by institutional investors—estimated at \$75.1 trillion in 2011 by the Organisation for Economic Co-operation and Development—must play a central role.

Funding for infrastructure projects can take a number of forms, including non-infrastructure

financial products (such as government bonds, infrastructure-related corporate equity, or debt products) and dedicated *pure* infrastructure financial products. The focus of this article is the latter. Dedicated infrastructure financial products include unlisted equity investment in infrastructure and infrastructure project debt. To date, these products represent a limited share of institutional investors' asset allocation—less than 5 percent on average, but more than 10 percent for large investors, such as Canadian and Australian pension funds. However, this share is growing, and this asset class is becoming more noteworthy to investors and, subsequently, to regulators.

A particularly interesting area is so-called greenfield infrastructure—or new infrastructure—

projects, which are developed as public–private partnerships (PPPs). While PPPs represent a limited share of total infrastructure investments, they are gaining speed. In the United Kingdom, the new framework to fund low-carbon energy-generation projects, the so-called Contract for Difference scheme, strongly resembles a traditional PPP. Also, PPP schemes are becoming more popular in mature economies like the United States and are expected to play a major role in addressing the infrastructure challenges of fast-growing economies like Africa's.

Why greenfield infrastructure is attractive to institutional investors

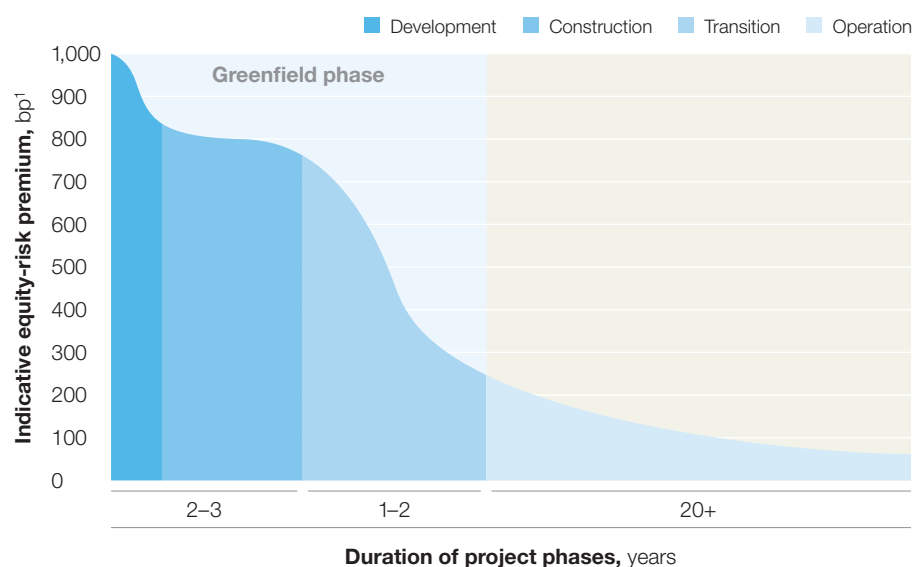
Traditional infrastructure-market players, such as governments and utilities, are under financial

pressure, and their budgets are strained. They are increasingly looking to private investment to fund infrastructure projects. PPPs can offer a number of benefits, including a whole-life costing approach that optimizes construction, operation, and maintenance costs, better risk management, and efficient project delivery. Well-structured PPPs can help ensure that greenfield projects are delivered on time and within budget and at the same time generate attractive risk-adjusted returns for investors.

Investors that enter a project in its early stages can capture a premium of several percentage points. Such a return usually takes the form of patient capital, or long-term capital. Investors must wait for the end of the construction period before

Exhibit 1

The indicative risk premium and timeline for an infrastructure investment varies by project phase.



¹Basis points.

they can expect a project to begin generating yield. Depending on the complexity of the project, this can take five years or longer (Exhibit 1); for instance, high-speed rail projects are known to be on the longer end of this timeline. However, investors in patient capital are willing to forgo quick returns for greater long-term returns. Typically, while investors in patient capital expect a return, they also value the economic and social benefits of a project.

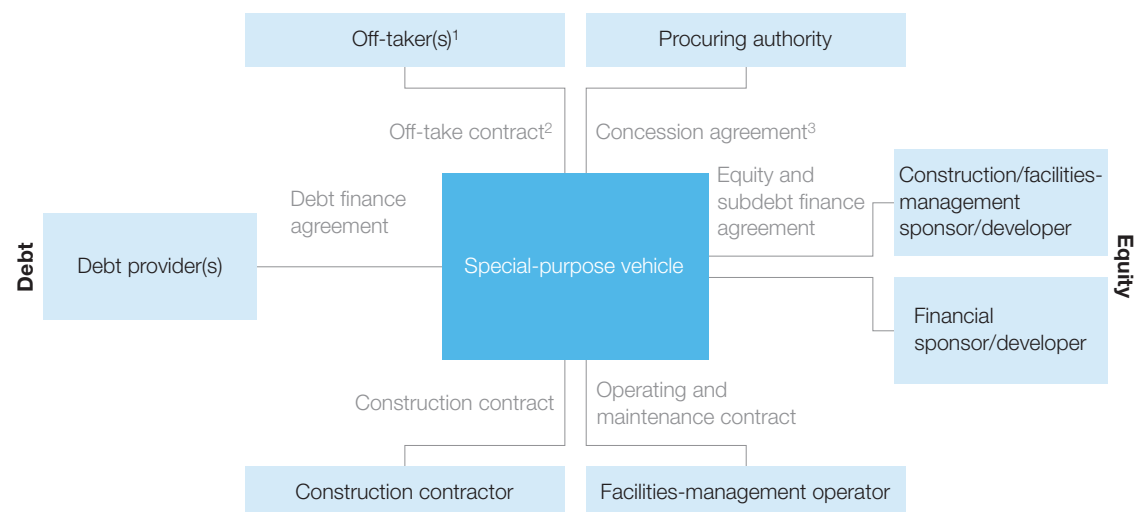
To secure this premium, investors must ensure that the risks associated with a project are properly managed. Greenfield projects usually begin with a clearly defined contractual framework that allocates risks to the most natural owners. Exhibit 2 illustrates a generic,

multicontract framework that will be familiar to project-finance professionals.

Contract frameworks bring structure and discipline to the execution of greenfield infrastructure projects. For example, the construction risk associated with greenfield projects is typically greater than brownfield projects. By transferring construction risk to experienced contractors and by establishing fixed prices and specific design and build deadlines, project managers and investors can protect against the delays and cost overruns that can plague infrastructure projects. The impact of such rigor can be significant: according to experts, the average cost overrun is below 3.5 percent for project-finance schemes—

Exhibit 2

A project-finance structure identifies parties and agreements.



¹ The off-taker is the party buying the service or product that the project produces.

² An off-take contract specifies the price and volume of the future product and helps ensure a market for it.

³ A concession agreement concedes the use of a public infrastructure asset to the project company for a specified period of time.

in particular PPPs—and close to 27 percent for a traditionally procured project.³

For investors to secure long-term returns, contracts must address the key risks inherent to all infrastructure projects, not only greenfield projects. Examples include revenue and volume risk, which relate to the effective use of the infrastructure at expected tariff levels (for instance, road traffic), or the availability and affordability of a critical input (for example, gas supply to a gas-fired power plant). These risks can be managed through risk-sharing mechanisms like minimum traffic guarantees from public authorities and long-term off-take agreements.

Political risk assessment and management is also essential over the long term. An infrastructure asset is captive by essence, and its performance relies on the willingness of local counterparties to respect the commitments made at inception. Managing this risk over the long term typically involves focusing on critical assets with proven added value (for example, a strategic urban-transportation project or a power plant essential to national energy supply), negotiating robust contractual agreements, and fully addressing the environmental, social, and governance aspects of all infrastructure projects. Project participants that do this are more likely to secure and sustain support from key government stakeholders and simultaneously protect their investment over the long term.

What government can do to encourage investment

Because investment in infrastructure is based on specific assumptions regarding the stability of legal frameworks and public policy over a projected investment period, government agencies can take several steps to encourage PPPs. One, governments are more likely to attract long-term

investment if they can provide a clear pipeline of investment opportunities. Investors will develop internal knowledge and skills in a specific sector, such as infrastructure, only if concrete investment opportunities exist. Similarly, government agencies must establish clear guidelines and reasonable timelines from project announcement to award in order to convince investors to develop their internal skills. Put another way, to make development risk manageable for investors, procurement agencies must avoid any “stop and go” when launching infrastructure projects. This will be instrumental to building credible pipelines of investable opportunities and enabling institutional investors to actually engage.

Two, long-term investment requires visibility into cash flow. PPP frameworks, and in particular, contracted cash flows, provide this visibility and also ensure predictability. Predictability, in addition to the natural correlation of cash flows to inflation, contributes to the attractiveness of PPP projects for institutional investors seeking assets that match their long-term goals. Still, some industries that are of great importance to the public sector suffer from a lack of investment predictability. The power sector in Europe offers a case in point. Securing funding for critical facilities such as thermal power plants is proving more difficult when revenues are derived from European deregulated wholesale markets. In the United Kingdom, where merchant and regulated energy assets did not typically benefit from the visibility that private-finance-initiative assets could provide—specifically with regard to appropriate mitigation of a change in law or public policy, force majeure, or hardship risks—low-carbon facilities may be at an inflection point.

This is also the case in the rest of Europe, where regulated power transmission and distribution

networks are better suited to short- or medium-term private-equity strategies, because visibility on tariffs is typically limited to five years.⁴ In contrast, the power sector in Africa, which is dominated by PPP-like independent-power-producer projects, can be considered more predictable by long-term investors. By providing greater and enduring visibility to investors, typically under contractual arrangements akin to PPPs, European governments could attract long-term investors in the power sector.

Three, financial regulations help ensure economic and financial stability. They also affect long-term investment. Government agencies must think strategically about how regulations can encourage long-term investment in infrastructure projects and whether they reflect the risk-reward equation of these nuanced investments. For instance, it will be interesting to see how Europe's forthcoming Solvency II framework evolves and potentially affects infrastructure investment. Regulations should also be built on hard data. For example, an academically validated index for equity investment in infrastructure projects will be instrumental to ensuring that all parties are aware of the financial realities associated with greenfield infrastructure.

Finally, government agencies can play a key role in addressing market failures, either directly or through public development banks. They can act as facilitators and provide credibility to

infrastructure projects. By funding transactions or supporting active market players, development banks provide a powerful signal to the private sector. Their presence suggests political support and stability over the long term. In addition, dedicated financial instruments—such as guarantee instruments, long-term funding, seed investment, and early-development stage facilities—can encourage long-term investment.



Channeling wealth and savings into productive investments, including greenfield infrastructure, will be essential for the global economy to grow. This is a historic opportunity for institutional investors and governments around the globe to secure both financial stability and performance and at the same time contribute to long-term growth fueled by efficiently managed infrastructure. ○

¹ Richard Dobbs et al., “Infrastructure productivity: How to save \$1 trillion a year,” McKinsey Global Institute, January 2013, mckinsey.com.

² *Capital for the Future: Saving and Investment in an Interdependent World*, World Bank Group, 2013, worldbank.org.

³ See Frédéric Blanc-Brude and Dejan Makovsek, “Construction risk in infrastructure project finance,” EDHEC Business School working paper, February 2013, edhec.com.

⁴ In Belgium, Italy, and Spain, the current regulatory period for electricity-transmission activities is four years; in Germany, it is five years. The only exception is the United Kingdom, where the Office of Gas and Electricity Markets now offers eight-year visibility on tariffs.



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Energy infrastructure:

Seizing the opportunity in growth markets

In some of the most promising markets, supply of and demand for reliable energy has outpaced infrastructure. For discerning investors, the opportunity to fund energy infrastructure is significant.

Arif Naqvi,
group chief executive,
The Abraaj Group

More than 35 million Kenyans, 80 million Nigerians, millions of Ghanaians, and countless others in growth markets live without electricity. Some experts call this “light poverty.” But it is misleading to suggest that this unwired population—many of whom live in urban areas—cannot afford to pay for power or that governments cannot provide it. For many, a steady supply of electricity and gas would lower their cost of living by replacing inefficient, costly sources of energy such as kerosene and batteries.

The growth economies of Africa, South Asia, and Latin America are grappling with an energy-infrastructure investment gap. Existing power grids are limited, weak, and subject to

outages; generation is insufficient. In sub-Saharan Africa, nearly 70 percent of the population lacks access to electricity, and those with access find it unreliable. According to the African Development Bank, the region needs to invest approximately \$42 billion per year in energy infrastructure over the next decade. A similar gap exists in South America; in Peru, it is estimated at close to \$33 billion.¹

Investment can influence growth. For example, if Africa had invested an additional 3 to 5 percent of GDP in energy infrastructure, experts calculate that it could have gained \$0.7 trillion to \$0.9 trillion in incremental GDP from 2000 to 2010. Still, I believe that investing in new energy

infrastructure is not about stimulating economic growth in these countries—rather, it’s about sustaining it. Growth markets are outstripping developed economies with respect to GDP growth. A majority of the global middle class² lives in growth markets, and that proportion is expected to increase significantly in coming years. Demand for reliable, affordable electricity from homes and businesses will only rise. The capital needed to close this infrastructure gap represents a unique investment opportunity.

The demand side of the energy story is well documented. However, many growth economies are not merely customers for oil and gas; they also have extensive natural resources of their own. Nearly one-fifth of the world’s oil reserves are in Latin America. Africa holds almost 8 percent of oil reserves, in addition to shale oil and gas deposits. By 2030, 71 percent of global fuel supply is expected to come from markets that are not part of the Organisation for Economic Co-operation and Development (OECD). Energy transportation and storage infrastructure will be critical to extraction and distribution to the end consumer.

The reality is that in many of these markets, energy infrastructure must be built, as few existing assets are operational. Many global investors are hesitant to commit their capital to greenfield infrastructure, where development and construction risk is greater, particularly in non-OECD markets. Such thinking views growth economies as a monolith and overlooks the attractive rates of return such investments deliver. Rather than placing a blanket risk premium on all growth markets, I would encourage investors to take a closer look and recognize those countries that have transformed their investment environment in recent years. We have identified a number of key

growth markets that have created an outstanding investment environment for energy-infrastructure projects by combining viable project pipelines with a regulatory environment that mitigates risk.

Kenya is one such example. The country has an exemplary history of commissioning independent power plants from private investors and paying the agreed-upon tariff through its supply company, Kenya Power, while minimizing off-take risk and providing a strong, bankable credit. Kenya also intends to bring 5,000 megawatts—including 1,600 megawatts of geothermal energy—online in the next 40 months. Investors in geothermal projects can opt to invest after the initial exploration phase or take advantage of new insurance products coming onto the market.

Nigeria, another dynamic economy, will face a 13-fold capacity shortfall by 2020. The country needs massive investment to provide new capacity and replace existing diesel plants. The rising cost of diesel generation, combined with attractive feed-in tariffs for renewables, has created a major opportunity for solar-energy projects that generate a good rate of return and undercut existing power sources. A program to privatize ownership of ten newly built gas power plants has attracted interest from more than 100 investors around the world. Nigeria, like Kenya, waives duty on power-generation equipment. With the right approach, investments in Kenya, Nigeria, and other select jurisdictions can deliver excellent risk-adjusted returns.

Investing in energy-infrastructure projects is not without complexity. On the contrary, investors need to draw on technical expertise to ensure that projects are sound. As investors we demand bankability, but how we get there differs from

A majority of the global middle class lives in growth markets. Demand for reliable, affordable electricity will only rise. The capital needed to close this infrastructure gap represents a unique investment opportunity.

place to place. Adapting to each growth market's unique conditions requires flexibility in the capital structure and security provisions for each project. And to be successful, investors need a deep understanding of how the project will be built, how it will behave over its lifetime (including the various risks at each stage), how to control life-cycle costs, and how to deal with the unique risks and challenges of each host country. These complexities and nuances can be addressed. Experienced developers with a deep understanding of the rules, regulations, and customs of the local market are well positioned to deliver successful projects in conjunction with their financial partners. However, financial partners need to expand their role, moving beyond providing capital to bring deep operational, technical, and geographical expertise.

In 2009, The Abraaj Group assumed operational control of Karachi Electric Supply Company (now known as K-Electric), a vertically integrated power utility in Pakistan. While there was latent and rising power demand in the area, underinvestment had left the company stagnant. We put together a comprehensive turnaround

plan, and over the next four years, the company curbed losses in transmission and distribution, decommissioned old power plants, and built new ones. As a result, it has generated positive earnings before interest, taxes, depreciation, and amortization since 2011 and reported positive net income in 2012 and 2013—after 17 years of losses.

The energy-infrastructure challenge is a unique investment opportunity that will pass when the infrastructure in growth markets catches up with that in developed regions. Although investor appetite is growing, competition among investors still lags behind more mature markets. Investors with deep local knowledge and in-house technical and operational expertise who partner with experienced developers will find quality investments that meet—and exceed—their needs. ○

¹ *The Report: Peru 2014*, Oxford Business Group, 2014, oxfordbusinessgroup.com.

² For the purposes of this article, the global middle class is defined as households with daily expenditures between \$10 and \$100 per person in purchasing-power-parity terms.



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Removing the roadblocks to smarter investment in American transportation

US infrastructure is aging, while the population is growing. To improve the transportation system, argues the secretary of transportation, the United States needs more funding and less red tape.

Anthony Foxx,
US secretary
of transportation

In 1894, the American photographer William Henry Jackson traveled around the world, documenting how different nations moved their people and their goods. Jackson's photographs, commissioned for an exhibit at Chicago's Field Museum (then known as the Columbian Museum of Chicago), feature everything from pack elephants in Hyderabad to dog sleds crossing Russia's frozen Amur River.

What's truly remarkable about Jackson's photos, though, is not how they differ, but what they share: each nation, he showed, needed to tame its terrain, connect its peoples, and knit together a changing world.

In the 120 years since Jackson's journey, not much has changed in this respect. By that I mean that if we commissioned similar pictures today, they would show that countries everywhere, despite their differences, still need to invest in transportation.

There are data, not just old photographs, to prove this. According to the World Economic Forum, the world is spending \$1 trillion less than it needs to on infrastructure every year. (That price tag includes public works other than transportation, such as power plants and telecom networks, but transportation is the largest single item.)

Of course, the kind of investment needed depends on the place. Some nations must maintain older infrastructure. Others must build new. Most must do both.

The United States falls into this last category. Our infrastructure is aging. As President Obama points out, America has 100,000 bridges old enough to qualify for Medicare. The US Department of Transportation estimates that there are more than 63,522 “structurally deficient bridges”—meaning that they require repair or should be replaced altogether.

At the same time, future trends demand that the US transportation system be expanded. Here is just one reason why: the United States will be home to up to 100 million additional residents by 2050. To support them, we’ll have to move 14 billion additional tons of freight—almost twice what we move now.

I believe that we can address our challenges in a way that is both instructive to—and in partnership with—the international community. As we see it at the Department of Transportation, there are three priorities.

First, we have to increase spending above and beyond recent norms. European nations, on average, invest 5 percent of GDP in infrastructure; the United States, only about half as much (including state and local funding). It is also important to make sure that the flow of money is stable and continuous. That is not happening.

Over the past six years, Congress has funded transportation through 28 short-term measures. Former mayors like me know that uncertainty undermines state and local leaders. When states

don’t know if, or how much, federal funding will be available, they start to pull projects off the books and halt construction. This exacerbates underinvestment because such delays make projects more expensive. For these reasons, my department has been pushing for more investment in transportation and also for a multiyear approach to funding transportation with a bill called the GROW AMERICA Act.

Second, while it’s true that the United States cannot solve transportation problems without a funding bill, it is also true that we can’t solve all of our challenges exclusively through public funding. We must also look to the private sector.

To this end, we’re working on a government-wide effort to encourage more innovative financing strategies, such as public–private partnerships, to help narrow the infrastructure deficit. For example, we are working to create a new one-stop shop where those interested in investing in transportation can learn more about financing options. Once this is established, everyone from state and local government officials to private developers and international investors can find out what kind of financing models might work best for them. We will also help them better understand our department’s credit, loan, and other programs.

Third, we need to address a common (and fair) criticism of US transportation projects: They move too slowly. One of the biggest barriers to private investment in public works is red tape. For instance, the permitting process for a bridge may take years before a shovel is ever put in the ground. Every nation looks at permitting differently, but I think the general principle that the Department of Transportation is advancing is a universal

one. Rather than one government agency having to approve a project before the next can review it, we're moving toward a system where all these reviews happen concurrently. For New York's new Tappan Zee Bridge, this meant that the permitting process, estimated to take up to five years, was completed in just a year and a half.

We're doing something similar when it comes to the environmental oversight. Rather than conducting environmental reviews project by project, we will cover many projects with a single review. The challenge is to make this happen on a broad scale. If we do, the result

will be lower project costs—and that means that we can do more with our transportation budget.

None of this will be easy. There are many obstacles to improving US infrastructure, including high project costs, budget deficits, political resistance, and engineering difficulties. But many other countries are confronting the same challenges; they know that *not* facing them is not an option. The nation that successfully maintains and modernizes its transportation is a nation that plays to win on the world stage.

The United States must be such a nation. ○



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The infrastructure conundrum: Improving productivity

**Infrastructure productivity can and should be much better.
Here's how to start improving.**

**Nicklas Garemo,
Martin Hjerpe,
and Jan Mischke,**
McKinsey & Company

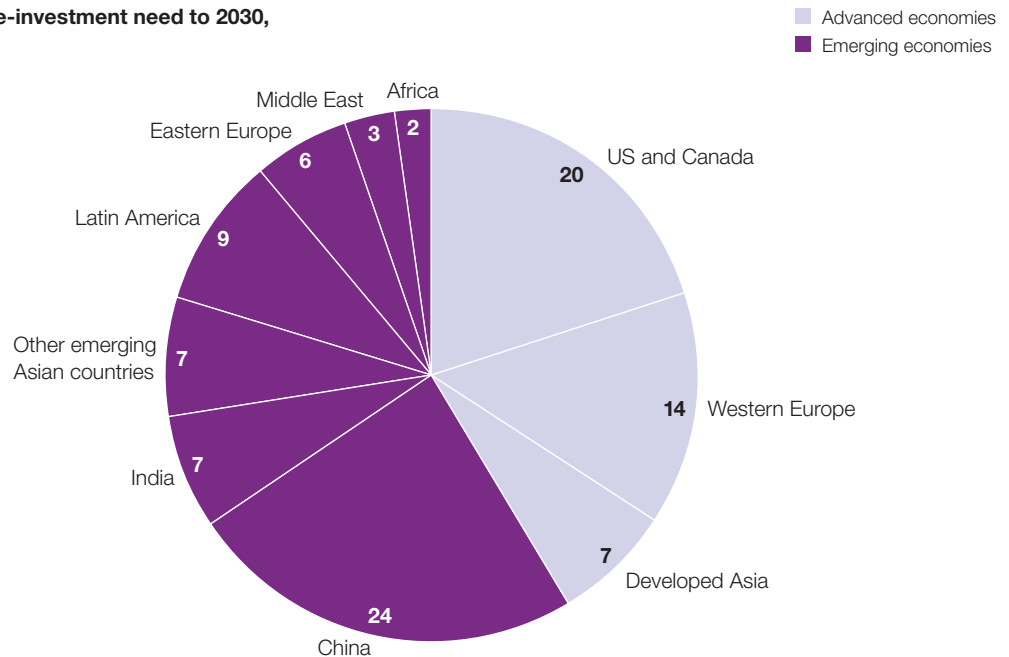
From now through 2030, the world will need to spend at least \$57 trillion to build the ports, power plants, rails, roads, telecommunications, water systems, and other infrastructure that the global economy needs.¹ For advanced economies, the priority is to renew aging and dilapidated infrastructure; for emerging ones, it is to build the structures required to support growth—this is the larger part of the total bill (Exhibit 1). Our research, based on 400 global case studies,² suggests that governments could boost infrastructure productivity by \$1 trillion a year in three ways: improving project selection, streamlining delivery, and making the most of existing investments. None of these actions requires radical change, and successful examples exist.

1. Project selection. Beyond palpable abuses of spending power, the more common problem is that decisions about whether or not to build are sometimes made without considering the larger socioeconomic objectives of the country. This happens when officials look at projects one by one rather than considering how each particular project fits into the entire portfolio. Or they do not evaluate whether other projects might have better returns. This matters: research shows that countries that take the time to get the planning right are able to eliminate noneconomic projects and reduce project overruns in the projects they do launch. The key is to create a rigorous, transparent, and fact-based process to decide what needs to be done, and in what order (see sidebar, “Infrastructure diagnostic”).

Exhibit 1

Emerging economies account for 60 percent of required infrastructure investment.

Infrastructure-investment need to 2030,
%



Source: McKinsey Global Institute

None of this is easy; in fact, it is almost bewilderingly complex. Take trying to calculate the socioeconomic benefits of a project. The relatively simple part is to calculate the direct benefits. This proposed road, if built, will shorten travel time by X minutes, and there are Y thousand people traveling every day, adding up to Z time saved. But that is only the beginning. With a better road, companies can recruit in a wider region, finding higher-skilled labor. How can that be calculated?

Additionally, decisions are sometimes made on a political basis rather than an economic one. There can be a lot of horse trading: “I agree on this project if you agree on that one.” Even more common

is a simple lack of knowledge. McKinsey has found cases where the cost of infrastructure in one country was up to 50 percent higher than in a neighboring country with similar characteristics—a discrepancy driven by different approaches to design, engineering, management, procurement, and sourcing.

Despite these challenges, there are ways that project delivery can be improved. One example is Infrastructure Ontario (IO), a corporation owned by the province of Ontario that provides a wide range of services to support the government’s initiatives to modernize and maximize the value of public infrastructure and real estate. Over the past decade, IO has implemented a long-term investment

plan and essentially rebuilt the province's hospital infrastructure, building more than two dozen new structures. IO has organizational independence, clear responsibilities, and a close partnership with the private sector. South Korea's Public and Private Infrastructure Investment Management Center is a similar organization; it has saved 35 percent of the nation's infrastructure budget by rejecting 46 percent of projects that it reviews, compared with 3 percent before it was established. The United Kingdom set up a cost-review program that identified 40 major projects for prioritization, reformed overall planning processes, and then created a cabinet subcommittee to oversee delivery. These measures reduced spending by as much as 15 percent.

2. Streamlining project delivery. In simple terms, "delivery" refers to getting the job done. Both the supplier and the client bear responsibility for this, and both parties can often fall short.

In the construction sector, labor productivity, when measured in real value added per hour worked, has been flat or worse in many developed economies for decades. In the United States, productivity in the construction sector has fallen about 20 percent since 1989; in the rest of the country's economy, it has risen almost 40 percent. Germany has seen the same trend, to a slightly lesser degree, since 1991 (see "Thinking of infrastructure globally, acting locally," on page 77).

One reason for stagnating productivity is the construction industry's structure. For smaller projects, the sector is fragmented; the ten largest companies account for only 3 to 4 percent of global market share. Therefore, there are limited scale efficiencies, investments, and innovation. At the top end, for bigger projects, there are sometimes not enough capable bidders to compete. What's more, incentives are usually structured such that neither the agents representing the public nor the contractors are rewarded for innovating and taking risk.

It is a core responsibility of governments to provide infrastructure. However, this area typically accounts for less than 5 percent of the budget. As a result, infrastructure often receives less attention than it should. There are ways for government to increase the focus on infrastructure while also saving money. Convolutioned permit and land-acquisition processes are major causes for cost overruns. By accelerating these processes, governments can cut costs. They can also improve management of contractors, by rigorously tracking their performance. These are important tasks, but ones that tend not to receive a lot of political credit.

In addition, infrastructure is a long-term investment, which can lead to complications when it intersects with the political cycle, which is often much shorter. It's not uncommon for a government



to plan a project, and then run into numerous problems. The next government will go through a lot of pain to actually build the planned project and face the bad press for any overruns. Then the third government cuts the ribbon and takes the praise. None of the three is accountable from end to end. There is little incentive to invest and plan well right from the start.

Then, there is the human element. In most projects, the skill set and capabilities of the project manager makes the difference. McKinsey analysis has found that only about 20 percent or so of project managers routinely deliver projects under budget and on time. A small minority are clearly unfit for the work. The bulk of people in the middle sometimes do well and sometimes not so well. Building their capabilities could lift productivity significantly.

An investment in early-stage planning, typically spending 3 to 5 percent of the total projected cost, is critical to improving project delivery. This involves making the commercial case as well as completing the technical drawings, specifications, risk assessments, and environmental and social-impact analyses. Eager to break ground, clients often rush this phase, later landing in trouble. Banks and donors often do not want to fund early-stage development but should insist that it occur; not investing in planning often leads to disaster. Preliminary McKinsey research has found that countries that consistently invested 1 percent or less up front experienced much larger overruns in time and costs that reached 50 percent or more. In one drastic example, the owner made 42,000 change requests in the course of a single project.

3. Underutilization. The cheapest, least intrusive infrastructure is that which doesn't have to

be built. "Intelligent" transportation systems, which use advanced signaling to squeeze more capacity out of existing roads and rail lines, can sometimes double asset utilization at a relatively low cost. Active traffic management on England's M42 roadway, for example, directs and controls the flow of traffic; this has reduced journey times by 25 percent, accidents by 50 percent, pollution by 10 percent, and fuel consumption by 4 percent—at only 20 percent of the cost of widening the road.

Pricing mechanisms and improved maintenance are other ways to increase existing capacity. But such simple fixes are underused, often for political reasons. Take congestion charges. If there is no charge to use the road at 6 a.m. and a \$5 fee an hour later, some people will move their commuting time to save money, smoothing out demand. That is the theory, and it has worked in Riga, Singapore, and even central London, where the red-and-white "C" (see the image on page 63) has become a familiar urban icon. The Panama Canal also uses congestion pricing, and so do many airports and railways, charging more to the boats, planes, and trains that want to use the facilities at more popular times of day. In each case, the result is that more traffic moves along, with fewer jams.

Although effective, congestion charges provoke opposition. There are ways, however, to make a case for their implementation. One is to demonstrate success. In Stockholm, residents were clearly ready to vote "no" on a referendum on the subject, so city authorities decided to test the idea by running a pilot plan for six months. When people saw how the system worked—traffic at peak hours fell by 20 percent—their opinions changed, and they voted to approve the program in 2006.

Infrastructure diagnostic

Getting policy right requires putting together the right information, and then drawing the right conclusions. But when it comes to infrastructure there's a problem: the information doesn't exist.

Competitiveness rankings from the World Economic Forum and the International Institute for Management Development business school measure the availability of infrastructure. The Construction Sector Transparency Initiative and country- and sector-specific benchmarks, such as the UK Cost Review, measure costs. The International Monetary Fund's proposed Index of Public Investment Effectiveness compiles data on transparency, audit standards, and internal controls to evaluate governance. To complement these metrics, we have developed a three-part infrastructure diagnostic. It provides a comprehensive assessment of infrastructure delivery and offers a database of more than 500 examples of good and best practices.

Part 1. Establish a starting point. What's the state of the infrastructure? Does planned funding match future needs? Where are the biggest improvement opportunities?

Part 2. Measure effectiveness and productivity. Five areas are evaluated: project selection, funding and finance, delivery, asset utilization and maintenance, and governance. These five areas can be broken down into 30 categories and 78 subcategories, each representing a global best practice. For each category, we also codify average and low performances against a set of clear criteria, providing a basis for scoring each government's performance.

Part 3. Define outcomes. What's the cost of delivering a road in Country X compared to next-door Country Y? Do projects come in on time and on budget? Do they meet quality

requirements? How many changes are required after first sign-off? The diagnostic considers quantitative indicators on availability, cost, and time to come up with an aggregate outcome, and also creates a basis for benchmarking.

The diagnostic compares participants not only against global best practices but also across regions, asset classes, and time. For each of the 78 categories, there are clear descriptions of good, average, and bad performance by international standards. Each category is scored from one (worst) to five (best). The final score, based on 400 criteria, reflects all participant responses. The goal is to help governments compare their performance, and also to learn from one another—something that doesn't happen nearly often enough.

Using the diagnostic, infrastructure providers can figure out where they are compared with their peers. Bad? Average? World class? This assessment can be done over the course of a day, a week, or a month.

So far, we have done roughly a dozen case studies, and some interesting patterns are emerging. One is that even the best countries score an average 3.7 out of 5.0, so there is room for improvement everywhere. Another is that in almost every single case, there are issues with capabilities and data, such as lack of an effective program manager and standard international benchmarks.

The diagnostic is and should be a moving target. Over time, many of the 500 best practices will only be good practices, as countries learn and improve. The assessment can work at different geographical levels—country, regional, or city—and with different asset classes. The strength of the diagnostic is that it provides a fact base in which to ground discussion. It marks the beginning of a systematic effort to analyze global infrastructure performance.

Another way to lower the cost of infrastructure is through better maintenance. Maintenance is not glamorous; in fact, it is time-consuming and sometimes tedious, and not nearly as exciting as cutting the ribbon on a new project. However, if assets are allowed to deteriorate, the costs of both operation and reconstruction increase markedly. And when countries do not make

the most of what they have, they need to build new structures, which is much more expensive.

Leading countries avoid this in part through good timing. They schedule maintenance often enough to avoid dilapidation and breakdowns. But they also seek to do so at the right times, to keep disruption to a minimum. The World Bank Group has estimated, for example, that if African

Exhibit 2

Most countries need to step up investment significantly.

Infrastructure investment gap,¹ % of GDP

Needed investment for 2013–30 growth vs historic investment for 1992–2011

North America

United States	–1.1
Canada	–0.8

Advanced Europe

United Kingdom	–0.9
France	–0.7
Germany	–0.6
Denmark	–0.6
Sweden	–0.5

Portugal	0.5
Spain	0.6
Switzerland	1.0

Emerging Europe

Bulgaria	–1.4
Hungary	–0.8
Russia	–0.6
Poland	–0.2
Czech Republic	0.1

Latin America

Brazil	–2.7
Mexico	–2.0
Chile	–1.3

Africa

DRC ²	–2.1
Egypt	–1.0
South Africa	–0.1

Asia-Pacific

Indonesia	–3.0
India	–2.2
South Korea	–0.2
Australia	0.7
China	2.1
Japan	2.4

¹ Gaps indicated relate to future growth projections, not to historic underinvestment nor to growth aspirations different from projections.

² Democratic Republic of the Congo.

Institutional investors have sufficient funds to finance all the world's infrastructure needs—as long as the projects are attractive. Even in poorer countries, the lack of access to money is not the problem. The challenge is to make investors feel confident that they will get their money back.

nations had spent \$12 billion on road maintenance in the 1990s, this would have led to savings of \$45 billion in reconstruction costs.

The role of money

Money plays a part in all three issues. If countries learned from one another with respect to best practices in productivity, cost cutting, and other practical measures, we estimate that total infrastructure spending could be reduced by almost 40 percent. It would be ideal—but unlikely—to recover that figure. Still, it gives an idea of the scale of the opportunity. One interesting development: the B-20, a business group that offers policy recommendations to the G-20 group of industrialized nations, has proposed setting up a “global infrastructure hub” to exchange best practices and develop benchmarks. In most countries, the annual spending needed to bring infrastructure up to the level required far exceeds what they have spent historically (Exhibit 2). In North America and Western Europe, the gap ranges between 0.5 and 1.1 percentage points of GDP per year and rises to 2.0 to 3.0 percentage points in Brazil, India, and Indonesia. Fiscal concerns have only made the infrastructure gap

wider. This is such an enormous investment, especially given the fiscal constraints that many nations face, that the all-too-common response has been paralysis.

Institutional investors and others have sufficient funds available to finance all the world's infrastructure needs—as long as the projects are attractive. Even in poorer countries, the lack of access to money is not the problem. A vibrant bond market in Malaysia has contributed more than half of the private-sector infrastructure investments since the early 1990s. The challenge is to make investors feel confident that they will get their money back by capitalizing sensible projects that will be completed and then run well.

Even so, there is often a sizeable gap between the resources that are needed and the resources that are available. Public–private partnerships (PPPs) can help narrow that gap. But project-specific financing represented only around 20 percent of total infrastructure investment in the boom year of 2008 and collapsed to around half that level a year later. PPPs with private financing remain small in comparison to

traditional public or corporate financing by utilities and other private-infrastructure owners.

Still, there is a larger benefit to PPPs: they bring the discipline of the private sector to risk assessment, evaluation, and construction. Many PPPs also entail a 20- to 30-year concession that includes operations and maintenance. That long-term responsibility encourages the partnership to optimize the total cost of ownership, so there is no cutting back on maintenance. In this sense, PPPs have enormous potential. But they need to be managed carefully, with recognition of their limits.

Governments acknowledge the importance of infrastructure productivity, but most initiatives seem to assume that private-sector involvement will guarantee high productivity without improvements in planning, delivery, and governance. This attitude fails to recognize the efforts required to deliver complex PPP projects successfully and results in missing opportunities to raise infrastructure productivity. Moreover, just because capital is private does not guarantee it will be deployed perfectly; both the conditions of the contract and the capabilities of the provider need to be scrutinized.

Public financing is going to continue to be dominant. Particularly in the developed world, this money

is cheap—well below 3 percent for ten-year government bonds in the United States and the United Kingdom. Public financing is especially important as a way to provide lower cost of capital in cases where risk is difficult to measure. In large, high-risk greenfield developments such as high-speed-rail networks, it may be the only option. To work most effectively, governments should provide certainty on infrastructure budgets beyond annual budgeting or electoral cycles, such as Sweden's ten-year plans for national transport. Capital recycling can free up funds for major projects; the Australian state of New South Wales, for example, has announced plans to sell off some publicly owned assets, such as ports and regional airports, to finance new investment.

Money is necessary to build the infrastructure the global economy needs, but it is not enough. Governance, commitment, and more than a little imagination are also required. As it is, the world spends much more money than it should for the results it gets. Even small improvements would bring huge benefits. ○

¹ If other forms of infrastructure are included, such as those associated with energy, mining, and real estate, the figure could be as much as \$9 trillion a year.

² For more, see the full McKinsey Global Institute report, *Infrastructure productivity: How to save \$1 trillion a year*, January 2013, on mckinsey.com.



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Inspired infrastructure

The secret to hitting a moving target is to aim slightly ahead of its trajectory. Stakeholders in infrastructure design, construction, and management face a similar challenge in working to develop cities capable of sustaining us tomorrow.

Uwe Krueger,
CEO, Atkins

At the inaugural meeting of the Global Infrastructure Initiative in 2012, we added our voice to those calling for a focus on infrastructure development. It remains one of the most pressing concerns of our age. The world's population is projected to reach nine billion within the next 40 years. By 2050, 64 percent of the population in the developing world and 86 percent of the population in the developed world are likely to be living in urban centers. These urban centers are already feeling the weight of shifting demographics, while being battered by increasingly volatile weather patterns and challenged by limited natural resources.

To create environments that are economically viable and able to withstand these unprecedented

challenges, we need to develop the right infrastructure in the right way. The right infrastructure fulfills multiple objectives; requires a coordinated, long-term approach; draws on the expertise of many; and above all is sustainable. Whether starting from scratch, rebuilding, or upgrading existing networks and structures in well-established cities, stakeholders that address these four areas will succeed in developing the right infrastructure in the right way.

Consider what the Malaysian government is doing with what used to be the country's main airport. Subang Skypark is being converted into Asia Aerospace City (AAC), a world-class hub for the aerospace industry. As lead consultant and master planner on the project, Atkins has to address

multiple objectives while ensuring this new city is sustainable for the long term. We must take into account numerous factors—including the ebb and flow of local populations, changing weather patterns, and the economic viability of the design. AAC will be designed as a smart city and include a convention center, state-of-the-art research and development facilities, integrated office suites, academic campuses, and residential areas. The government agency responsible for education and entrepreneurship hopes AAC will attract global aerospace-engineering services to the region.

Infrastructure development and design requires a coordinated, long-term approach. Governments must put policies in place now to protect cities' environmental, economic, and social fabric. And the industry must work together to support these policies with infrastructure that is fit for the 21st century. Qatar offers a case in point: its national-development strategy plans to deliver more than \$65 billion in infrastructure by 2016. The work will include diverse projects—roads, bridges, highways, railways, and ports—and require a coordinated effort. To make this happen, the Ministry of Municipality and Urban Planning created a central planning office that acts as an anchor for all major infrastructure schemes and creates solid links among engineering contractors, consultants, and various departments of government. Atkins's role in this endeavor is multifaceted: we need to be innovative designers, influencers, and good partners, keeping an eye on the long-term vision throughout.

Major infrastructure development in established cities creates challenges that would be impossible to solve without drawing on the expertise of a range of technical specialists. For example, the new east-west rail link through central London, Crossrail, has the potential to redefine the way the city moves. But weaving 42 kilometers of

tunnels through a maze of existing underground sewers, foundations, chambers, and lost watercourses is no easy feat. Getting the most out of this project and creating something truly sustainable requires tapping into the collective expertise of all engineers, government agencies, and contractor partners. At the same time, experts must maintain a clear view of the project's long-term goals: increasing investment opportunities through over-site development; putting more people within easy reach of the city, which is fundamental to the business case; adding extra capacity and cutting journey times; running more comfortable, energy-efficient trains; and creating strategic transport hubs. By breaking out of our silos, we as an industry can work together to create integrated solutions and measures for future proofing our cities.

How do we future proof our cities? How does the industry take the lead and emphasize the clear link between sustainable thinking and economic development? By promoting and delivering sustainability in everything we do, no matter the size or type of project. Consider the pollution challenges facing some cities in China. While experts may be tempted to seek out major infrastructure solutions to the problem, more sustainable alternatives exist. Smart solutions can be used to address inefficiencies in the manufacturing sector. A more energy-conscious and efficient manufacturing process could help reduce air pollution and revitalize the sector in China.

An exciting collaboration among UK Trade & Investment, leading academics, and industry representatives from the United Kingdom and China is one such alternative. These parties are working together to analyze Chinese factories' energy and water consumption and identify savings opportunities. They will offer a variety of recommendations—from replacing lighting to

How do we future proof our cities? How does the industry emphasize the link between sustainable thinking and economic development? By promoting and delivering sustainability in everything we do.

installing submeters, upgrading motors or kilns, and reusing water. The collaboration is still in the pilot phase, but experts anticipate that factory owners will realize savings within 12 months and return on investment within five years. Thousands of facilities have been identified as possible participants in the next stage of this program. Factories and pollution are not new challenges, but the key to unlocking their sustainable potential is the development of easy-to-install, low-cost technology. What's more, this example illustrates the power of innovative investment models and shows that sustainability efforts can pay for themselves by addressing existing inefficiencies. This concept is already

maturing in other parts of the world, such as Germany and the United States.

Cities can foster innovation and improve standards of living, but only if we ensure their future. Future proofing our cities means anticipating problems and finding solutions before the problems materialize, which cannot be achieved by working in isolation. This demands an unprecedented level of imagination and cooperation among engineers, scientists, planners, policy makers, and other experts from across the built and natural environment. And it means we must look beyond our immediate goals to what lies ahead, if we are ever going to hit our target. ○



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Quick fixes: How one European city got moving (literally)

Going after quick wins helped city leaders create momentum for continuing improvement.

Yakov Sergienko,
McKinsey & Company

It's an all-too-common collection of sights, sounds, and emotions: major roads that are clogged with traffic, resounding with car horns, and oozing with exasperation. The daily, relentless annoyances associated with getting to work and then back home put millions of people on edge.

In one European city, one in five people spent more than three hours a day commuting, while more than 50,000 cars were parked illegally each day, forcing pedestrians to wend through a treacherous obstacle course. Most taxis on the road were unregistered and unsafe at any speed. Overcrowding on public transport was common.

The city leadership inherited plans that called for tens of billions of dollars in capital spending for new roads, subways, and trams. But there was no strategy. How all this was supposed to fit together, with respect to timing or functionality, was apparently never considered. Moreover, millions of miserable commuters would have to wait and stew many years before these projects could begin to deliver.

So the mayor decided to take a different, complementary approach: go for fast, cheap, and relatively easy wins. In a matter of months, commuters experienced a discernible, positive effect. This is not the end of the road by any means. Much more

needs to be done. By delivering real improvements, however, the city enhanced people's lives and created confidence that it could do more. Successful, speedy change, in effect, is creating momentum to do more.

How they did it

City leaders started by defining a set of objectives and announcing the formation of a committee to come up with ways to address them. They had a fairly good idea of what to do first; voters had made it clear that congestion was their biggest concern. So the government set a goal of cutting commuting time, improving the loading and unloading of cargo, and reducing the number of cars on the road during peak hours. The overall idea was to help commuters and improve economic efficiency.

Then they began to devise solutions to the problems identified. At a high level, one key was to consider various data from public and other sources. For example, they analyzed transport demand and supply to identify the places where commuters hit the most congestion. Armed with this information, they formed a data-driven strategy to reduce congestion. As with any strategy, this required good governance, in the form of leadership, performance metrics, and regular public engagement. The city also systematically involved the private sector, for instance, in towing, mobile-app development, and the creation of a bicycle-sharing system.

That is the broad view. Here are some of the quick wins the city delivered (defined as those achieved in no more than three years—and usually less).

Parking management. The city implemented a comprehensive parking-management system

that dramatically increased the number of paid parking spaces in its central areas. Enforcement was also stepped up, through the use of such technologies as vehicles enabled with license-plate recognition and handheld electronic sets that could issue on-the-spot violations. Fines and tows now force drivers to take the system seriously. An Internet portal allows drivers to find streets and parking lots with vacancies; mobile apps support payment and navigation. A network of new parking meters collects payments. In one district in which these changes took place, the average travel time and road-occupancy rate both improved, even though car ownership grew by 7 percent. Crucially, the authorities did an extensive information campaign first, explaining the rationale and how it would benefit the city. This helps to explain a surprising result: even the majority of car owners viewed the introduction of paid parking positively; only 28 percent thought it was a bad idea. The reason was that most drivers noticed fewer traffic jams and less rule breaking. Moreover, average traffic speed rose by 10 to 30 percent, depending on the neighborhood.

Transit-ticket system. People will not use public transport if it is difficult to use. The introduction of longer-term, refillable tickets compatible with all kinds of transport cut purchase lines and made public transport cheaper and easier to use. As a result, more people used it; just six months after the pilot project started, the average number of daily passengers was up by more than 10 percent.

Commercial traffic. New regulations restricted truck access to the inner city during business hours; that rule alone helped to increase local speeds noticeably. Truckers did not love the idea at first because it was less convenient for them;

on the other hand, they found that they could work more efficiently because they were not spending nearly as much time stuck in traffic. This change cost the city nothing but the time to devise the new rules on travel hours, weight, and class for cargo traffic. Again, the authorities made the case to the public before instituting the program.

Improved road usage. Through the effective use of data, the city instituted “reverse lanes” (in which traffic moves in different directions depending on the time of day) and integrated traffic-light control; this smoothed and speeded traffic on major arteries. The development of a methodology to track and improve effectiveness

of dedicated bus lanes led to a 15 percent increase in ridership and 20 percent higher speeds for 25 percent of passengers. Reallocating buses to areas of peak demand increased capacity without the need to buy more buses and pay more drivers.

The usual instinct in dealing with poor transit is to go for big, expensive, long-term projects, led from the top down, with little analysis of effects on residents or the local economy. There is, of course, a place for big projects; this city is also extending its subway and suburban-rail lines. But the approach described here is an excellent way to spark ideas about how to carry out low-cost, high-return, high-speed change. ○



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Thinking of infrastructure globally, acting locally:

An interview with Lee McIntire

How small changes could make a big difference.

Rik Kirkland,
McKinsey & Company

Lee McIntire is the former executive chairman of CH2M HILL. Founded in 1946, the employee-owned, US-based company builds energy, infrastructure, transportation, and water projects in more than 100 countries. In this interview with McKinsey's Rik Kirkland, conducted in the summer of 2014 when McIntire was still with CH2M HILL, he explains why social media is good for infrastructure and discusses the state of productivity in the construction business.

McKinsey: *Give us a long-term view of how you see infrastructure in the global economy.*

Lee McIntire: It goes back to the early 1990s, after the Berlin Wall came down and democracy had a global breakout. People figured out pretty

quickly that without infrastructure there is no economic growth.

Infrastructure investment has been shown to produce economic development faster than anything else. You can't have a good economy without good water, transportation, and power, plus hospitals, schools, and data bandwidth. So every government is working on infrastructure. Also, in the past couple of decades, public-private partnerships have received a lot of interest as a way to finance infrastructure needs.

Over the next couple of decades, the world is going to need something like \$57 trillion worth of infrastructure. If you look at the numbers, there is funding for only about half that. So we

need to get creative. One way to do that would be to reduce that \$57 trillion figure by doing a better job with operations and maintenance, which, for example, could mean things like having different kinds of transport work together. Public-private partnerships could be part of that.

McKinsey: *My impression is that compared with two decades ago, the infrastructure industry is more global than ever. Is that right?*

Lee McIntire: Absolutely, globalization is huge. Just in terms of travel, places have become hubs of transportation that weren't five years ago. Every country has its own globalization plan. That's something I've discovered in the past couple years. As a business, if you don't fit into their globalization plan, you won't be able to reap the benefits that the specific country offers.

The other important thing is that the world is getting richer. Yes, there are haves and have-nots, but overall the world is getting richer and the middle class is growing. This middle class has new transportation needs, new standards, and new demands.

Then there is urbanization: Everybody is moving to the cities. It won't be long before 80 to 90 percent of the world's population will live in cities. Already in Latin America, it's 80 percent. So all these forces are coming together at once, and infrastructure is rising to be one of the top issues of almost every country.

McKinsey: *What are some of the most important challenges?*

Lee McIntire: Governments change, and a new government might have different priorities. Infrastructure is a 20-, 30-, 40-year item. Not

every project is a great project. Not every project is even a good idea. So it's important to have really good master planning and the wisdom to plan and build and finance the right things. That's not trivial. It's pretty hard for any single government entity to pull this off in a well-communicated and constructive manner.

What can we do about that? Technology and data management could really change how we do everything, whether it's water, transportation, power, or conservation and efficiency. The question is how to manage that: for example, in transport, you can give people information so they can pick their own routes and their own times. All this is difficult, but it's also exciting.

McKinsey: *Construction is a difficult business because it's often bespoke. Is that why it hasn't seen the kind of productivity gains we've seen in other industries?*

Lee McIntire: You're right that productivity has not been improving, and there are a lot of studies trying to figure out why that is the case. It's something I've observed myself. When you see a road being built, it looks a lot like it might have 20 years ago.

Or look at engineering. While the drawings for engineering are now in 3-D and color and easier for contractors to use, it still takes as long to do an engineering drawing as it used to. Considering all the technology and the billions invested in computer-aided design, it's disappointing.

Do I see any big breakthroughs coming? No, actually, I don't. I see small technology moves and approaches and more mechanization and less labor. That's been going on for 30 years. But I don't see anything big coming.

Lee McIntire



Vital statistics

Born in Nebraska, 1949

Education

MA, finance,
Thunderbird School of
Global Management

BA, civil engineering,
University of Nebraska

Career highlights

CH2M HILL

(2014)
Executive chairman,
board of directors

(2009–13)
CEO and president

(2006–09)
COO and president

That's the opportunity for my industry. It might take a revolutionary change in thinking and approach.

McKinsey: *What are some ideas that might help?*

Lee McIntire: I'm a big believer in spending a lot of time planning before you put a shovel in the ground. Good planning is money well spent.

You might think I'd be biased the other way: let's get going on the job so we can win one. But I believe that more needs to be done early on. Get all the smart people and stakeholders in a room. Don't just have a government agency produce a request for proposal; it's better to have the players come in and talk because they can really help the government. Infrastructure tends to be government-oriented, but it is really all about people. Roads are about people. Sewage and water treatment plants and communication are about people. Everybody's a transportation expert.

McKinsey: *What are you doing differently, compared to, say, five years ago?*

Lee McIntire: We started using social networks to assist management, to recruit and hire people, and to change the way we do business. I am not sure how they will apply, but social networks could help us with infrastructure, too. About four years ago, a presenter told our board that if we didn't understand social networks we'd be out of business in five years.

I never really quite believed that. But we thought we ought to look into it, and we went after it. For one thing, social media has totally changed the way we recruit people. We used to get a few thousand CVs a year. Now we get multiples of that. People who don't want to join a company like ours simply don't, so we are expecting less turnover. The people we're trying to attract and keep energized are in the age group that uses social networks continuously. So if you're not in, you're out. And that doesn't make good sense. ○



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Rethinking conventional construction: An interview with Broad Group chairman and CEO Zhang Yue

Traditional construction practices can be costly, inefficient, and detrimental to the environment. In this interview, Zhang Yue reflects on how the industry can change.

David Xu,
McKinsey & Company

Zhang Yue, chairman and CEO of Broad Group, is not one to shy away from ambitious targets. In 2010, his prefabricated construction company, Broad Sustainable Building, completed a six-story building, Broad Pavilion, at the Shanghai Expo in one day. He continued to challenge this feat by building two more structures at record paces—the 15-story Ark Hotel in less than one week and the 30-story T30 tower and hotel in 15 days. His latest ambition is to build the world's tallest structure. Known as Sky City, the 202-story steel skyscraper is expected to be magnitude-9 earthquake resistant and energy efficient. Ninety percent of the structure is being built at a factory and just 10 percent assembled on site. While the timeline is impressive,

what matters most to the Broad Group is its sustainable design and production process. Zhang sees this high-rise as a step toward redefining urbanization and addressing the energy and pollution problems that have accompanied industrialization in China. In this March 2014 interview with McKinsey's David Xu, a director in the Shanghai office, Zhang describes his journey to sustainable building and shares his thoughts on the future of construction and infrastructure in China.

McKinsey: *What are the biggest challenges facing the infrastructure and construction industry today?*

Zhang Yue: In general, the industry is under-performing. In many ways, we live in a very intelligent time. Yet there is still no precedent for a creative, low-emission, and practical approach to construction. From city planning to infrastructure development and building construction, from resource consumption to energy use, the industry is lagging the time in which we live. I think this is largely due to mind-sets and that humans must change. The construction industry is inherently long term. A small error in construction can cause significant harm to humans and the environment. The consequences of construction errors can reverberate for decades, centuries, and even a millennium. Yet the industry does not always think long term. We tend to think of a project—one building or infrastructure asset—and its timeline.

McKinsey: *How can the industry change its thinking?*

Zhang Yue: We need to ask ourselves more strategic and long-term questions: What is the objective of this building or asset? How does it relate to the rest of the neighborhood and the city? How will it affect people's quality of life? How much energy does it use? What problems could it create?

In China, urbanization is happening rapidly. If it continues at this pace without careful consideration of the long-term consequences to the environment, it can cause severe problems. We must take a long-term approach to city planning, construction, and infrastructure and address resource and energy consumption. People living in big cities, with excessive pollution and energy consumption, can hardly enjoy a high quality of life. Urbanization should not

happen at the expense of land and the environment. Stakeholders in China can pursue a long-term path to land- and energy-efficient urbanization.

McKinsey: *Technology is evolving rapidly and disrupting other industries. To what extent is this happening in the infrastructure industry?*

Zhang Yue: Unfortunately, the construction and infrastructure industry is the exception. It is antiquated and out-of-date. Most work is still performed manually and on site, which is costly and time consuming. For example, today a skyscraper can take five years or more to complete. When the Empire State Building was constructed, it only took about 13 months.

McKinsey: *Why do you think technological innovation has failed to permeate the industry?*

Zhang Yue: There are two reasons. One, rapid urbanization in China is driving significant investments in infrastructure development. At the same time, innovative financing and investment products are also pouring money into the industry. When demand is strong and the market is good, people do not have much enthusiasm for new technology. They are not motivated to innovate because the profits are there.

Two, excessive regulation of the industry and its supply chain can hinder innovation. In China, there are so many regulations that they do not encourage innovative technology or even thinking. For instance, in construction design, regulations can be so detailed that they specify which types of materials to use and what standard of thickness the materials should be. So, in China the industry falls back on what we call "standard." Because regulations emphasize standard, builders pursue it at the expense of creativity, efficiency, safety,

and ultimately responsibility. As long as a builder does not violate standard, he or she does not bear responsibility for any issues.

McKinsey: *What do you envision as an alternative?*

Zhang Yue: I think Western countries offer an alternate model. Regulations exist and the guidelines are stringent, to be sure. A building or infrastructure asset must pass inspections and meet safety standards. While engineers bear responsibility for their work, they are free to explore different products and approaches. This model encourages innovation and accountability.



McKinsey: *Sky City is not the Broad Group's first sustainable project. When did you start thinking about sustainable building?*

Zhang Yue: We began to explore sustainable building after the Sichuan earthquake in 2008. I was attracted to the idea of challenging conventional thinking about construction. Our construction process places special importance on air quality, energy conservation, and sustainable materials. By using 20-centimeter insulation layers, quadruple-paned windows, power-generating elevators, light-emitting-diode lights, and Broad's cooling-heating-power and air-filtration technology, Sky City will be five times more energy efficient than a conventional building. In China, most builders use concrete because it is standard and they are familiar with it. Sky City will be made mostly of steel, all of which can be reused, if the building is ever decommissioned.

McKinsey: *How does the use of an energy-efficient product or material challenge conventional thinking?*

Zhang Yue: One product can have tremendous effects. Consider thermal insulation. It does not require fancy technology, simply a willingness to do. A small, up-front investment in insulation significantly reduces the overall cost of a building by lowering heating and cooling expenses. Why then are so few builders in China using thermal insulation? In a word, it is about mind-sets. Thermal insulation is outside of their conventional process and thinking.

McKinsey: *How does your construction process differ?*

Zhang Yue: If conventional construction is a man building cars in his garage, our approach is

Zhang Yue



Vital statistics

Born in Changsha, China, 1960

Married, with 1 son

Education

Degree in fine arts, Chenzhou College

Career highlights

Broad Group

(1988–present)
Chairman and CEO

Fast facts

Holds patents for a number of inventions, including a nonpressurized boiler (1989), a nonelectric air conditioner (1992), and a combined cooling, heating, and power system (1999)

Received the Champions of the Earth award from the United Nations in 2011 for his contributions to building energy efficiency and sustainable production

Worked as a teacher and librarian in Chenzhou early in his professional life

to build cars on the assembly line. Ninety percent of the work for our prefabricated, sustainable buildings is done in the factory. Only the remaining 10 percent is done on site. Plumbing, electric, heating and cooling vents, plus the flooring and ceiling, are fitted into a module of 60 square meters. The walls, doors, and windows are stacked on top of the module, which is then transported to the construction site as a whole.

McKinsey: *What are the benefits of this process?*

Zhang Yue: Our production process is not only fast, but it maximizes efficiency and minimizes waste—less than 1 percent construction waste, compared with the 30 percent generated by conventional methods. Because the majority of work is done in advance, our approach also speeds on-site construction. And because our main site is the factory, our transport and logistics

costs are lower. We have greater capacity in the factory to store additional materials and supplies, whereas at a conventional construction site, materials like cement and steel are often delivered daily because the site cannot accommodate extra supplies. All in all, our construction process maximizes efficiency—in resources, labor, logistics and transport.

McKinsey: *As a new entrant, you are showcasing a vastly different business model. What is the likelihood that this model can be replicated?*

Zhang Yue: We hope to be a model in countries like China, where the urban population is growing, existing infrastructure is incomplete, and the demand for infrastructure development is significant. But the precondition is that we finish the job and do it well. I must build the best product with the highest efficiency, of the

We are constructing the tallest building to promote the concept that urbanization need not sacrifice land or energy efficiency.

highest quality, at the lowest possible cost. For other builders to follow suit, the production process must be efficient and cost effective, without sacrificing quality. If a building is expensive to develop, the market will be limited. If labor costs are too high, or the construction speed is too slow, the market will evaporate. If quality is hard to control or technicians are required to learn many new and advanced technologies, the barriers to entry will be too great. Return on investment must also be realized fairly quickly, in two to four years; otherwise, investors will lose patience.

McKinsey: *When complete, Sky City will measure 202 stories high, with 6 more stories below ground level. It could become the tallest building in the world. What does that mean to you?*

Zhang Yue: We are constructing the tallest building to promote the concept that urbanization need not sacrifice land or energy efficiency. This is the real significance of Sky City. When a building is taller, it naturally uses less land. Also, Sky City is a mixed-use development and will include residential housing; commercial space for business, shopping, and entertainment; a school; a hospital; and two square kilometers

of green space covered by 100,000 trees. Residents will have access to everything they need in this self-contained development. Think of how lovely our cities could be if we all traveled to work and school and ran errands on foot. Such a lifestyle lessens energy consumption and the number of roads, cars, and traffic jams in our city. According to our calculations, Sky City could help reduce the number of cars in Changsha by 2,000 and carbon emissions by 120,000 tons. These figures mean more than the title of world's tallest building. We are determined that Sky City will have an impact on the people and city of Changsha, on China, and ultimately on the world.

We hope this project leads three important revolutions: one is a revolution of the construction process; two is a revolution of resource efficiency; and three is a revolution of the construction-industry business model and oversight. If we do not take action and showcase a different model that challenges conventional construction, the industry will not change. There will be huge obstacles, many of which are beyond my imagination. But my resolve is strong. And I look forward to the day when we can reflect on those obstacles over coffee on the 202nd floor. ○

Big data versus big congestion:

Using information to improve transport

Digitization in infrastructure networks could improve forecasting, promote reliability, and increase efficiency.

Carl-Stefan Neumann,
McKinsey & Company

Congestion—on the road, in the air, on the rails—wastes time, increases pollution, and is costly to society. Commuters in Brussels and London waste more than 50 hours a year in traffic jams; that's the equivalent of more than a full week of work. Across Europe as a whole, infrastructure congestion costs 1 percent of GDP. In the United States, airport delays alone cost some \$6 billion to the economy.

It doesn't have to be this way. In 2013, the McKinsey Global Institute concluded that, globally, \$400 billion a year could be saved by “making more of existing infrastructure” through improved demand management and maintenance.¹ That is where digitization, in the form of big data, can help.

The collection and strategic use of information can improve forecasting and help to nudge behavior in ways that improve the reliability of transport infrastructure and increase its efficiency and utilization. In fact, some of this is already happening.

- Israel has introduced a 13-mile fast lane on Highway 1 between Tel Aviv and Ben Gurion Airport. The lane uses a toll system that calculates fees based on traffic at the time of travel. To make it work, the system counts the cars on the road; it can also evaluate the space between cars to measure congestion. This is real-time pattern recognition of a very high order. The information is then put to use in a way

that increases “throughput,” or the amount of traffic the road can bear. If traffic density is high, tolls are high; if there are few cars on the road, charges are cheap. This not only keeps toll revenues flowing but also reduces congestion by “steering” demand.

- In Brazil, aviation traffic has been growing fast for the past decade, and annual passenger traffic is expected to more than double by 2030, reaching more than 310 million passengers. Not surprisingly, airspace congestion is a growing concern. To deal with the problem, Brazil is introducing a system that harnesses GPS data to optimize the use of available airspace, enabling less separation between aircraft and shorter routes.

The usual practice has been to line up planes preparing to land in an airborne queue. Under the new system, each plane is assigned its own flight path. It may sound simple, but making the system work requires enormous amounts of data, as well as fast and sophisticated evaluation of the data. The distance, speed, and capabilities of each aircraft are processed in a way that results in the shortest flight path. Instead of queuing up on approach, planes can “curve in” much closer to the airport.

The first deployment, at Brasília International Airport, is saving 7.5 minutes and 77 gallons of fuel per landing, as planes fly 22 fewer nautical miles on average. Brazil plans to roll out the system to the country’s ten busiest airports. Initial impact estimates suggest that deployment of this system at North American airports could increase capacity 16 to 59 percent, depending on airport conditions.

- Railway-infrastructure providers in Europe typically ask operating companies for detailed itineraries of the trains they want to run, and then the providers create a schedule that tries to fulfill every request. The system is well intentioned but rigid—and it doesn’t lead to optimal capacity usage or operational stability. In Germany, the great majority of cargo trains do not depart as scheduled, a fact that inevitably leads to complications down the track.

Recently, some railway companies have started to follow a more “industrialized” approach that uses big data. They are splitting track capacity across the network into “slots” of different speed profiles based on an analysis of past demand and are allocating trains to available slots as requests for capacity come in. Capturing these opportunities requires advanced planning techniques that can, for example, allow trains to swap slots along their itinerary in order to recoup time lost to operational delays. Such innovations can improve punctuality and reliability while accommodating up to 10 percent more traffic.

In spite of these (and other) encouraging examples of the integration of information and infrastructure, progress in general has been slow. At airport-industry gatherings, there’s lots of enthusiasm about using big data from tracking passengers’ mobile devices for tailored information and management. Ideas include text-message alerts on when to go to the departure gate, taking into account individual walking speeds, and reduced security queues based on better short-term demand predictions or tailored shopping suggestions. At the moment, though, no more than a few dozen airports are actually implementing ideas like these.

Collectively finding a solution that makes every stakeholder a winner is not a simple task and requires a certain level of mutual trust that cannot be assumed.

Why are infrastructure providers so slow to integrate big data? And what can be done to speed things up? Economic viability cannot be the reason. The payback from investing in such technologies is usually much better than investing in equipment with similar ability to boost capacity.

Based on conversations with industry practitioners, we have identified three significant barriers to leveraging information effectively to improve transport-infrastructure usage.

First, there is a lack of transparency. Transport infrastructure involves complex networks with many participants. An airport, for example, will have dozens of different airlines, ground-handling companies, and retailers, plus air-traffic control, customs, and the airport-operating company itself. Each player collects its own data and does not necessarily want to share it. That can sometimes make sense; no retailer wants to give away the store. But the ability to track passengers could benefit just about everyone. For example, knowing where foot traffic is and how it moves can help to optimize gate and asset allocation. That could not only increase airport capacity but also boost retail revenues. For that to happen, though, the data need to be pooled.

Another issue is how to divvy up the costs and benefits of sharing information; different players do not always have the same goals. Airlines might want faster transit times—for example, in order to minimize travel times for connecting passengers—while retailers might prefer passengers to linger to increase store sales. Airports would prefer a high utilization of assets, but they might value lower utilization to foster flexibility and enable them to recover quickly after irregular events. Collectively finding a solution that makes every stakeholder a winner is not a simple task and requires a certain level of mutual trust that cannot be assumed.

Finally, there are regulatory constraints. Infrastructure in many cases is a natural monopoly. Governments therefore have an important role to play—in ensuring that operations are fair and cost-effective, and in creating a regulatory environment that allows data to be collected and used while protecting confidentiality and privacy. But before that can happen, competition and data-protection authorities need to be convinced of digitization's benefits. One sizable challenge would be to overcome users' privacy concerns by clearly stating what data are being collected, how they're being used, and the ultimate benefit to consumers of cost-effective solutions emerging from data insights.

All three barriers are interdependent and therefore need to be addressed at the same time. Without transparency, there is no way to build trust and achieve equitable sharing. Without equitable sharing (and clear public benefits), regulators will not be sympathetic. Without responsible regulation, players will be reluctant to make their data available.

It's no easy matter to get all the parties in an infrastructure network to work together. A leader is required. Governments have an obvious interest in making the most of existing infrastructure, so one option is a national or multinational government entity. But it could also be the main concession holder, such as an airport operator or railway company. Or it might be a combination, with the government setting goals and establishing

the conditions on data use and sharing, and the concession holders setting up structures to put the data to work.

Using big data in infrastructure is a work in progress; in important ways, it is just getting started. To build momentum, one proven strategy is to launch a pilot program, perhaps at a single airport or railway station, that tests data strategies and documents the benefits. But perhaps the most important thing is simply to recognize the potential that information has to improve infrastructure. ○

¹ For more, see *Infrastructure productivity: How to save \$1 trillion a year*, McKinsey Global Institute, January 2013, on mckinsey.com.



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Full speed ahead: How the driverless car could transform cities

Self-driving cars are not just about a hands-free driving experience. Their emergence points to an urban transformation that will change the way people navigate, access information, and interact with one another.

Matthew Claudel,
research fellow,
SENSEable City Lab,
MIT

Carlo Ratti,
director, SENSEable City
Lab, MIT

Just like Ford's Model T, which debuted in 1908, today's automobiles have four tires, a steering wheel, and seats. Henry Ford would have little trouble behind the wheel, but he would be completely baffled by the technology under the hood. Cars today are, in many ways, high-performance computers that can race at 70-plus miles per hour. Automotive digitization has led to important transformations, but the networked era has only just begun to tap its ultimate potential: the driverless car. Thanks to the advent of ubiquitous computing, various forms of semiautonomous technology, such as adaptive cruise control, automatic parallel parking, and collision warnings, are already widespread.

Indeed, full-fledged self-driving vehicles already exist. Several manufacturers, including BMW, Ford, GM, Toyota, and Volkswagen, have integrated these systems into their fleets and expect to start selling premium cars with different degrees of autonomy as early as 2016. MIT has worked with local researchers in Singapore on a prototype, while Google is using them in California. While fully self-driving cars cannot be bought off the shelf yet, autonomy is, in a sense, the next step in a continuing evolution of silicon under the hood.

Cars and the city

But what is the point of self-driving cars? Are there substantive benefits beyond sending guiltless

text messages on the way to work? The answer lies in broader trends that point toward societal and urban transformations. Over the past 20 years, digital tools have changed the way people meet, access knowledge, and navigate—all built upon networks, sensors, mobile communication, and real-time information. These technologies are only now beginning to enter the urban space. In effect, more and more intelligence is suffusing our cities. It is possible to collect real-time information, seamlessly, on every dimension of urban life. HubCab, for example, is a web-based interactive visualization that looks at how New York's 170 million annual taxi trips connect the city.

A parallel trend is happening with regard to the automobile: cars collect information about passengers and about the environment. Systems inside the car can detect drivers' sleepiness, and galvanic skin-response sensors can give a metric for stress. Outside the car, radar, cameras, and laser scanners can "read" the road and then respond. Autonomous cars are at the nexus of these two lines of development, benefitting from advances on board and on the street.

Researchers at the MIT SENSEable City Laboratory are interested in the urban consequences of autonomous technology. Self-driving vehicles will have a dramatic impact on urban life when they begin to blur the distinction between private and public modes of transportation. "Your" car could give you a lift to work in the morning and then give a lift to someone else in your family—or, for that matter, to anyone else: after delivering you to your destination, it doesn't sit idle in a parking lot for 20-plus hours every day. By combining ride sharing with car sharing—particularly in a city such as New York—MIT research has shown that it would be possible to take every passenger to his or

her destination at the time they need to be there, with 80 percent fewer cars.

Clearing the roads of four out of five cars has momentous consequences for cities, by measures such as environment, traffic, efficiency, and even parking. In most cities, for example, designated parking accounts for a huge amount of land, which ends up being useless for most of the day. With fewer cars, much of this space could be freed for other uses. Such reductions in car numbers would also dramatically lower the cost (and related energy consumption) of building and maintaining the roads. One engineering study found that automation could quadruple capacity on any given highway. And, of course, fewer cars also means less noise and a smaller environmental impact.

Driving patterns of individual cars can be algorithmically optimized as well. Because autonomous vehicles don't get lost, they create less congestion and shorten travel times. More important, self-driving cars would also make for much safer roads; more than 30,000 people a year die in automobile-related deaths in the United States every year and 1.2 million worldwide. One of the key challenges for the driverless future is to address the underlying logistics and legalities. Insurance, specifically, is an open question: When an accident involves a self-driving car, who is liable? Social acceptance is another important component: Are drivers ready to take their hands off of the wheel? Digital security is a third. Computer viruses are all too familiar, but the question is what to do if somebody "hacks" a self-driving car and changes the gas pedal into the brake, or even worse, makes the intersection go haywire.

As it always has, technology will continue to advance, and none of these issues is

insurmountable. At this point, the transition is poised to happen, but several things must fall into place over the coming years—specifically outside the car—to pave the way forward. At the moment, fewer than half a dozen US states allow driverless vehicles on the roads, but many more states and countries are beginning to address the question. The federal government is working on creating a national policy to inform future development, but it is moving slowly.

It is likely that autonomous cars will deploy gradually—first, with more semiautonomous functions becoming standard (as GPS already has), then proceeding to systems that let drivers choose

to take their hands off the wheel in certain situations (such as traffic jams or parking), and finally, to fully driverless vehicles. According to IHS, a firm that provides automotive forecasts and insights, sales of autonomous cars, including driver control, will begin by 2025 and could reach 11.8 million in 2035; sometime after 2050, says IHS, almost all vehicles will be autonomous.

From a technological point of view, driverless cars have arrived; the bigger task is for cities to integrate them. As autonomous driving matures, one thing is all but certain: the world's mobility challenges will increasingly be met with silicon rather than asphalt. ○



Four global infrastructure priorities:

An interview with Roland Busch

How traffic, energy, water, and security issues will shape the future.

Rik Kirkland,
McKinsey & Company

Roland Busch, a member of the managing board of Siemens, is responsible for its Building Technologies, Energy Management, and Mobility divisions, as well as for the Asia/Australia region and the company's Corporate Sustainability Office. He joined Siemens in 1994 and has worked in several areas, including automotive, process management, and strategy. In this interview with McKinsey's Rik Kirkland, he talks about how cities can get smarter and why incremental improvement is not enough.

McKinsey: *What are the themes that will define how infrastructure evolves?*

Roland Busch: Urbanization is one key trend. More and more people are moving to cities, for good reason. Cities are the most effective and efficient way to provide the infrastructure that people need, including education, health, housing, and transport. This is a chance and a challenge. It requires new technologies, new ways of thinking, and a lot of investment.

Another important point is that while there are many differences between emerging cities and mature ones, they also have many of the same problems. So, when I'm meeting mayors and urban planners, whether it's

in Asia or Europe, we often discuss the same topics.

It starts with traffic. This is the most pressing problem of every city—how to move people and goods. Next is the need for energy. Many cities have a greenhouse gas–reduction target as well. Number three is wastewater. And number four is security. Cities are competing against one another, after all, and nobody wants to live in an unsafe city.

McKinsey: *Tell us a little about how to make cities smarter. By that, I mean using technology to make infrastructure more responsive.*

Roland Busch: Incremental infrastructure improvement will not do the trick. Think about transport. If you want to leverage the huge amount of capital that has been invested in a metro line, for example, you naturally want to get the most out of it. Intelligent systems such as control centers and trackside control equipment can help. A driverless metro system can increase capacity compared with a conventional system by 20, 30, or even 50 percent. That's because by making systems smarter, you get much more out of them.

It's the same thing with power grids. They have to be controlled and managed with the right hardware and software. If you know what the consumer is going to consume, and when and where, then you can manage the overall load much better. That has financial benefits for both grid operators and consumers.

Buildings are another example of how technology can make infrastructure more intelligent. Automation systems, sensors, and actuators can

manage buildings while saving a lot of energy and still being very comfortable. In Berlin, our engineers worked on a project with the city to cut energy consumption in more than 160 buildings by 20 percent. And they achieved their targets—with the right technology in place. That saved a lot of carbon dioxide and reduced operational costs, too.

McKinsey: *Does Siemens install the sensors or manage them?*

Roland Busch: Both. You definitely need to have more sensors so that you can generate more data. But it's more important to use that data to create value. For example, we are using management systems in buildings that not only optimize for energy efficiency but also take care of fire safety and security.

It's not about big data per se; it's about relevant data. You start by defining the problem you want to solve. What is the business case? What is the value for the customer? And then you ask: What data do we need, and how can we deploy it?

Let me give you an example. We have sensors on rail tracks that listen to each and every wheel and can determine which one is going to break or which one needs to be refurbished, say, in 500 or 1,000 kilometers. This is predictive maintenance. It improves the availability of the fleet and lowers the cost of maintenance. And you can do similar things in industry.

McKinsey: *It sounds like you need a high degree of expertise in information technology to do these kinds of things.*

Roland Busch: Yes, and that's a big challenge. We differentiate between horizontal and vertical IT. Horizontal IT refers to the systems that run on PCs. Vertical IT is about addressing the core processes of our customers. That includes our field devices and our automation devices. Vertical IT uses data that have been generated by sensors and other hardware sources. With software, you can use these data to improve your processes and future investments.

It's about how IT can optimize processes, and that's a real challenge. We have many engineers who know how to program an automation system. We have others who know IT by heart. What we

need is a blend—people who understand processes and IT. And you don't find them on the street. So we try to find them on the working level, as well as on the management level, and then we train them.

McKinsey: *Some countries are building new smart cities. What's different between working in an older city versus doing something from scratch?*

Roland Busch: In both kinds of places, the basic idea is to deploy technology as effectively as possible. Siemens is supplying the turnkey system for two [of six] driverless metro lines



Roland Busch



Vital statistics

Born in Erlangen, Germany, November 1964

Education

PhD in physics, Friedrich-Alexander-Universität Erlangen, Nürnberg, Germany

Career highlights

Siemens

(2011–present)
Member of the managing board

(2011–14)
CEO of Siemens Infrastructure & Cities Sector

(2008–11)

Head of corporate strategies, corporate-development department

(1994–2008)

Various titles

in Riyadh. This system is all new, so we can design it such that all the technologies fit together, from the rail tracks to the ticketing system. But when we were refurbishing a line in Paris and going from driver to driverless, there were certain limitations, starting with the rolling stock.

McKinsey: *How do you see the future of infrastructure?*

Roland Busch: My colleagues and I talk about industry being close to 4.0. But when it comes to infrastructure, we are at 1.0. Still, the technology is there to go for the next level or even the next one; it's just that it takes time.

Infrastructure projects are complex, expensive, and political. So I would say two things: we need higher productivity, and we need to get more capacity out of existing infrastructure.

We cannot afford to slow down the development of cities. This is where people are moving, and cities also drive the global economy. By 2025, 600 cities will generate nearly 65 percent of world economic growth, and they are growing fast. That means if countries want to grow, they have to address the state of their cities. That means urban authorities and the companies that bring technology in have to work together. ○



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Infrastructure's central role in China's 'new urbanization'

To bring the benefits of urban life to hundreds of millions of new residents in city clusters, infrastructure development and financing must be innovative, sustainable, and high quality.

Xiaodong Ming,
deputy director of
the planning department
of China's National
Development and
Reform Commission

People and their quality of life are at the center of China's approach to urbanization. By 2020, China aims to integrate 100 million rural migrant workers into urban life, offering them benefits such as access to jobs, schools, and healthcare. The country also plans to revamp shantytowns where around 100 million people reside and urbanize about 100 million people in China's central and western regions. This is a massive undertaking, but urbanization is not only about the numbers. Its basic principle is the importance of the roles of people and regions. The build-out of China's urban environment is an important story because it changes lives.

Of course, "new urbanization" faces multiple hurdles. Integrating migrant workers poses

an important population challenge. Coordinating regional development will have a critical impact on economic development. Upgrading the industrial capacity of cities as they expand will define, to a large extent, the future of China's growth profile.

All these important tasks require the support of better infrastructure construction. A modern economy depends on reliable roads and rails, electricity, and telecommunications. China has had the single biggest development of infrastructure in the history of mankind. Over the past 10 or 15 years, it has been the world's largest market for infrastructure. And there is clearly more to be done for China's "people centered" urbanization approach to achieve its goals.

To develop an infrastructure plan that fits seamlessly into China's new urbanization blueprint, it is crucial to look at the overarching goals and strategy of China's urbanization, key areas for infrastructure construction, and methods of infrastructure financing.

Overarching goals and strategy

China's urbanization has entered a new stage; the focus has shifted toward higher quality and efficiency. At this stage, China's people-centered effort emphasizes city clusters as its major component. Urbanization will provide economic integration, growth, and the benefits of an urban lifestyle to populations of 10 million to 50 million people in each cluster. Comprehensive capacity and system innovation will support this integration. To achieve this overall goal, five major tasks must be accomplished.

The first is to promote migrant-worker integration step-by-step, which will help to eliminate the divide between urban and rural populations. To do so, household registration (*hukou*) reform should be pushed forward to provide equal access to public services for all citizens, and the process should be conducted in accordance with local conditions.

The next task is to improve the layout and patterns of urbanization, which will greatly increase the efficiency of land use in urban construction. The goal is to balance the spatial layout, optimize the scale of cities and towns, and coordinate development of small, midsize, and large cities, as well as small towns. It requires promoting urbanization strictly in accordance with plans for managing land, water, and ecology.

Increasing the sustainable-development capacity of cities is another goal. That means improving a variety of aspects in the development of cities—

industry job creation, the functions of downtown areas, regulation of city extensions, urban financing mechanisms. The overarching goal is to develop new cities that are innovative, green, smart, and human.

Coordinated urban-rural development should also be promoted, as it will vitalize the development of rural areas and narrow the gap between urban and rural regions, thus promoting new urbanization.

The fifth task is to improve the system and mechanism of urbanization. Relations between markets and government, and between central authority and local administration, should be aligned smoothly and effectively. The goal is to swiftly remove the hindrances to urbanization and create a favorable environment for healthy urban development.

The Third Plenary Session of the 18th Communist Party of China (CPC) Central Committee mandated that the new urbanization be people centered. Advancing this policy—and delivering the desired living conditions for massive numbers of new urbanites—cannot be accomplished without the support of high-quality infrastructure.

Key areas for future infrastructure construction

The requirements of China's new urbanization strategy define the focus of China's infrastructure build-out. The strategy requires several interconnected elements: the transportation network needs to play a leading role, the build-out should follow a strategic spatial-planning framework for expanding economic growth and market areas from east to west and from north to south, and the layout and patterns of urbanization must be optimized. Moreover, public infrastructure should also be enhanced to cater to

China's sweeping urbanization is set to create tremendous demand for building out infrastructure and massive need for investment and financing.

the needs of the growing urban population and to economic development. Therefore, construction of China's infrastructure should mainly target four areas.

First, step up the capacity of integrated transportation in eastern city clusters. In doing so, city clusters could exercise effective and integrated management over transportation, narrow the economic gap between cities, and enhance eastern city clusters.

Second, accelerate the construction of high-speed railways and highways among major cities in the central and western city clusters. By shortening travel time between cities, high-speed railways and highways will greatly facilitate the flow and allocation of labor and capital. In central and western regions, the construction of high-speed railways and highways will also improve the attractiveness and overall competitiveness of city clusters. These projects will help to urbanize 100 million people and optimize the structure of urbanization nationwide.

Third, ramp up public-transport facilities that connect small and midsize cities and small towns to traffic hubs or cities with major transport routes. These cities and towns should be incorporated into the national traffic network to achieve coordinated urban development.

Small and midsize cities and small towns do not have the economic foundation or demand to serve as traffic hubs. As such, their connections to traffic hubs should become a focus of infrastructure construction.

Fourth, enhance public infrastructure to better support the growing population and demand for services. Increasing numbers of urban residents have posed great challenges to cities' infrastructure, public services, and environment. These areas have to be strengthened if China is to achieve true people-centered urbanization.

Investment and financing strategy

China's sweeping urbanization is set to create tremendous demand for building out infrastructure and massive need for investment and financing. To address this issue, the Third Plenary Session of the 18th CPC Central Committee explicitly stipulated that a transparent and well-regulated financing mechanism for urban construction should be established.

It also decided to allow local governments to issue bonds to add to their financing methods and to allow social capital in infrastructure projects through means such as franchises.

Within this framework, the urban-construction strategy should primarily include three aspects.

First and foremost, ensure investment from central and local governments. The central government can issue special treasury bonds to finance a particular project, while local governments should ensure their level of investment. It should be noted that although the government should invest in the development of cities, it should also control the financing scale to prevent risks.

Second, attract private investment. Since the central government has made it clear that social capital is allowed in urban construction, policies should be made to encourage private investment. Moreover, methods like investment subsidies and service procurement can also be used to engage more private capital in urbanization.

Finally, be innovative in devising financing mechanisms. For example, projects that contribute

greatly to public welfare are usually long-term projects with high credit ratings. If government investment cannot be secured and if it is difficult to raise funds in the market for such projects, those undertaking the project may issue long-term bonds or seek capital from investment funds or policy banks. For projects that aim for both public welfare and profitability, new models of public-private partnership should be encouraged and experimented with. In such projects, the roles and responsibilities of the government and those of the market should be properly defined.

With growing population and increasing demand, China is urbanizing at a pace that has impressed the rest of the world. At this stage, it is important to maintain the efficiency and quality of urbanization. To achieve people-centered urbanization, it will be crucial to plan ahead and keep the big picture in mind. ○





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Critical issues in the next decade of China's infrastructure effort

More sustainable financing, higher quality in urban projects, and new markets to soak up construction overcapacity will determine how the country writes the next chapter of its remarkable story.

Zuo Kun, executive vice president, China Development Bank Capital

Over the past 30 years, China has become the world's largest infrastructure market, thanks to its economic reforms and burgeoning urbanization effort. As positive and dramatic as this evolution has been, it is now possible to identify several critical issues that will bear heavily on the direction and shape of China's infrastructure planning and its construction sector. In brief, the single-source financing model that underpins government-led infrastructure development is not sustainable, the quality of urban infrastructure is poor, and despite the vigor of China's infrastructure-building efforts, infrastructure companies now face overcapacity challenges similar to those in developed economies.

To understand where China's remarkable infrastructure story goes next, it is valuable to explore these developments and anticipate ways to address these critical issues.

Building a new finance model upon private infrastructure investment

Government-led infrastructure development's heavy dependence on a single source of financing has increased government debt significantly. The model is not sustainable. For a long time, China's infrastructure financing mainly came from government lending and land-transfer revenues. As revenues have diminished, solvency pressures and risks for local governments have risen to high levels. To address the issue, the central

government has made it an economic priority to control and reduce local-government debt risk this year by reducing the amount of credit banks provide to local governments and by increasing the level of audit and transparency of local-government accounts.

In light of these circumstances, a better infrastructure-development model would shift away from dependence on government to greater reliance on market finance. The central government is advocating the idea of diversified ownership by encouraging social investment in infrastructure operations through franchises, equity investment, and public–private partnerships (PPPs).

China's ministry of finance is working to promote the PPP model in infrastructure projects by identifying the respective rights, obligations, risks, and revenues of both public- and private-sector partners. In this way, the government hopes to build complementary and mutually beneficial partnerships with the private sector on public projects. For example, Zhongtian Urban Development Group worked out such a deal with the government of Yunyan District in Guiyang to take charge of primary land development, road construction, river improvement, and other projects. The company and local government will work together to balance out development costs and land-transfer fees. Private investment in joint ownership of projects helps reduce government debt, solve financing issues, and improve operational efficiency and revenues at the same time.

Improving the quality of new urban infrastructure

The quality and operational efficiency of urban infrastructure, especially of new urban projects,

is poor. Recently, the Chinese government issued a national urbanization plan that extends to 2020; this sets the tone for its “new urbanization” effort, which calls for significant infrastructure creation. At the same time, however, more and more attention is focused on the fact that so much new infrastructure is of low quality. Moreover, inadequate urban infrastructure, low standards for construction practices, and operational management of projects contribute to a failure to meet the infrastructure needs of China's cities.

To solve the issue, the central government is determined to improve urban infrastructure in four areas:

- urban transit, including subway, light rail, and bus rapid transit
- city pipe networks, including water supply, rainwater, fuel gas, heat supply, telecommunication, power grid, drainage and waterlogging prevention, flood control, and utility tunnels
- sewage treatment and garbage disposal
- eco-gardens

President Xi Jinping recently announced plans to improve urban infrastructure quality and build an advanced, interconnected functional system to meet future demands. The fundamental idea is to create world-scale transport capacity linked to mixed-use development and district energy infrastructure. A good example is the Hongqiao Hub, a combined system with high-speed-rail service, an airport terminal, and metro connection in one location that also includes a district energy system. In short, future urbanization and infrastructure construction will have to meet higher quality requirements, which imply bigger development potential.

After years of tremendous demand for infrastructure projects and construction services, infrastructure companies now face overcapacity pressures, as well as problems related to a shrinking construction market that many developed economies have experienced.

Globalizing 'made in China'

After years of tremendous demand for infrastructure projects and construction services, infrastructure companies now face overcapacity pressures, as well as problems related to a shrinking construction market that many developed economies have experienced. China's urbanization and infrastructure development has transitioned from rapid growth to stable development. Therefore, initiatives to boost domestic demand, such as the new-urbanization effort, will have limited impact on domestic infrastructure-market expansion. Within ten years, significant demand will fade for the construction of highways, high-speed-rail systems, ports, and airports, bringing the overcapacity issue in construction to the fore.

In the meantime, however, China's construction industry still enjoys comparative cost advantages globally. That makes tapping overseas infrastructure demand a strategic priority. At present, developing countries in Asia, Africa, and Latin America are still in the early stages of industrialization and urbanization, which is

driving substantial demand for infrastructure. Simultaneously, developed economies—including the United States and European nations—are renovating and upgrading infrastructure on a large scale, which will also provide overseas opportunities for Chinese construction companies.

China's government is pushing construction companies to go global. For example, on his recent visit to Southeast Asia and Central and Eastern Europe, Chinese Premier Li Keqiang promoted Chinese transportation-equipment manufacturing in sectors including high-speed trains. The Chinese government has also put forward plans for a "Silk Road Economic Belt" with Asia and Europe and a "Maritime Silk Route" with Southeast Asian neighbors to encourage cooperation and trade. As these connections would rely on interconnecting highways, railways, air routes, and other networks, the government anticipates that they will provide significant strategic opportunities for Chinese construction companies to go global and strengthen international cooperation. ○



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Making infrastructure exciting:

An interview with Peter Dawson

**The public appreciates the creation of great infrastructure—
but the process is difficult.**

Adrian Booth,
McKinsey & Company

Peter Dawson has worked for the privately owned American engineering/construction giant Bechtel Corporation since 1978. He oversees a global portfolio of major projects, ranging from motorways in Kosovo to subway lines in Riyadh to gas plants in Africa to nuclear cleanup and construction in the United States. In this interview with McKinsey's Adrian Booth, he talks about the challenges of building infrastructure in both developed and developing countries.

McKinsey: *You once said, "Vibrant economies depend on world-class infrastructure." What did you mean by that?*

Peter Dawson: Infrastructure is an enabler for economies. There is the benefit of money coming

into the economy through spending, plus the benefits of the infrastructure itself once it is finished. Building roads in Eastern Europe, for example, generates opportunities for agricultural exports. We benefit today from people being bold in the past, and the next generations will benefit from people being bold today.

McKinsey: *What are the big roadblocks when operating in developing countries?*

Peter Dawson: Financing is a problem, whether it's a port, rail connections, roads, or distributed energy. Almost by definition, infrastructure is about building a long-term asset, and these projects can take a long time to finish. How do you manage political decision making when

the benefits are not immediate? Where is the money to be found in the budget? How do you borrow against the future with confidence?

McKinsey: *What do you think of developments in infrastructure funds and public–private partnerships?*

Peter Dawson: I think we’re making progress. It’s easier for private money to evaluate the existing infrastructure—for example, taking over an existing airport terminal and then increasing efficiency. Starting from scratch (what is known as greenfield infrastructure) is a different risk. The confidence that the political framework will last 20 or 30 years for the life of the assets has to be there. Private investors, infrastructure funds, and the like have to be confident that they can get something to closure. You’ve got to be confident that the political risk of the asset you’re funding—whether it’s an airport or a hydro plant—is covered, even after development. You also need repeatability.

McKinsey: *How can repeatability be encouraged?*

Peter Dawson: In developed economies, we’ve seen private money being successful where there’s been standardization. That gives a degree of confidence that you will get across the finish line. In some developing countries, there are so many interested parties and so many people who need to be consulted that such repeatability is difficult. That makes me sound like I don’t want to have stakeholder involvement. That’s not true. But it’s a matter of how.

McKinsey: *How do you think about skill and capability building?*

Peter Dawson: From a company perspective, the short-term way of thinking is to bring in skilled workers from outside and then move them to another country, another place, when the project is finished. On the other hand, if I develop a local workforce and a local supply chain, I can use them on the next project. But there’s another side to this coin. If the project is in an area where there is likely to be no further work, then what happens? Do you then get a frustrated community saying, “Well, I have all these skills. Now what do I do with them?”

“You’ve got to be confident that the political risk of the asset you’re funding—whether it’s an airport or a hydro plant—is covered, even after development.”

Peter Dawson



Vital statistics

Born in London, 1956

Married, with 2 sons

Education

BA and MA, natural sciences, St. Catharine's College, University of Cambridge

Career highlights

Bechtel Corporation

(2012–present)

President, global infrastructure

(2002–12)

Director, senior vice president, and chief financial officer

(2002)

Senior vice president of telecommunications

Fast Facts

Third-generation supporter, Arsenal Football Club; first-generation San Francisco Giants fan

Enjoys wine tasting and collecting

Board member, Cambridge in America

In Africa, an oil company we were working with was interested in developing a local supply chain that could provide fabricated steel or pipe bending or the like, even if it cost more. There would be a skill left, and even if the initial cost was higher, the recycling, the economic advantage, was good. Thousands of workers received skills training, from safety all the way through to welding and planning skills.

A Middle Eastern country offers another example. The country knows that it's important to have skilled jobs for its growing population, rather than just depending on petrodollars. For example, the country has to buy thousands of air conditioners every year. So the government decided to favor in procurement a company that would build a manufacturing unit in the country and train or develop a skilled workforce and management. I think it's a more sophisticated way of looking at pooling the power of national spending.

McKinsey: *Are there models of success that governments can look at and say, "We can replicate that"? Or is it more that each country has specific issues and needs to find its own path?*

Peter Dawson: A bit of both. Take the oil and gas companies. The global majors recognize that they're a common owner with common customers, even if they're teaming with national oil companies. There are global standards if you're building a refinery in the Persian Gulf, in Europe, or in Singapore. The standards and efficiencies, the whole operating and maintenance side, will all be optimized.

Other forms of infrastructure, by their nature, don't work that way. For roads, European standards may say you can't have a certain degree of curvature if you want to drive above 80 kilometers per hour, but other countries or regions

may have different standards. There's a problem with the fact that you don't have common owners.

McKinsey: *What could be done to improve this?*

Peter Dawson: The most difficult infrastructure projects we do are when we don't have an experienced owner on the other side of the table. You want people who are knowledgeable and experienced. A European government did something interesting along these lines. A few years ago, it realized that most major infrastructure-related projects were late and over budget. In a sense, the government was the owner of these projects but was not knowledgeable enough to be able to manage them. So the government set up a joint education program with a first-rate business school to figure out how to become smart owners.

If governments or public institutions or global infrastructure firms could develop common purchasing standards, that would also make things more efficient.

McKinsey: *You've said before that government leaders, democratic or not, sometimes don't see infrastructure as something that is to their immediate advantage. Is there a way to frame infrastructure so it gets people excited?*

Peter Dawson: How you connect major infrastructure development to something that resonates with the public or the taxpayer is difficult. Particularly in developed economies where things are not yet broken, there may not be a sense of urgency. People are apt to say, "What about me? I don't fly out of London, so why should I care if Heathrow or Gatwick gets another runway?"

In some economies, the population is so connected with the success of the country and the economy as a whole that these things can happen because everyone knows it's a good thing. The French, for example, have done extraordinarily well in two areas. One is building nuclear-power-generation capacity. That took decades, but it is obviously very significant and good for them. The other is building a very strong high-speed-rail culture. So the country expects new rail; it takes for granted that that's what will happen.

McKinsey: *It often seems that big infrastructure projects are controversial at the beginning but taken for granted once they're done.*

Peter Dawson: Yes—like the Channel Tunnel, between England and France. There were big arguments about that in the 1990s; now people couldn't imagine not having it. ○



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Infrastructure and economic development: An interview with John Rice

The need for speed in delivering progress.

Bill Wiseman,
McKinsey & Company

Since joining GE in 1978, John Rice has worked all over the world in departments as diverse as auditing, power, finance, and transport. Based in Hong Kong, he leads the company's global growth organization, which accounts for more than half of total revenues. In this interview with McKinsey's Bill Wiseman, he talks candidly about the slowness of bureaucracy and the role of the private sector in encouraging sustainable growth.

McKinsey: *What role does infrastructure play in supporting growth in developing markets?*

John Rice: Everybody is looking for “sustainable” or “inclusive” growth—growth that improves quality of life for all. Growth in and of itself is no

longer good enough. If you're not creating jobs, you are never going to have sustainable and inclusive growth.

But before you can create jobs, you've got to do a few things. You've got to have electricity. You've got to have healthcare—you can't have sustainable growth if people die when they're 45 or 50. You've got to have the basic building blocks of a society, and then you have to have a combination of financial and human-capital development. Only then do you have a shot at sustainable and inclusive growth.

McKinsey: *Do you find that countries value that way of thinking?*

John Rice: In many democratic countries (and not just developing ones), there is often a short-term focus on the next election cycle. In countries that don't have elections, there might also be a short-term focus on keeping the population happy. Also, when budgets are constrained, you tend to punt the long-term stuff. Infrastructure is long-term stuff.

I think there has been what you might call a “cycle compression” when it comes to how fast governments want investments to pay back. When I meet with senior government officials, they want to know what can be done quickly—temporary power, quick investments in clinics and healthcare—so that they can show visible progress. But those kinds of actions do not necessarily address the broader challenges.

There's no question that social media, and the ability of people to communicate and transfer information and assess their own circumstances, is increasing the pressure on governments. Even people who have very little disposable income are still connected. Expectations are being built up that problems are going to be solved quickly, and governments pick up on that and feel pressure to respond.

McKinsey: *The McKinsey Global Institute has estimated that up to three billion people could join the global middle class by 2030. How will this affect the demand for infrastructure?*

John Rice: The growth of the global middle class is creating another, higher set of expectations. For example, the growth in China's aviation industry over the past several years is evidence that the middle class will want to travel; the roads can't handle the increase in demand, and as a result, you are seeing the government invest in both aviation and rail infrastructure. Across

emerging markets, there is broad recognition that problems need to be tackled, that people aren't going to wait forever for the ability to travel, to read at night, to treat their sick child, and so on.

At the same time, I think you also have to remember that something like 1.3 billion people still don't have electricity, most of them in Africa and South Asia. You're not going to get to the middle class if you don't have the basics.

McKinsey: *What is the role of the private sector in developing the human and financial capital needed to help deliver infrastructure?*

John Rice: The private sector is right in the middle of it. In 50 countries where GE is bidding for big projects, we're expected to train and develop people. It's moved beyond just creating jobs, any jobs; we're talking about higher-scale, more sophisticated manufacturing value creation. If GE is not prepared to invest in capacity building, we are going to have fewer opportunities.

Whether we are building manufacturing facilities in Pune, India, or planning them in places like Calabar, Nigeria, we have to think about and fund capacity building for our own employees and suppliers. This investment can be a multiple of the plant-and-equipment cost and usually involves partnering with local universities.

McKinsey: *How do you scale up that kind of program?*

John Rice: You base it on markets and regions. Our expectation is that the work we do in places like India and Nigeria will support the local and regional market. The fact is, sometimes the volume won't support the investment; programs have to work from a financial perspective.

McKinsey: *The need for infrastructure is huge, but progress has been slow in many places to create public–private partnerships. Why is that?*

John Rice: Part of what slows things down is that bureaucracies don't get paid to move fast or take risks—and this is true in Europe and the US, as well as in developing countries. How do you give governments the confidence that they can make these decisions and not be attacked? And how can you get private capital to invest in a power project in difficult political environments? For that to happen, third-party investors need to have an assurance on the fuel supply and cost; they also need a bankable off-take agreement.

Public opinion is another factor. Many countries subsidize power, which in effect means that the investor return must be subsidized too. The

“private” part of the partnership is looking for a risk-adjusted market return, while the “public” side wants local energy prices. The difference becomes a political issue, sometimes leading to accusations of mismanagement and corruption.

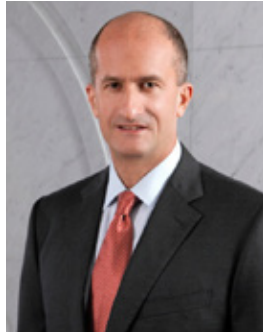
McKinsey: *What, if anything, can the private sector do to improve these circumstances?*

John Rice: It would be interesting to combine the efforts of institutions like the World Bank, a couple of export-credit agencies, and a half a dozen companies and say, “OK, we’re going to build a model for how to get this stuff done quickly and honestly.”

Something’s got to give, because governments alone are not going to fix the electricity problem. And they won’t attract a lot of third-party capital without certainty around fuel, costs, and off-take arrangements.

“There’s no question that social media, and the ability of people to communicate and transfer information and assess their own circumstances, is increasing the pressure on governments. Even people who have very little disposable income are still connected.”

John Rice



Vital statistics

Born in 1956

Married

Education

BA, economics,
Hamilton College

Career highlights

GE

(2010–present)

Vice chairman;
president and CEO,
GE Global Growth

(2007–10)

Vice chairman; president
and CEO, GE Technology
Infrastructure

(2005–07)

Vice chairman of
GE's industrial and
infrastructure businesses

(2000–05)

President and CEO,
GE Energy

McKinsey: *Is there any particular type of infrastructure program or product that is working well?*

John Rice: Distributed power comes to mind, meaning small-scale, often on-site sources of electricity. These are technologies that have been around for a while, but there has only recently been a general recognition that this is an important way to get electricity to those who don't have it. It will take decades to create transmission and distribution networks to carry electrons from big centralized plants to everyone who needs power.

You need smaller power sizes that run on a variety of fuels. It could be liquefied natural gas or biofuels or solar or a lot of different things. This idea is really beginning to capture people's attention, not least because these projects can be done fast.

Distributed power is also a good option for places that today rely on power from generators that run off trucked-in diesel, which is expensive and environmentally awful. Smaller gas turbines that can produce cleaner power at about half the price are a huge step forward; we're seeing a lot more demand for this type of technology. ○

