

A better road to the future

Improving the delivery of road infrastructure across the world

Interim report

McKinsey's Capital Projects & Infrastructure Practice
in partnership with the International Road Federation
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Foreword

Roads are the world's first "social network". They are fundamental building blocks for the creation of wealth, economic growth, access to services, and social cohesion.

Many authoritative studies have underscored the growing gap between investment needs on the one hand, and the combined spending on road construction and upkeep on the other. Less attention has been paid to the policies and mechanisms required to "stretch" available funds through better project selection, efficient procurement strategies, and effective delivery practices.

This report focuses on what can be done to enhance the whole delivery system, ensuring that the spend results in the best possible road network – defined as the road network that best fulfills the transportation needs of the economy.

Given the complexity of the task at hand, all stakeholders have a role to play: governments can set up the playing field right and enable sufficient flow of funds; infrastructure owners can build comprehensive plans for investments, maintenance and, improved use; companies can strive for innovation; courts and municipalities can streamline permitting; and citizens can make their voices heard on effectiveness measures. The task may feel overwhelming, but as the work with this report has shown, a good way to start is to take stock of the current state and design an inclusive plan for improvements based on the desired future state.

McKinsey & Company and the International Road Federation (IRF) established a partnership from 2015 to 2017 to survey the global road sector and develop a comprehensive view of market trends and best practices. The results of this research provide transportation decision makers with a comparative study on the cost-effectiveness of these productivity-enhancing practices.

It is our hope that, at all levels of government, decision makers across our industry will find these recommendations essential to their work.

Nicklas Garemo and Martin Hjerpe
McKinsey & Company

Patrick Sankey and Brendan Halleman
International Road Federation

Authored by:
Nicklas Garemo
Martin Hjerpe
Brendan Halleman

The authors would also like to thank the many colleagues at McKinsey and IRF who have contributed generously to the report.

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The world faces an unprecedented infrastructure challenge and needs to invest more than \$900 billion in its roads annually

Improving infrastructure delivery to enhance the road networks of the world

Reliable and accessible infrastructure is a cornerstone for socioeconomic progress. It enables productivity growth, shortens travel times and costs, creates jobs, and connects different parts of society. McKinsey Global Institute (MGI) estimates that infrastructure typically has a socioeconomic rate of return of 20 percent over time—that is, each invested dollar delivers a 20 cent increase in annual GDP in the long run.¹ This means, provided sustainability is considered in the project, infrastructure investments can be a rare win-win, combining short-term job creation with long-term economic development.

However, on a global scale, investments fall short of demand for new-build and annual maintenance of existing infrastructure (across all asset classes) by some 10 percent per year. This gap widens by almost four times when factoring in the infrastructure investments required to meet the targets set under the 2015 UN Sustainable Development goals.

In the road sector alone, MGI research shows that investments need to be approximately \$900 billion per year to keep pace with projected growth. Current investments in the road sector unfortunately fall short of this figure by \$180 billion per year.

Part of the problem is that too many countries have, over long periods of time, paid insufficient attention to the maintenance of existing assets. As a result, large (and often increasing) maintenance backlogs occur. Congestion, deteriorating quality of roads, and sometimes structural concerns lead to economically harmful closures. Clearing the maintenance backlog adds significant financial and capacity burdens to the already sizeable needs for new-build and ongoing maintenance.

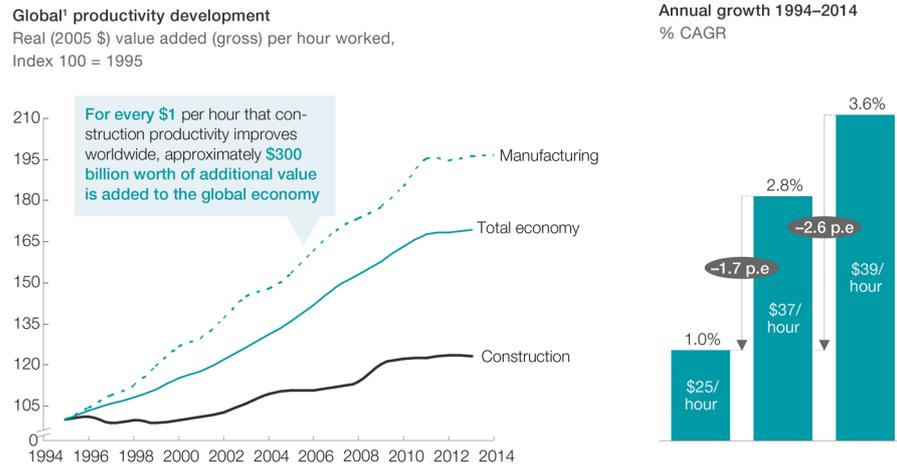
Many government leaders recognize the problem and talk about increasing investments. However, the investment gap widened after the financial crisis of 2008–09 as governments, especially in the developed world, cut back on infrastructure spend as share of GDP. It is only in the past two to three years that investments have again started to grow fast enough to slowly close the gap, but it is an open question if this will be sustainable over the business cycle.

To date, the debate in many countries has largely focused on identifying new funding sources. However, infrastructure delivery is fraught with problems. Productivity in the construction industry has been flat for decades. Project cost overruns and delays are commonplace—for example, research by Bent Flyvbjerg at Oxford University's Said

¹ For details, see *Bridging global infrastructure gaps*, McKinsey Global Institute and McKinsey's Capital Projects & Infrastructure Practice, June 2016.

Exhibit 1

Construction productivity grew 1.7 p.p. per annum slower than the overall economy



¹ Based on selection of 42 countries, constituting 96% of global GDP.
Source: GGCD-10; national statistical agencies of Turkey, Malaysia, and Singapore; OECD; Rosstat; US Bureau of Economic Affairs (BEA); US Bureau of Labor Statistics (BLS); WIOD; World Bank; McKinsey Global Institute analysis

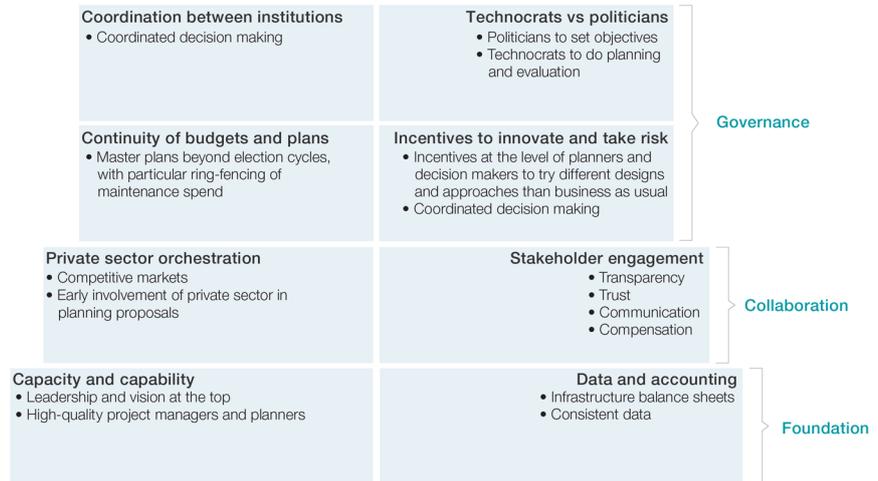
Business School shows that 85 percent of major projects experience cost overruns on average of 20 to 45 percent. There are also many examples of countries investing in politically beneficial but socioeconomically suboptimal projects—the “bridge to nowhere” problem. As a result, construction productivity has grown at a significantly slower rate than that of the total economy: between 1994 and 2014, this disparity amounted to 1.7 percentage points per annum (Exhibit 1). Granted, there are known problems with measuring productivity in the construction sector, leading to underestimation of real productivity growth, and there are also segments where the development has been notably better—but, overall, the challenge is real.²

Sector fragmentation is part of the problem and an important inhibitor of productivity improvements. Many stakeholders influence both new-build and maintenance: public sector organizations, private sector companies, as well as citizen groups. Project selection and funding, permitting, citizen protests, appeals, regulatory requirements, technical norms, public procurement rules, and other forces combine to create a complex web for anyone trying to improve road and transportation networks. This landscape of stakeholders and the environment in which they work constitute a “delivery system.” The system includes the sector governance (how decisions are made, how budgets and plans are structured, how incentives are aligned, and how tasks are divided between politicians and technocrats); collaboration between stakeholders (private and public sector, citizens, and organizations); and enabling foundations (capacity and capability, data, and accounting principles) as Exhibit 2 indicates.

² For further reading on construction productivity, see the MGI report from 2017 *Reinventing construction: A route to higher productivity*.

Exhibit 2

Improving infrastructure outcomes requires that the right system, governance, and enablers are in place



Source: McKinsey Global Institute

Our experience has repeatedly shown that in order to significantly and sustainably improve a country’s road network, the whole delivery system must be taken into consideration. Improvement interventions will only reach their full potential when they are designed and implemented with the full delivery system in mind. The impact of any intervention aimed at increasing the pipeline of planned road projects will be limited if the permitting process is slow and complex due to, for example, poor stakeholder management or collaboration between institutions. Likewise, increased funding for roads will likely only lead to increased cost if the supplier market is capacity-constrained and/or oligopolistic in nature.

In other words, it is not enough to increase funding for road investments and maintenance. The way infrastructure is being delivered—the delivery system—must also change for the better, or the economic growth of countries will be hampered with slower socioeconomic progress as a result. By studying over 20 road infrastructure delivery systems across the world and using a diagnostic tool based on the insights in the 2013 MGI report *Infrastructure productivity: How to save \$1 trillion a year*,³ we have identified a number of root causes and potential improvements. This report summarizes our findings from these diagnostic efforts on how to address the road infrastructure challenge.

³ For details on infrastructure productivity opportunities, see *Infrastructure productivity: How to save \$1 trillion a year*, McKinsey Global Institute and McKinsey’s Capital Projects & Infrastructure Practice, January 2013, and its 2016 update *Bridging global infrastructure gaps*



How to assess the effectiveness of road infrastructure delivery systems

In consultation with leading industry experts, we developed a diagnostic for the full infrastructure delivery system. The diagnostic evaluates five key areas:

- A. Fact-based project selection
- B. Streamlined project delivery
- C. Making the most of existing road networks
- D. Strong governance and capabilities
- E. Robust funding and finance

These areas are broken down into 30 categories and 80 sub-categories, each representing a globally leading practice, and are connected to a database of over 500 examples of best practices found across the world (**Exhibit 3**).

More than 20 countries in Europe, the Middle East, Africa, Latin America, and South-East Asia have applied this diagnostic and analyzed the delivery systems in the road infrastructure sector. In parallel, we have worked with several countries and road agencies on specific parts of the delivery system: for example, fact-based project selection, procurement strategies, supplier industry competition, and technical standard simplifications. These efforts have yielded insights into the root causes behind the challenges in the infrastructure industry in general and the road sector in particular. They have also enabled us to identify successful and proven approaches to overcome these challenges.

Exhibit 3

An analysis of national delivery systems in the road-infrastructure sector, range¹ 1–5 (wh

Robust funding and finance framework

Clear strategy for market competition and ownership

Suitable regulation, pricing, and value-capture investment

Sufficient financial capacity

Suitable conditions for private-infrastructure finance

Effective approach to public-private partnerships

Strong framework for long-term public funding

Attractive overall investment climate

Strong governance and capabilities

Strong governance and collaboration

Robust infrastructure data

Strong capabilities

Focus on sustainability

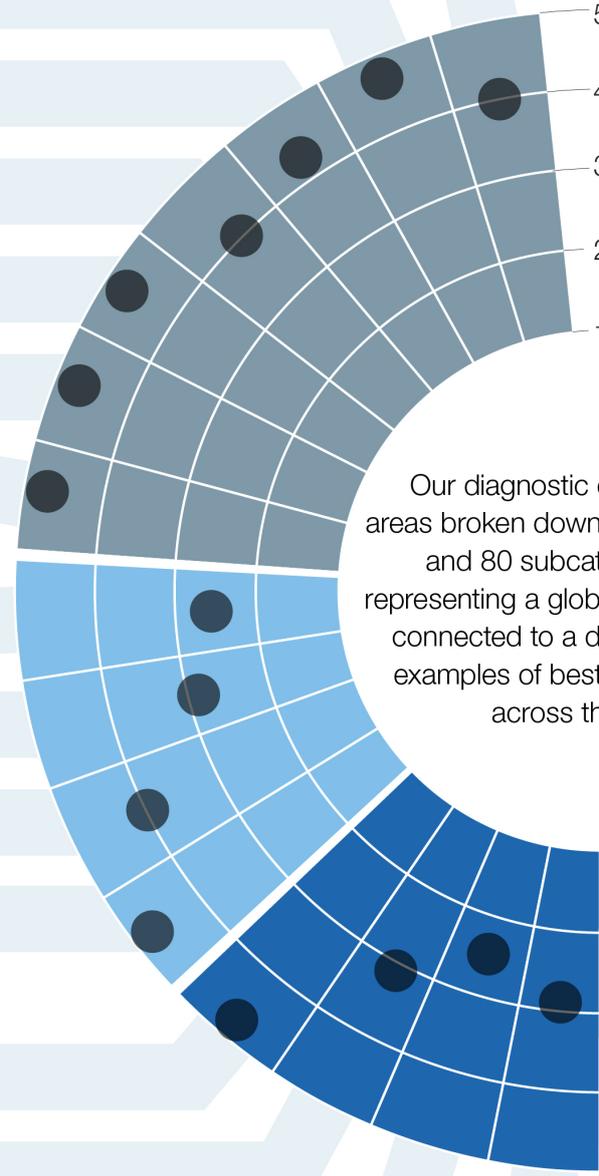
Making the most of existing road networks

Demand management

Increased asset utilization and loss reduction

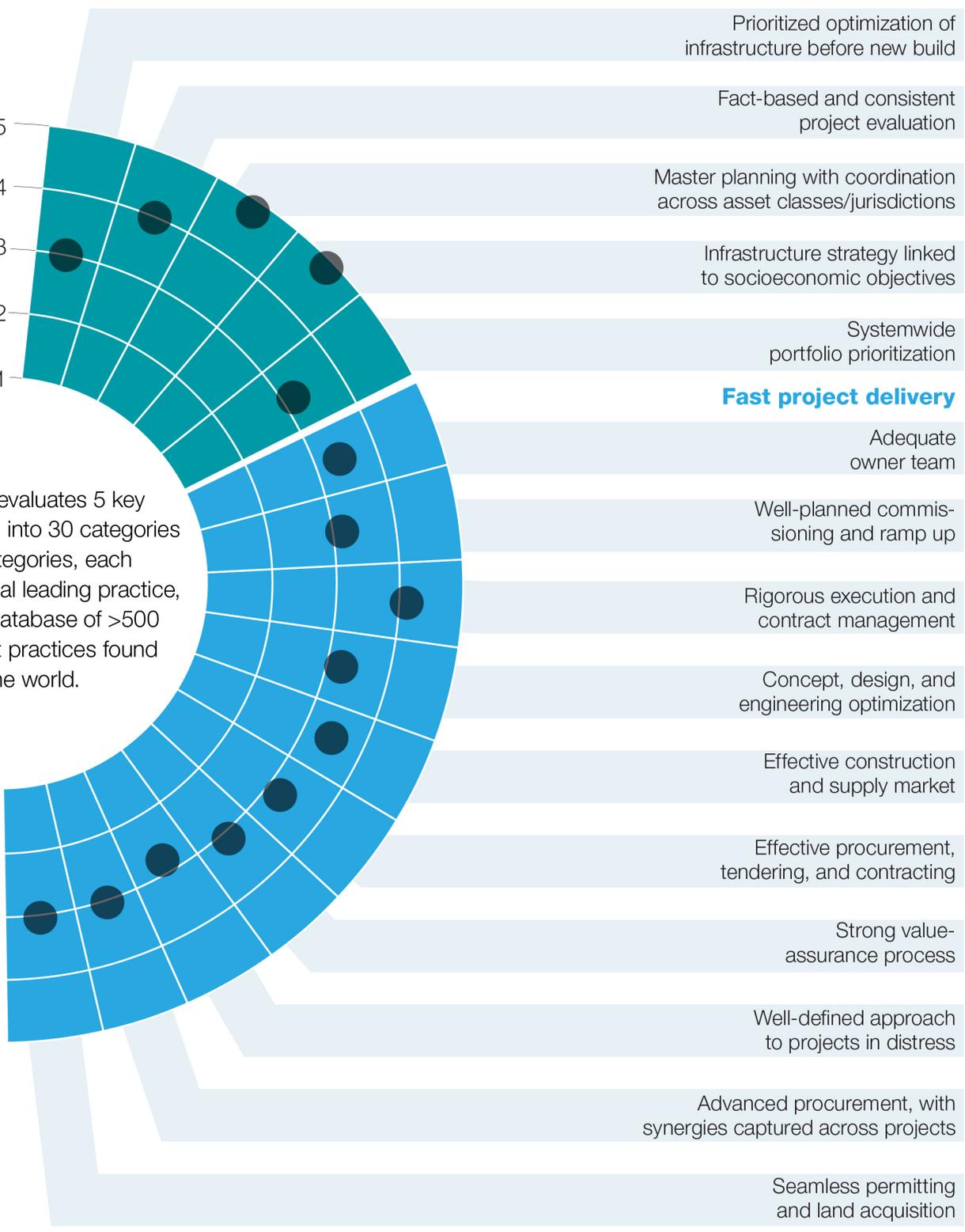
Robust institutions and processes for combatting corruption

Total cost of ownership-oriented maintenance



¹Spread of ratings from high to low among 20 countries studied.

(where 1 = poor, 5 = good)



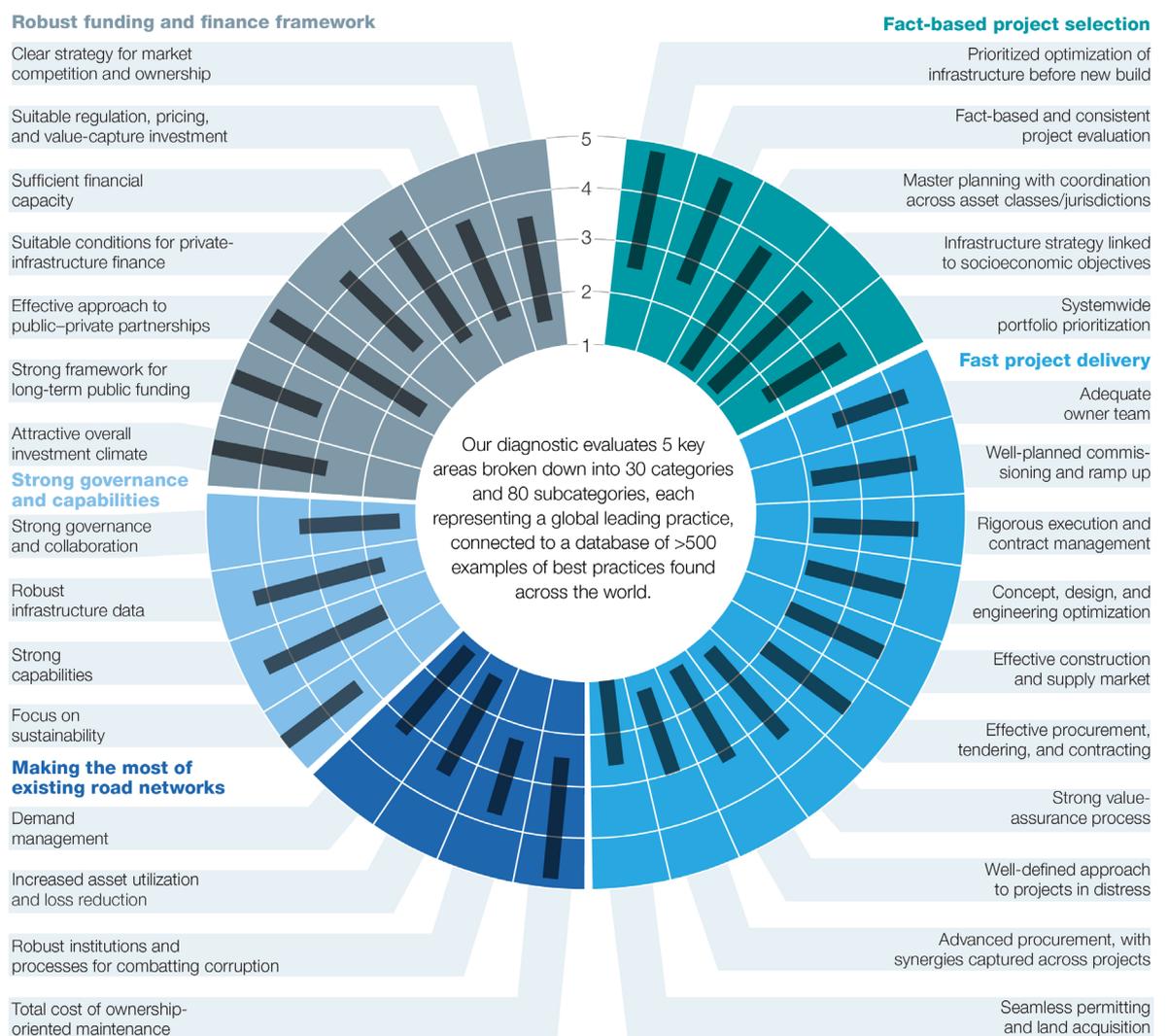


STOP

Root causes of the infrastructure problems in the road sector: Learnings from around the globe

Overall, there is large variability in performance across countries. However, no country in our analysis stands out as best practice across the board. Rather, each country has strengths as well as challenges on different dimensions (Exhibit 4).

Exhibit 4 An analysis of national delivery systems in the road-infrastructure sector, range¹ 1–5 (where 1 = poor, 5 = good)

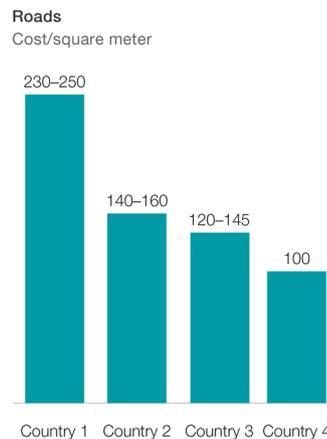


Additionally, stakeholders in well-performing countries tend to be more critical of their own performance than those in poorer-performing countries. While the effect is difficult to prove with statistical significance (as there is no fundamental objective performance metric covering the full spectrum of the diagnostic), this may be a signal that a certain level of maturity in infrastructure is needed to unearth existing, less visible problems and create awareness of how to improve.

Exhibit 5

Large cost variations across countries

Index at 100, normalized for topography and ground conditions for 4 countries in the same region



Source: IATA data; press search; published reports; team analysis

Differences in design, standards, ground conditions, supplier markets, and other factors lead to difficulties in benchmarking costs between countries and projects. Even when normalizing for as many of these differences as possible, we often see large disparities in road construction costs between countries, illustrating the productivity challenge even further (Exhibit 5).

We find that a number of drivers inhibit productivity improvements in the sector:

Ineffective project selection and prioritization

One of the most common problems in infrastructure, and a source of considerable waste, is found in the prioritization and selection of projects. In theory, it should be simple to calculate the socioeconomic benefits from a specific road project and prioritize based on its returns to society. In reality, there are multiple challenges that prevent countries from doing this effectively. Not all countries have a standardized and fact-based way of conducting the socioeconomic cost-benefit calculation. The direct cost of construction and savings from shorter travel time are very often used in the calculations, but when different methodologies for traffic prognoses and construction cost estimates are used, the results can vary significantly. For example, traffic forecasts are regularly off by more than 20 percent. Second-order effects (agglomeration effects, environmental impact, citizen satisfaction, and so on) are often not included at all, or included when a positive “business case” is actively pursued. In addition, decisions about road investments are often made for political reasons, meaning that the socioeconomic cost-benefit calculation does not always serve as the deciding factor for prioritization. In one Middle Eastern country, we also saw a tendency to build roads in peripheral parts of the country, with fewer inhabitants and a lower actual need, but where zoning and permitting could be completed in a reasonable timeframe. The net result of all these factors is a road investment budget that is not used in the most effective way.

Ineffective construction and supply market due to fragmentation across the value chain

The construction industry has many small-scale players. To illustrate, 50 percent of the output in the US construction sector is produced by companies with fewer than 50 employees. Even large construction companies often use many sub-contractors, and a single road construction site can have employees from many different companies in place at any given time. This increases the on-site coordination challenge, but also limits the ability to innovate, drive efficiency, and share learnings from project to project since the set-up continually varies by project. The problem grows when incentives are not fully aligned between all the players, which is often the case. In addition, there is a risk that administrative costs and margins add up across the different layers of sub-contractors, increasing the overall project cost. Some also claim that the risk of a sub-contractor deviating from rules and regulations (for instance, by employing unregistered employees or paying lower than minimum wages) rises as more sub-contractors are involved. For example, Norway has introduced a limit on the number of layers of sub-contractors in construction projects: as a general rule, no more than two layers of sub-contractors are allowed on public infrastructure projects.

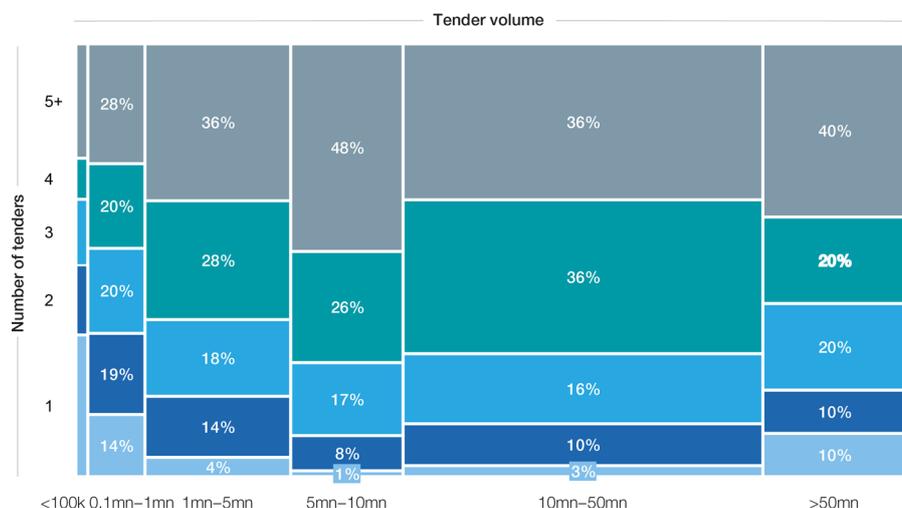
Oligopolistic supplier industries

There are hints of oligopolistic behavior across all parts of the value chain. For consultants, contractors, and material suppliers, there are many examples where relatively few bids are being made on public tenders, especially when it comes to smaller works below around \$50 million. When one road agency analyzed 2,200 tenders over a five year period, covering consultants, contractors, and design-build combinations, 30 to 40 percent of these tenders received three or fewer bids, and only around 40 percent of tenders received five or more (**Exhibit 6**). Small tenders (\$5 million to \$10 million) often attracted just the smaller,

Exhibit 6

Many tenders receive few bids

Number of bids per expected size of contracts, roads, 2012–17, USD



local companies, while only the major projects (\$100 to \$200 million) attracted international companies or consortia. National leaders are active in the middle range, but international companies rarely consider these projects large enough to tender. As a result, it is difficult to be certain that the most competitive bid won the tender, especially since price differences between the different bids could be large despite few bids.

Insufficient planning and design and lack of value assurance processes

Generally speaking, more than 80 percent of a project's cost is determined by the time 10 percent of its funds have been spent. The planning phase sets the conditions for what will be built, and choices are made very early in the project that dictate land purchase costs, mass balances, needs for bridges and tunnels, and so on. Too often there is not enough focus on the early stages, leading to decisions that subsequently increase costs. This is especially common where there is limited communication between stakeholders across the value chain. Often the initial road corridor is decided with strong influence from politicians with limited transparency on the costs of alternatives. Additionally, the design consultant often has few incentives to lower overall project costs and to ensure it is possible to increase effectiveness of actual construction. When the construction contractor is then hired, there is little left to do that can improve the overall cost. As one CEO told us, "It would be easy to reduce cost by 30 percent by moving to different designs—but if we are given those designs already, rather than being able to influence them, we have to deliver the more costly project."

Construction techniques and technology not fully industrialized

Approaches such as lean construction, the use of big-data-driven building information modeling (BIM) systems, telematics in construction machinery, digital twins of physical objects, prefabrication, effective and automated machinery, and construction flow balancing are often not applied to their full potential. There are many examples of smaller-scale innovation trials, but many contractors bear witness to the difficulty of scaling innovations to be used across projects and across geographies. We have even seen examples of countries prohibiting the use of large-scale, capital-intensive machinery in some contracts in order to increase competition and promote participation of small- and medium-sized enterprises in the tenders.

Lack of innovation caused by inertia in design and engineering

Construction is typically a low-margin business, meaning that any large failures or rework that cannot be passed on to the customer can quickly lead to project losses. In addition, infrastructure assets have a long lifecycle: a new road must withstand the impacts of traffic and nature for many years. This tends to create a preference for tried-and-tested methods and materials. Combined with detailed norms and standards, and long, complex processes or changing them, this means that many stakeholders are unwilling to experiment and innovate.

Ineffective procurement processes and contract structures

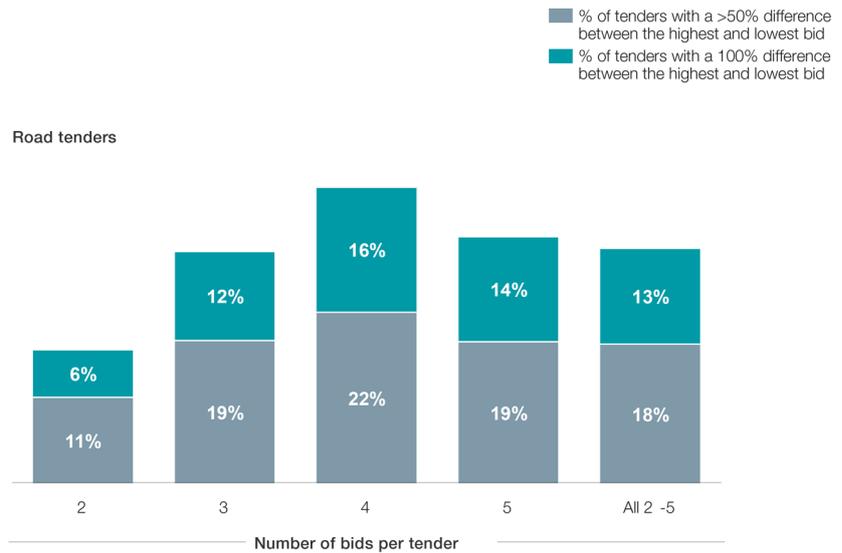
Several countries in our study maintain a simple adherence to public-tender rules, often with price as the only selection criterion. This means that the road agency gives up much of the ex-ante control over contractor quality—often, anyone that fulfills very basic quality requirements can bid, and high quality is not preferentially weighed in the evaluation. In addition, and partly as a consequence, bids in public tenders for road contracts very often display large differences in price levels. In one road agency, 30 percent of all tenders with two or more bidders exhibited a price difference between the lowest and highest bidder of 50 percent or more (Exhibit 7).

The total spread in bids could of course be due to one single bidder leaving a very speculative bid (high or low), but the difference between the winning bid and the second-best bid is also

Exhibit 7

Large (>50%) price differences in many tenders

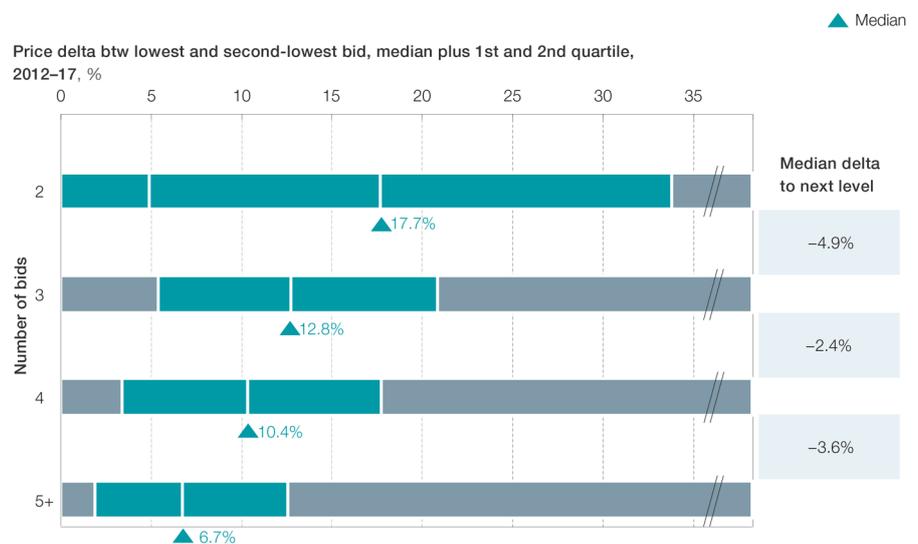
Price difference between lowest and highest bid, per number of bids, 2012–17, percent



large—often 20 percent or more—especially when there are fewer bidders on a tender (**Exhibit 8**). While the median difference declines with an increasing number of bids, there is still a risk of

Exhibit 8

Increased number of tenders reduces the price difference between the two lowest bids

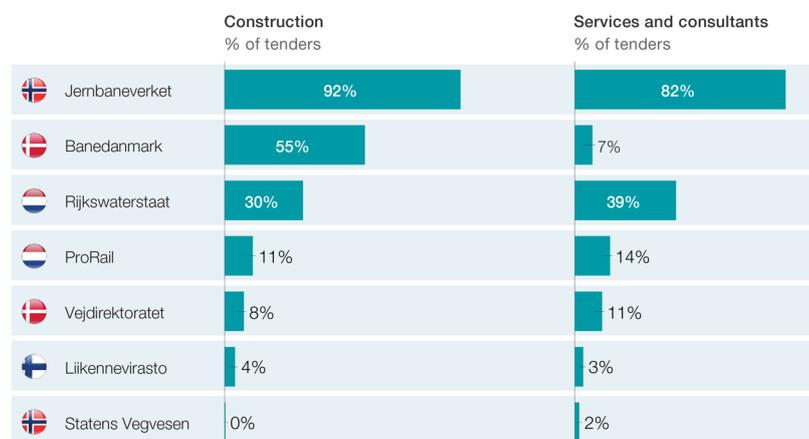


a “winner’s curse” with one bidder underestimating risks and/or calculating the cost too optimistically. If the bid is unrealistically low, and the bidder wins, there is considerable risk that the project will be a prolonged battle over change orders between the road agency and the contractor, risking delays and increased taxpayer costs. One European country astonishingly found that 70 percent of projects executed by winning bidders were ultimately more expensive than the proposed budget of the “runner up” when accounting for cost overruns over the life of the project. It is of course possible that overruns were due to acceptable circumstances, such as material cost increases or geological conditions that were impossible to predict; in which case one would assume that the cost of the “runner up” would also have increased. Nevertheless, the trend is so prevalent that it begs the question of how often the wrong contractor wins the bid to begin with.

Limited use of more advanced procurement, including negotiated tenders

While public procurement laws typically allow negotiated tenders, countries vary widely in their use of this option. Several countries rarely use negotiations, often in order to reduce the risk of appeals. There are also questions about how to best use the negotiations. In our experience, we have heard the justifiable view that negotiations aimed only at putting pressure on price will be counterproductive in the long term. However, when negotiations are used to give feedback on the selected solution and to ensure that all bidders have truly understood what needs to be delivered, they can provide significant benefits to all parties involved. The Publications Office of the EU, which gathers statistics on the use of negotiations in tenders, suggests notable variations in practice between different north-European infrastructure owners, despite similar underlying EU regulations (Exhibit 9).

Exhibit 9 Use of negotiated tenders in selected European road and rail agencies
Share of negotiated tenders¹ 2014–17 per category



¹ Tenders above the threshold (€5mn for construction, €135k for services).
Source: Publications Office of the EU; TED

Limited use of demand management

In more densely populated and heavily trafficked areas, it is generally economically infeasible to build enough new road capacity to solve congestion without causing other negative effects. New roads in and around cities have a tendency to induce increased traffic over time. Pricing mechanisms, or other mechanisms to manage demand, can often have a very high socioeconomic return on investment. The introduction of congestion charges has shown this effect in several cities. Regions and countries could increase their use of demand management to make more use of the roads, spread traffic out to off-peak hours, and/or limit certain types of traffic at rush hour.

Ethics and integrity

In some geographies, corruption is prevalent in the construction industry. Regardless of whether corruption happens in the early stages of project selection or later in the construction phase, it has the direct effect of wasting resources and the indirect effect of raising barriers to innovation and new entrants. Few countries are fully spared—examples exist in countries with otherwise very low corruption—but the magnitude of the problem varies. Fighting corruption wherever it occurs must be a priority.

Additional sources of funds

Several factors limit the availability of funds in both the public and the private sector. Given the fiscally challenged position of many governments, it is unlikely that traditional “pure” public funding will be sufficient to bridge the global spending gap. There are also many different priorities that “compete” for available public funds, and the justification for spending the next dollar on infrastructure is sometimes difficult given other pressing public needs. That said, there are sources of funds that are not used to their full potential and that could offer additional relief, such as revenue capture from roads (e.g. tolls, user charges, real estate appreciation capture) or use of alternative financing sources (e.g. public-private partnerships).

The future of mobility

Finally, there is substantial uncertainty about the future needs of the road transport sector. We have not yet seen this uncertainty become a barrier to investment in roads, but several countries are facing a lively debate on how to future-proof the road network, raising fundamental questions on how investment needs will change as the future of mobility becomes reality. Should it, for example, be the responsibility of the government to invest in the requisite charging infrastructure once the majority of vehicles become electrified? And how much should be invested in capacity enhancements in and around congested cities, if future intelligent traffic management systems will be able to increase the utilization of existing roads significantly? These questions need to be debated and incorporated in all road transport master plans. For further reading on this topic, we recommend the 2016 report *An integrated perspective on the future of mobility* (Bloomberg New Energy Finance and McKinsey).⁴

⁴ See *An integrated perspective on the future of mobility*, Bloomberg New Energy Finance and McKinsey & Company, October 2016.



What can be done about the challenges?

Our work illustrates the complexity of the challenge in infrastructure. The solutions are equally complex, and there is no silver bullet that a country can apply to significantly improve its road infrastructure delivery system. However, there are many components of best practice that are already being demonstrated in countries all around the globe. The diagnostic approach to assess the performance of road infrastructure delivery systems outlined in this report illustrates that each country could build an improvement journey based on its individual starting point. It is clear, however, that improvements across the main dimensions of the diagnostic approach are needed.

Improve project selection

The key to improved project selection is to establish (and stick to) a rigorous, fact-based project evaluation and a transparent process for establishing what can be done and in what order. Having one entity responsible for evaluating projects and establishing a fact-base enables policy makers and elected officials to properly prioritize. Ensuring an outcome-focused approach to prioritization will bring the greatest benefits to citizens and businesses. Transparency in the process and on the criteria for prioritization also helps with stakeholder management. In 2015, when Norway established a new road delivery unit, Nye Veier A/S, the entity was tasked with establishing a refined project portfolio process with the aim of prioritizing and sequencing road construction projects in an objective way. Nye Veier is now twice a year publishing its portfolio prioritization alongside its methodology for calculating the cost-benefits—a good example of how increased transparency and a fact-base can help improve economic effectiveness. The result has been both a clearer timeline and more effective stakeholder discussions on how to potentially change the design of projects to create more value and enable higher prioritization. Another example, as described in the 2013 MGI report on infrastructure, is South Korea's Public and Private Infrastructure Investment Management Center (PIMAC) that has helped to lower the country's infrastructure budget by 35 percent, in part by introducing a highly rigorous project selection process.⁵

It is equally important that the fact-based project selection method originates in the infrastructure strategy and is linked to the overall strategic goals of the society. What transportation needs does the country aim to fulfill? What other objectives are important? And how will these needs most effectively be met? The needs are diverse, and we often observe different stakeholders holding very different views on what is most important. Unless there is a clear link to the country's overall strategy, it is difficult to reach a workable consensus on a reprioritized road investment portfolio. The impact of effective alignment can be profound. A recent study of the full road network in a Middle Eastern country identified an opportunity to reprioritize the upcoming project portfolio and improve the fulfillment of the strategic objective while saving 20 percent of the total future spend.

Streamline delivery

The construction industry has seen slow productivity growth over several decades, which makes road construction more expensive relative to other goods and services in the economy. Infrastructure construction takes several years from planning to completion, and in many cases there will be different political leaders and priorities during the course of a single

⁵ For details, see *Infrastructure productivity: How to save \$1 trillion a year*, McKinsey Global Institute and McKinsey's Capital Projects & Infrastructure Practice, January 2013.

project, creating additional challenges. Early-stage planning sets the prerequisites for the whole project, but we often see too little investment in this stage. Eager to break ground, and sometimes fearing that funding will go away if a project isn't started under the current budget, infrastructure owners too often rush through this phase, which can cause problems further down the road.

The key to improving streamlined delivery is to boost cooperation in the sector across contracting, tendering, site management, and stakeholder management. The infrastructure owner decides the type of contract and how to tender the projects. For example, in an effort to improve innovation in the sector, Sweden's National Transport Administration in 2012 decided to move away from design-bid-build contracts and increasingly to design-build contracts. The aim was to launch design-bid contracts in 50 percent of all road and rail construction projects. In just a few years, the target was met, and while it will take time for consultants, contractors, and the project owners to fully adjust to the change, the overall experiences have been positive. Design-build contracts are not a panacea for the industry—many projects are better suited for design-bid-build contracts—but their increased use in Sweden illustrates how the public and private sectors can improve cooperation, align incentives, and better draw on each other's strengths. We have also seen cases where the use of negotiations under the framework of public procurement laws have positively affected infrastructure projects. The negotiations can be used to limit erroneous calculations, to reduce overly wide discrepancies in risk estimates, and to encourage improved use of alternative construction methods—however, they also increase the need for advanced tendering capabilities with both the infrastructure owner and the suppliers.

Make the most of existing infrastructure

Governments often have a tendency to address transportation needs by launching a new project. While cutting a ribbon to inaugurate a new road may seem like a powerful step toward an improved transportation situation, the existing stock of roads will always be more important than any new addition to the network. Thus, making better use of the existing road network is key to effective transportation. However, our diagnostic shows that many countries do not focus enough on this lever, for example by letting existing roads deteriorate due to lack of maintenance, underusing pricing mechanisms, and not fully embracing the opportunities of “intelligent” transportation systems.

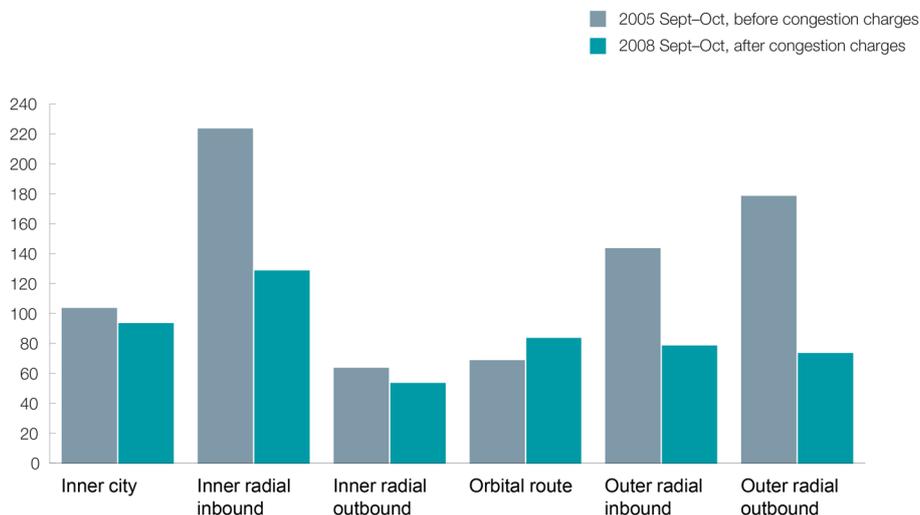
First, by focusing on maintenance, building a fact-based maintenance strategy that reduces lifecycle costs of the road, and ensuring that assets are not allowed to deteriorate to the point where reconstruction costs start to rise sharply, governments can increase the reliability of the road network and reduce the overall cost of ownership. To achieve these improvements, road agencies must have a solid understanding of the deterioration rates for the different assets that constitute the road network, and ensure both funding and a fact-based prioritization of repairs.

Second, pricing mechanisms such as congestion charges can improve the utilization of the road network and lead to higher economic effectiveness. Congestion charges are often unpopular, but when correctly implemented, they change how and when people travel and reduce both congestion and travel times. Effects on the environment are also often positive. Cities as diverse as London, Riga, Singapore, and Stockholm have proven this point. When Stockholm introduced congestion charges in 2007 (after a trial period in 2006), a significant

Exhibit 10

Effect on road travel times from the Stockholm congestion charge

Relative increase in travel times on different sections of the road network, morning rush hour (07.30–09.00), %



Source: Stockholm Trafikkontoret "Analys av trafiken i Stockholm – med särskild fokus på effekterna av trängselskatten 2005-2008"

reduction in delays was observed as people either switched to public transportation or traveled outside of peak hours (**Exhibit 10**).

Thirdly, the capacity of existing assets can increase by making them more “intelligent.” This includes both solutions that have been around for a number of years, such as adjustable road signs, reversible lanes, adaptive traffic lights, and so on, and also newer technology such as navigation apps with crowd-sourced traffic information. The impacts of existing technology for intelligent traffic systems are already large, but they pale in comparison with more optimistic views on what can be achieved with autonomous vehicles. It is possible that connected and self-driving vehicles can increase the capacity of existing infrastructure significantly, both through reduction of accidents and reduction of “stop-and-go waves.” A recent study at Cornell University showed that even if only as few as 1 in 20 cars have autonomous capabilities, the impact on congestion can still be sizeable. The standard deviation in speed between the cars in a congested lane was reduced by half, and more than two-thirds of sharp brakes disappeared, leading to better traffic flow, less congestion, and reduced fuel consumption.

Ensure effective sector governance

Across the board in our diagnostic efforts, we find that three enablers need improvement for the road infrastructure sector to work better: capabilities, collaboration, and governance.

The effectiveness of the road delivery system ultimately rests on the capabilities and competence of the people involved. More often than not, there are not enough skilled experts and talented professionals to meet the needs of the sector. The impact can be profound. Our research across thousands of infrastructure and construction projects shows that the skills of the project manager make all the difference—no other factor correlates as strongly with the result of the project. In one analysis, we looked at 1,000 projects over five

years and followed the results of each project manager involved. Approximately a quarter of the project managers (with more than ten projects completed) were consistently high-performing; one tenth were consistently low-performing; and the rest (approximately two-thirds) had a mixed performance record. The average gross margin in the high-performing group was three times higher than the margin achieved in the consistently low-performing group. It is clear that attracting, developing, and retaining talent is imperative, but also something that many governments and private sector representatives acknowledge as an important challenge.

An effective road sector requires collaboration between a broad range of stakeholders from the private sector, public sector, and citizens. Across our efforts, we consistently see how this collaboration lacks efficiency, often because there is not a commonly shared goal for the road sector. The road agency of one Scandinavian country benefited from improved collaboration (and enhanced delivery performance of major projects) once it introduced a more formalized upfront alignment on exactly which problem a new road was supposed to solve. Often the agency, the municipalities, public interest groups, and other stakeholders had different (or diffuse) ideas of the objective, and by aligning upfront, many of the subsequent collaboration issues could be avoided.

Finally, when it comes to governance, cooperation between different parts of a government can pose challenges. In one Latin-American country, the collaboration between different government agencies had become so inefficient that it was deemed necessary to reorganize and introduce a new entity for coordination and delivery of road projects. Separating technical and political responsibilities (as, for example, Sweden has done with the separation of powers between its agencies and ministries) can help clarify the roles and facilitate improved governance, but the specific solution must be tailored to the political situation in each country.

Enhance funding and finance frameworks

While funding of roads will likely continue to be predominantly sourced from government budgets, many countries would be better off if they could complement public funds with access to private money. No one solution is right for all countries, but tools ranging from toll stations, infrastructure bonds, real estate appreciation capture, congestion charges, public-private partnerships, build-operate-transfer, and other methodologies can be part of the toolbox and considered as a way of topping up available funds.



A prize too big to ignore

Addressing all of these areas is a significant challenge, but the potential impact is correspondingly huge. The 2013 MGI report analyzed best practices from around the world and estimated that, if fully implemented, these practices could save as much as 40 percent of the overall spend (or equivalently deliver two-thirds more infrastructure for the same spend).⁶ This number should be seen as a stretch target, since it requires best practices across the board, and we observe lower potential in real-life transformations. However, capital expenditure (capex) and maintenance savings of 20 percent or more are routinely seen, even without ensuring the correct project prioritization. This is also in line with overall industry productivity numbers. If the underlying productivity growth could be raised to the same level as the productivity growth of the economy, it would only take ten years to realize 20 percent savings worldwide—that is, the equivalent value of \$180 billion annually in the road sector alone. This is the same amount that MGI research has identified as the current shortfall in road investments to keep up with projected growth globally. At this pace, the full 40 percent identified in the MGI report would take two decades to realize, at a total value of \$360 billion annually (in today's prices). Clearly, the size of the prize is too large to ignore, and all stakeholders should consider putting all possible efforts into improving the way we build, maintain, and operate roads.

⁶ For details on our productivity research, see *Infrastructure productivity: How to save \$1 trillion a year*, McKinsey Global Institute and McKinsey's Capital Projects & Infrastructure Practice, January 2013 and *Reinventing construction: A route to higher productivity*, McKinsey Global Institute and McKinsey's Capital Projects & Infrastructure Practice, February 2017."

Authors

[Nicklas Garemo](#) is a senior partner in McKinsey's Abu Dhabi office.

[Brendan Halleman](#) is vice president of Europe & Central Asia at the International Road Federation.

[Martin Hjerpe](#) is a partner in McKinsey's Stockholm office.

[The International Road Federation](#) is a global not-for-profit organization, headquartered in Washington, DC since 1948 and supported by regional offices throughout the world. The IRF serves a network of public and private sector members in more than 70 countries by providing knowledge resources, advocacy services, and continuing education programs which together offer a global marketplace for best practices and industry solutions. Learn more at irf.global.

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