Infrastructure Practice

Building India

Accelerating Infrastructure Projects

McKinsey&Company

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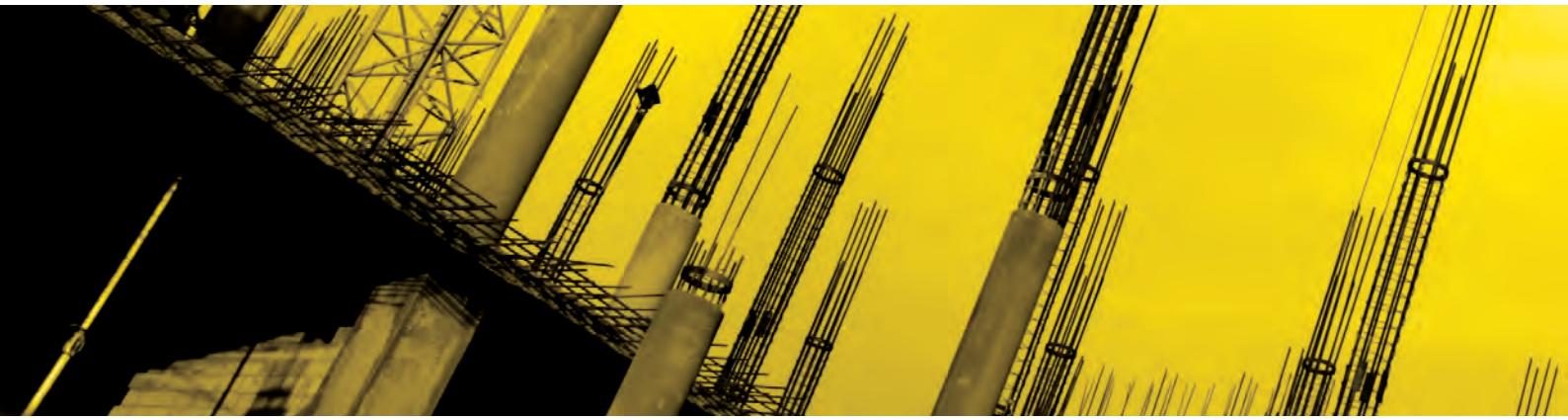

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Preface

Over the past 10 years, India has successfully executed projects such as the Golden Quadrilateral road programme and the expansion of ports in the country. Recognising that infrastructure is key to enable economic growth, the government has also committed massive investments of close to USD 500 billion in the infrastructure sector in the Eleventh Plan period (2008 to 2012). This plan follows several progressive initiatives taken in recent years, including the Electricity Act 2003, the National Highways Development Project (NHDP), the National Maritime Development Programme (NMDP), and Dedicated Freight Corridors (DFCs). However, much more needs to be done to accelerate the implementation of infrastructure in India.

India's rapid economic growth over the last decade has placed tremendous stress on its limited infrastructure. The sector has received growing attention from the government and the public, bringing the shortage of infrastructure to the fore. Fulfilling India's aggressive economic growth aspirations would be seriously challenged due to this shortage. The country needs to urgently accelerate the conceptualisation and implementation of all its infrastructure development to enable planned growth.

Trends during the first two years of the Eleventh Plan have raised doubts over whether India will be able to realise its ambitious infrastructure plans. Issues that plague the sector include a shortfall in awarding projects as per plan, inefficient project execution and constrained capital flows to the sector.

McKinsey & Company has conducted proprietary research in the areas of infrastructure financing, infrastructure implementation, logistics strategy and power strategy. This report is a part of our four-part series, Building India, a comprehensive perspective on infrastructure development in the country. It provides a perspective on the potential GDP loss due to the inefficiencies in infrastructure implementation and the challenges that drive these inefficiencies, and proposes a set of measures that the various stakeholders can take.

This study has benefitted enormously from the valuable inputs provided by business leaders, policy makers and current and former government officials across ministries and agencies. We are grateful to all of them for sharing their experiences and insights.

In particular, we would like to thank Mr. Deepak Dasgupta, former Chairman, National Highways Authority of India; Mr. Ajit Gulabchand, Chairman and Managing Director, Hindustan Construction Company; Mr. Gajendra Haldea, Principal Advisor (Infrastructure), Planning Commission; Mr. Vimal Kaushik, Managing Director, Punj Lloyd Limited; Mr. Cyrus Mistry, Managing Director, Shapoorji Pallonji and Company Limited; Mr. Amitabh Mundhra, Director, Simplex Infrastructures Limited; Mr. Yogendra Prasad, former Chairman and Managing Director, NHPC Limited; Mr. Abhijeet Rajan, Chairman and Managing Director, Gammon India; Mr. K. V. Rangaswami, Director and Head, Engineering and Construction Division, Larsen & Toubro; Mr. T. Sankaralingam, former Chairman and Managing Director, National Thermal Power Corporation; Dr. A. Didar Singh, Member (Finance), National Highways Authority of India; Mr. Mangu Singh, Director (Works), Delhi Metro Rail Corporation Limited; Mr. Nirmal Jit Singh, Additional Director General, Department of Road Transport and Highways; Mr. K. Subrahmanian, Managing Director, Afcons Infrastructure Limited; Mr. Mohan Tiwari, Managing Director, IRCON International Limited; Mr. Sanjay G. Ubale, Managing Director and Chief Executive Officer, Tata Realty and Infrastructure Limited; and Mr. S. K. Vij, former Member Engineering, Railway Board.

We would also like to express our thanks to our colleagues, Sriram Jambunathan, an associate partner based in our New Delhi office, and Anu Madgavkar, a partner based in our Mumbai office, for the direction and support they provided to this study.

This report has benefitted from the expertise of Benjamin Cheatham, Ehren Corey, Per-Nicklas Hoglund, Stefan Larson, Jules Seeley, Carrie Thompson, Jay Walder and Markus Zils, all leaders of our global Travel, Infrastructure and Logistics Practice. Vivien Singer from the McKinsey Global Institute and Manish Sharma from the McKinsey Knowledge Centre also provided key inputs.

Rahul Raswant, a consultant based in McKinsey's New Delhi office, worked closely with us to provide overall leadership for the project team comprising Anupam Agarwal, Mukul Arora, Nitesh Gupta and Vaibhav Poddar, all consultants in McKinsey's New Delhi office.

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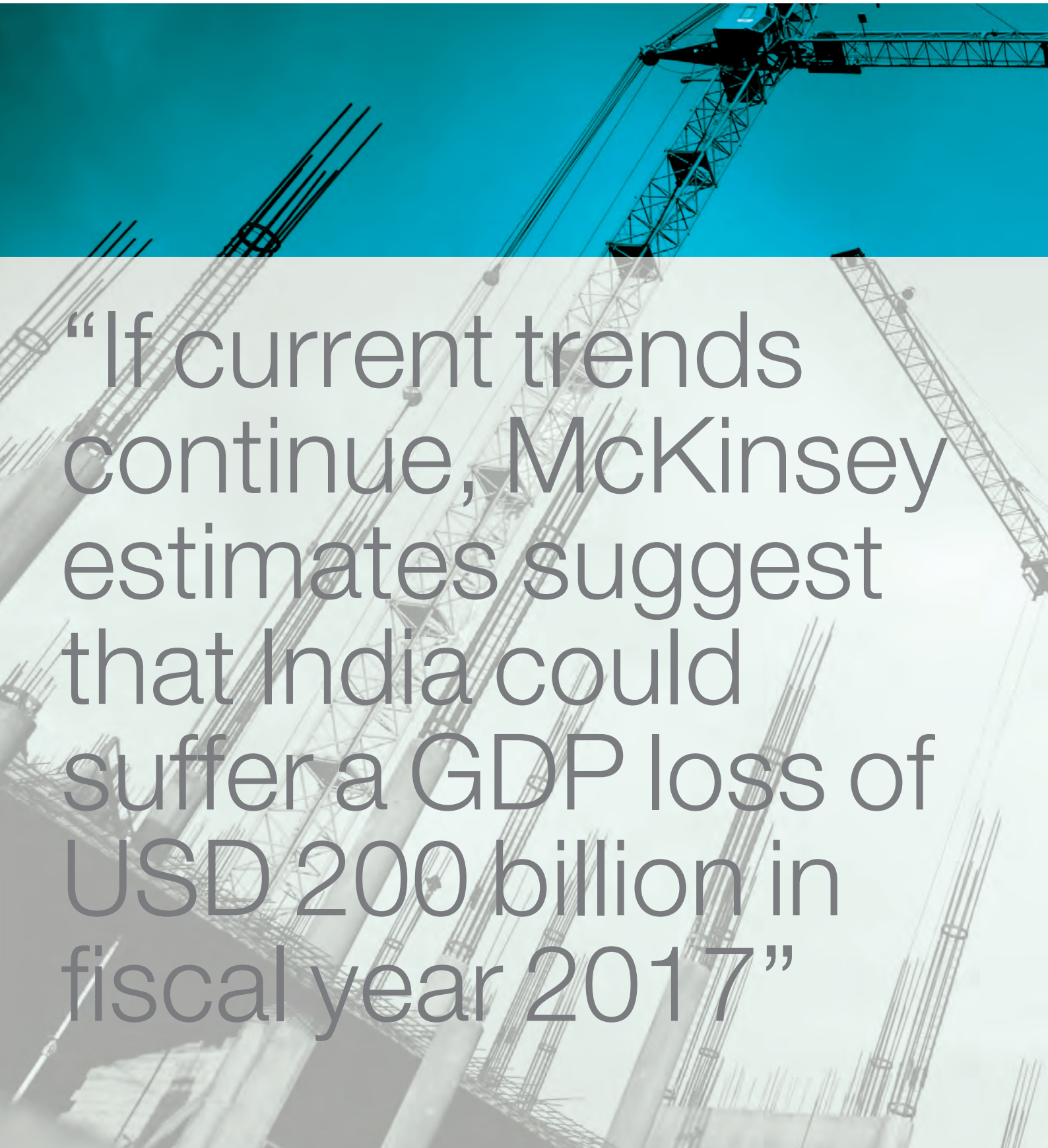
executive assistants Surbhi Duggal, Tessie D'Silva, Margaret Fernandes, Rita Motiani and Poonam Sodey for their much-needed administrative support.

Our goal in this report is to provide business leaders, government, policy makers and nodal agencies with an outline of suggested structural reforms required to de-bottleneck infrastructure implementation in India. This work is independent and has not been commissioned, sponsored or endorsed by any business, government, or other institution.



"If current trends continue, McKinsey estimates suggest that India could suffer a GDP loss of USD 200 billion in fiscal year 2017"

Executive Summary

India has set an ambitious target of investing USD 500 billion in infrastructure during the Eleventh Plan period. However, the country has consistently fallen short of meeting such targets over the last few years and early signs of implementation challenges are already visible. During the first two years of the Eleventh Plan, fewer infrastructure projects have been awarded than planned. We estimate that the average rate of awarding projects has been around 70 per cent of the planned rate. Further, government data[1] suggest that a majority of projects—close to 60 per cent—are plagued by time and cost over-runs.

Inefficiencies In Infrastructure Impede Growth

If current trends continue over the Eleventh and Twelfth Plan periods (2008 to 2017), McKinsey estimates suggest that India could suffer a GDP loss of USD 200 billion[2] (around 10 per cent of its GDP[3]) in fiscal year 2017. In terms of GDP growth rate, this would imply a loss of 1.1 percentage points.

In addition, India's economy could lose up to USD 160 billion in 2017, by forgoing the industrial productivity impact of infrastructure. However, there is no conclusive approach for estimating the value of such productivity impact, and hence it is not included in our estimate of the GDP loss, which is pegged at USD 200 billion.

Inefficiencies in implementing infrastructure projects in India occur at all stages. This includes awarding projects as per plan targets, securing financial closure, and executing projects within cost and time. Our estimates suggest that the shortfall in awarding projects as per plan could result in a USD 100 billion loss to the GDP; time and cost over-runs in project execution could lead to another USD 80 billion loss; and capital constraints would account for the remaining loss of USD 20 billion.

Shortfall in awarding projects as per plan

The shortfall in awarding projects during fiscal years 2008 and 2009 has been on two levels. One, nodal agencies such as the National Highways Authority of India (NHAI), have not tendered projects as per the Eleventh Plan; two, many tendered public-private partnership (PPP) projects have not found bidders due to viability concerns and bidding eligibility criteria (e.g., players who had been shortlisted for eight or more projects were restricted from bidding in the National Highways Development Project or NHDP, Phase 3). Overall, our analysis suggests that this has resulted in a shortfall of around 30 per cent in awarding projects in power generation, national highways and major ports.

Inefficient project execution

India does not compare favourably with other countries in executing projects. Data from government and industry suggest that on average, each project suffers from 20 to 25 per cent time and cost over-runs, while in some sectors this is as high as over 50 per cent. Further, discussions with leading industry players suggest

1 Project implementation status report of central sector projects costing INR 20 crore and above (April to June, 2008), Ministry of Statistics and Programme Implementation.
2 Based on an exchange rate of INR 41 per USD.
3 Based on an average GDP growth rate between 2008 and 2017 of 7.5 per cent.

that Indian providers (engineering, procurement and construction or EP&C companies) often fail to tap significant opportunities to reduce time and cost.

Impending shortfall in funding

Structural impediments in the financial system coupled with the global credit crisis will constrain capital flows to the sector. The core[4] infrastructure sectors are on course to a deficit of USD 150 billion to USD 190 billion in financing during the Eleventh Plan period. This deficit is equal to around 35 per cent of the investment planned in core sectors over this period[5]. However, the shortage of funds has not been acutely felt during fiscal years 2008 and 2009 because the slow pace of tendering and uptake of projects has suppressed the sector's demand for capital.

Major Bottlenecks Hamper Infrastructure Implementation in India

Our analysis and discussions with stakeholders including policy makers, nodal agencies, construction companies, developers, financiers and bureaucrats, highlighted major bottlenecks in different phases of implementing infrastructure projects in India.

Challenges in the tendering phase affect viability of projects, delaying implementation

Several bottlenecks in the tendering phase of projects impact their viability and uptake, and create delays during pre-tendering or construction stages. Our discussions with a range of stakeholders reveal several common challenges in the tendering phase of infrastructure projects:

- **Quality of planning and engineering design is poor:** Project plans are of poor quality and lack attention to detail, which creates problems such as scope changes and variations during project execution, thereby creating disputes and delays. Also, nodal agencies often do not adopt a value engineering mindset to project design, thereby increasing the project costs.
- **Tendering unviable PPP projects is common:** Many examples of unviable projects exist in the national highways sub-sector. Three issues that hamper the viability of projects are: projects that are planned beyond their scope, dated cost estimates that lead to insufficient viability gap funding (VGF), and increased risk to the provider due to several contractual terms such as the possibility of termination of concession, if traffic crosses a threshold level.
- **Contracts in use are inappropriate:** Item rate contracts are common as opposed to lump-sum EP&C contracts. These contracts allow the designs to be variable and increase the frictional cost of interaction between the nodal agency and the construction contractor.
- **Pre-tendering approval process is centralised and slow:** The multitude of approvals required across many infrastructure sectors (e.g., from the External Finance Committee, Public Investment Board or by the Cabinet Committee for Economic Affairs) can add almost up to one year to the pre-tendering process. Several processes, such as ministerial approvals, do not have defined timelines. Furthermore, the individuals involved are not always held accountable for delays in approvals.

Construction phase beset with over-runs and disputes

In the construction phase, delays in land acquisition, ineffective resolution of disputes, shortages in the availability of skilled manpower and weak performance management in nodal agencies result in time and cost over-runs.

- **Land acquisition delays are common:** Global best practices suggest that land acquisition should be complete before a project is tendered. In India, projects are often awarded with only part of the land physically acquired, sometimes as low as 30 per cent. Delays in subsequent land acquisition are possibly the single largest factor causing project

4 Power, roads, railways, ports, airports, irrigation, water storage, gas.

5 Please refer to McKinsey's *Building India: Financing and Investing in Infrastructure*, 2009, for more details.

delays. These delays are driven by three factors: 1) under-valuation of land price; 2) dependence on state governments for land acquisition; and 3) the ambiguous definition of the term "unencumbered land"[6].

- **Dispute resolution processes are ineffective:** Arbitration is the method of choice to resolve disputes globally. However, in India, arbitration has been largely ineffective. The Arbitration and Conciliation Act, 1996, is ambiguous about the challenging of awards, and lacks enforceability. During industry interviews, customers and providers agreed that arbitration awards are almost invariably appealed against, resulting in long drawn-out disputes that often last 3 to 10 years.
- **Performance management is weak:** Nodal agencies are hampered by weak performance management including: 1) low transparency in performance, which would help create public pressure; 2) lack of meaningful incentives (financial or otherwise); and 3) absence of clearly defined consequences in the event of under-performance.
- **Availability of skilled and semi-skilled manpower is insufficient:** The growth of skilled and semi-skilled manpower in India has not kept pace with the growth in infrastructure projects. While a survey by the National Sample Survey Organisation[7] estimates that 13 million workers enter the market every year, only 3 million receive training. India's vocational training curriculum is largely outdated and not based on clear standards. Further, the current certification process is based largely on theoretical testing, and does not ensure employability.

Provider skills are weak across the value chain

While there are examples of companies that have matured from small, unorganised contractors to large, well-organised construction companies, notable skill gaps remain. These include:

- **Weak risk management skills:** The skills and tools Indian providers have to assess and manage risks are weak compared with their counterparts in developed countries. McKinsey's assessment of leading construction companies in India reveals a low prevalence of global norms of risk assessment. This increases project costs and results in project failures when providers take up projects beyond their capabilities.
- **Below-par design and engineering skills:** Providers under-utilise the value engineering opportunity in EP&C and PPP projects due to the lack of a value engineering mindset as well as poor capabilities. Most providers do not have an adequate organisational set-up to capitalise on this opportunity.
- **Lack of best-in-class procurement practices:** While most Indian providers attempt to optimise procurement, their practices are not best-in-class. Global majors commonly follow practices such as demand consolidation, new vendor development, preferred relationships through frame contracts, and joint cost reduction. Prevalence of these procurement practices in India remains relatively limited. As a result, our estimates suggest that potential savings opportunities of 5 to 20 per cent of the addressable costs are forgone.
- **Low prevalence of lean construction principles:** Lean construction is a nascent phenomenon globally. Discussions with leading industry players suggest that most Indian providers have not adopted lean principles. As a result, opportunities to reduce time and costs by 20 to 30 per cent are forgone.

Way Forward for Government, Policy Makers and Nodal Agencies

A few key initiatives could help address the bottlenecks and allow policy makers and nodal agencies to emerge as best-practice customers. Given the critical role of

6 The National Highways Act, 1956, defines land as "free from all encumbrances" after issuing a 3D notification. This does not necessarily imply the absence of physical encumbrances such as dwellings.

7 Paper titled "Challenges before Construction Industry in India", 2004, by Arghadeep Laskar and C.V.R. Murthy, Indian Institute of Technology (IIT), Kanpur.

infrastructure in ensuring a sustained growth trajectory for India, it is imperative that these initiatives are acted upon at the earliest. While several of them can have immediate impact, others would need sustained efforts over the long term.

Five initiatives can have immediate impact

These five initiatives, after due deliberation with key stakeholders, can be implemented immediately.

1. **Change land availability norms and tighten contractual penalties for delays:** Acquiring 90 to 95 per cent land could be a pre-condition for tendering PPP and EP&C projects; for other projects this limit could be 80 per cent. The definition of "unencumbered land" could also be modified so that it is based on the absence of any physical encumbrance such as dwellings. Further, after a project has been awarded, the nodal agency's commitment to acquire the balance land should be secured by including an unambiguous penalty provision in the contract.

2. **Establish a high-power group to monitor and de-bottleneck infrastructure projects:** This group could be a part of the Committee on Infrastructure and its scope could include all projects above USD 25 million to USD 50 million. It should monitor project portfolio and nodal agency performance, and ensure transparency in performance. The group should have powers to escalate inter-ministerial bottlenecks to relevant decision makers and expedite their resolution.

3. **Amend policies and regulation to hasten dispute resolution process:** A few initiatives could help improve the dispute resolution process. These should include, for instance, strengthening India's arbitration laws to make arbitration awards more effective and enforceable (even if they are appealed against), ensuring equal representation of both parties on the arbitration panel, deterring frivolous litigation by issuing policy guidelines, and setting up a dedicated tribunal for infrastructure cases, with powers equivalent to those of High Courts.

4. **Judiciously adopt delivery mode to increase success rate of tendering PPP projects:** To make tendering more efficient, the delivery mode of each project should be decided upfront on the basis of size, viability and feedback from potential providers. The government could create a think tank that has technical and analytical capabilities to test and modify the scope of individual projects. This think tank should also make appropriate and much more binding recommendations than are made currently on delivery mode to the PPP Appraisal Committee (PPPAC).

5. **Select design and engineering consultants on the basis of quality-cum-cost assessment:** Technical consultants should be selected using a quality-cum-cost based approach (QCBA), instead of the traditional L-1 basis. This approach would be similar to what other countries follow. Including the past performance of consultants in their quality assessment could help increase its relevance and accuracy.

Four initiatives will need continued efforts for impact

The four initiatives described below should be kick-started immediately, with a long-term commitment towards developing the right capabilities, systems and processes.

1. **Reform contracts:** Nodal agencies need to consider reworking their contracts to capture private sector efficiencies and accelerate project execution. In line with global norms, they should consider moving from item rate contracts to lump-sum EP&C contracts. The suitability of this approach would depend on project size, complexity and provider sophistication. Further, they should use standard contracts, possibly based on those used in multi-lateral agency-funded projects, as it would make

interpretations of clauses consistent and lead to lesser disputes.

2. **Carve out programmes of national importance as special purpose vehicles (SPVs) with world-class governance:** The government should identify a few large programmes and put them under new independent entities; each should span a few high-impact projects of national importance and have excellent capabilities.

3. **Institute strong performance management systems at nodal agencies:** While external governance will continue to be important, its success depends critically on the agencies' ability to create stronger performance orientation internally. Broadly, this will entail developing comprehensive quantitative performance metrics, establishing tracking mechanisms for these metrics, and setting up consequence management systems.

4. **Kick-start a construction-focused vocational training programme:** The government could initiate a programme to generate an additional 2 to 3 million skilled/semi-skilled workers per year for the construction industry alone. This programme should develop viable PPP models to attract private entrepreneurs with the government potentially providing partial equity and real-estate for these institutions. This programme should use industry expertise in setting standards, faculty training, apprenticeship and certification.

A Call to Action for Providers

Operationally, the capabilities and practices of Indian providers need to mirror the standards of their global counterparts. Bridging this gap would reduce both the time taken and costs incurred in infrastructure projects. In addition, providers need to make some conscious choices about their business models and the corresponding skills required to win sustainably in chosen spaces. They should also collectively take a set of actions to become more professional and competitive.

Improve risk assessment and management: As efforts to meet India's infrastructure needs gain momentum, increasingly, government and nodal agencies will offer larger projects transferring a majority of risk to providers through PPP and EP&C modes of project delivery. Accordingly, providers will need to improve their risk assessment and management capabilities. This would include setting up an independent team to assess risk; institutionalising processes to manage risk at multiple stages; and developing sophisticated tools and systems.

- **Upgrade design and engineering capabilities:** As PPP and EP&C projects become more prevalent, the engineering role will be increasingly transferred to providers. Providers should aim to capture the full potential of value engineering by building strong in-house value engineering teams, putting in place the right performance tracking and incentive mechanisms, and enforcing value engineering in all steps of the design process. They should aggressively eliminate the redundancies and over-engineering in project design, and explore the use of standardised design modules across projects.

- **Make procurement and sub-contracting world-class:** Providers should adopt a total cost of ownership (TCO) approach to optimising procurement. They should manage their supplier and sub-contractor base with the mindset of developing long-term, preferred relationships. This would entail tracking their performance to identify high performers, and investing in their development. Low-cost countries such as China, Russia and those in Eastern Europe should be explored as sourcing options by setting up local offices. Internally, the demand for large spend categories should be consolidated for centralised sourcing.

- **Adopt lean principles in construction:** At the very least, providers need to improve their basic construction management, by putting in place practices such as planning to the L-5/L-6 level before starting construction, translating plans into daily productivity schedules, ensuring on-time availability

of material and equipment, and using automated equipment and tools. To reduce waste and increase their productivity substantially, they should use lean principles such as construction flow balancing (CFB). To accomplish these improvements, they will need to substantially strengthen their planning and construction management organisation.

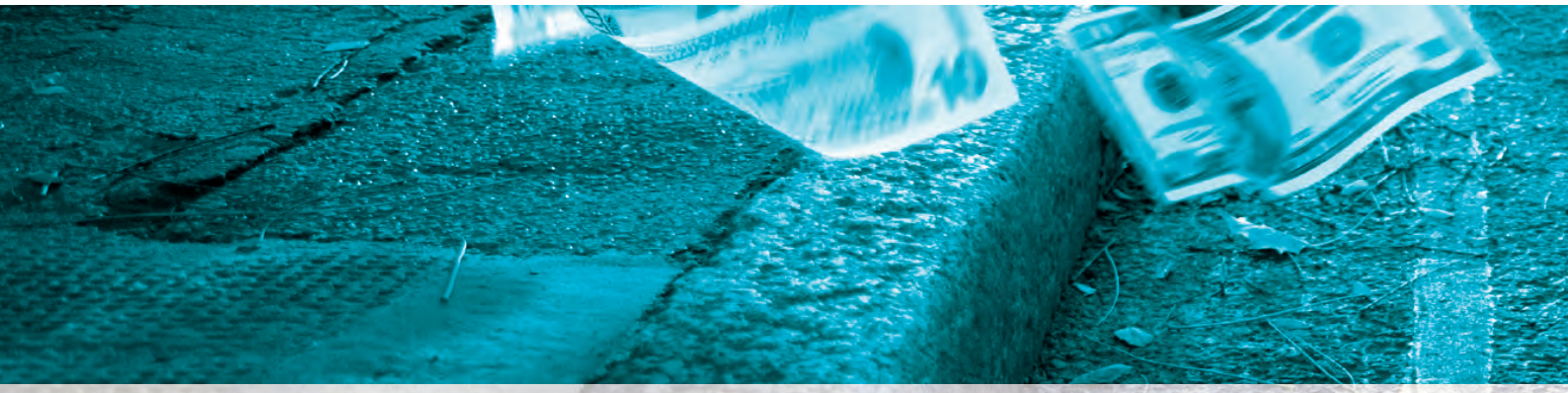
Beyond operational improvements, India's large spend on infrastructure and the changing nature of opportunities (e.g., more PPP projects, increase in usage of lump-sum EP&C contracts) will force providers to make strategic choices along several dimensions. In particular, providers should consciously decide their footprint across the value chain (e.g., becoming developers) and the segments to participate in (e.g., restrict to one versus diversify into multiple segments). These decisions will determine the business model of the providers and help them prioritise the right capabilities.

Finally, providers should collectively take a set of actions to become more professional and competitive, safeguard the interests of their employees, and enhance the industry's reputation. These actions should be taken through a well-organised industry association with committed participation from major players. They could include the adoption of latest health, safety and welfare standards for employees; working with industry participation and government for enhancing the availability of skilled and semi-skilled workers; and increasing awareness among industry participants about important issues such as demand patterns, risks and technology evolution.

* * *

Setting an ambitious target for infrastructure investment is only the first step towards improving infrastructure in India. Significant inefficiencies plague the sector, posing a threat to the successful achievement of this target. In the past few months, the government has taken several measures to address these inefficiencies, such as providing close to USD 20 billion of low-cost funds for infrastructure projects, through the India Infrastructure Finance Company Limited (IIFCL). The new government has also expressed strong commitment towards infrastructure, for example, the target of adding 20 km of roads every day and investing USD 60 billion in roads during the next five years. However, eliminating these inefficiencies will require more of such concrete steps, based on a common understanding of the key bottlenecks that hamper infrastructure implementation.

“Setting an ambitious target for infrastructure investment is only the first step towards improving infrastructure in India”



"Impediments and inefficiencies plague the sector in India, seriously threatening the achievement of the current plan"

Chapter 1

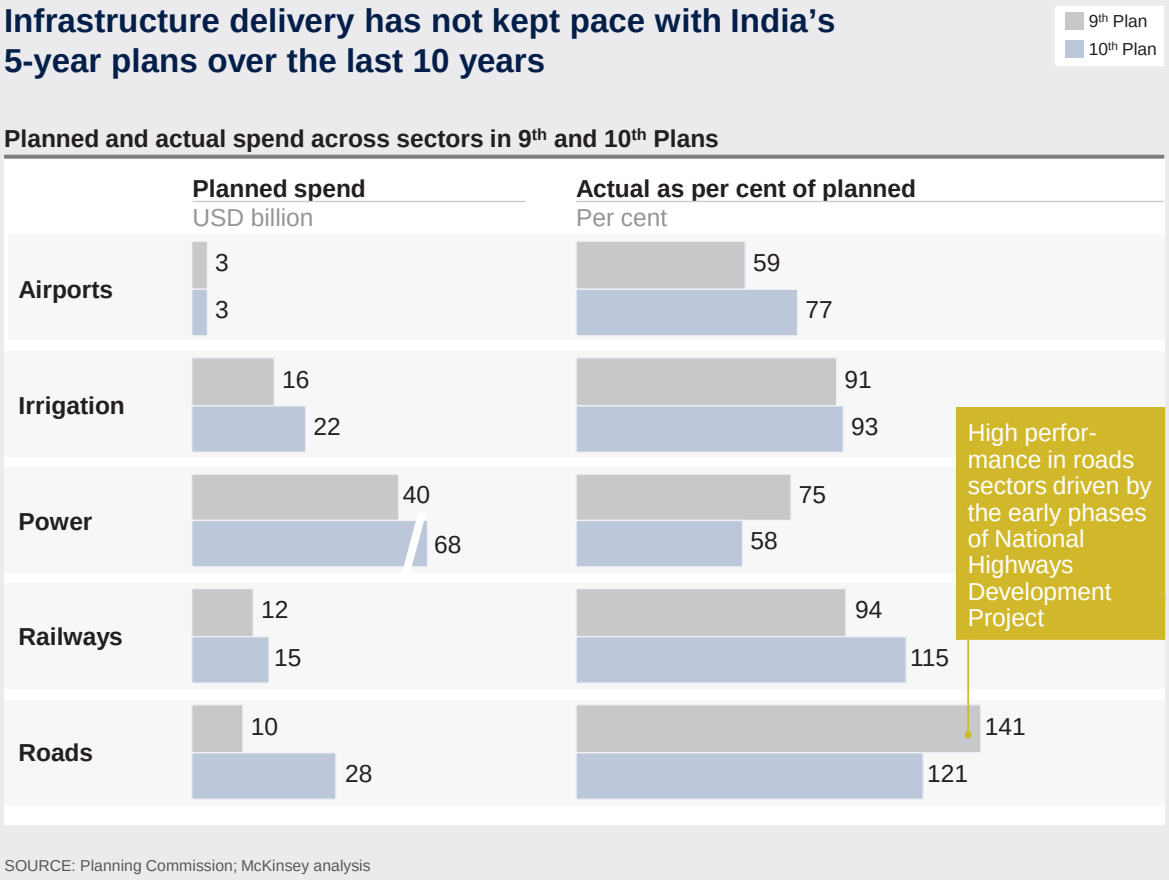
Inefficiencies in Infrastructure Impede Growth

Across the world, infrastructure plays a key role in stimulating economic growth. In view of India's aggressive growth plans, the Eleventh Plan has set a massive target of investing USD 500 billion in the country's infrastructure. This includes power, roads, railways, ports, airports, water, irrigation, storage, gas and telecom. However, India has consistently fallen short of meeting such targets over the last several years (Exhibit 1.1). Impediments and inefficiencies plague the sector in India, seriously threatening the achievement of the current plan.

McKinsey estimates suggest that these inefficiencies could cause a GDP loss of USD 200 billion (around 10

Exhibit 1.1

Infrastructure delivery has not kept pace with India's 5-year plans over the last 10 years



SOURCE: Planning Commission; McKinsey analysis

per cent of the GDP) in fiscal year 2017. In terms of GDP growth rate, this would mean a loss of 1.1 percentage points. In terms of lost opportunity, this would imply a loss of 30 million to 35 million jobs. These jobs could lower the unemployment rate by 5 to 6 percentage points and move 3 to 4 per cent of India's population above the poverty line (Exhibit 1.2). The inefficiencies will contribute to the GDP loss in 2017 in two ways—through the loss of revenues of projects that did not materialise during 2008 to 2017, and through the loss of revenues of upstream industries that act as suppliers for the creation[1] and operation of these projects. In addition, the economy will also suffer by forgoing the industrial productivity impact of infrastructure. However, there is no conclusive approach for estimating the value of such productivity impact. One of the more prominent approaches, based on infrastructure's contribution to the growth in total factor productivity (TFP), suggests that GDP loss due to productivity impact could be USD 95 billion to USD 160 billion in 2017. We have estimated this loss only for illustrative purposes. It is not included in our estimate of the GDP loss, which is pegged at USD 200 billion.

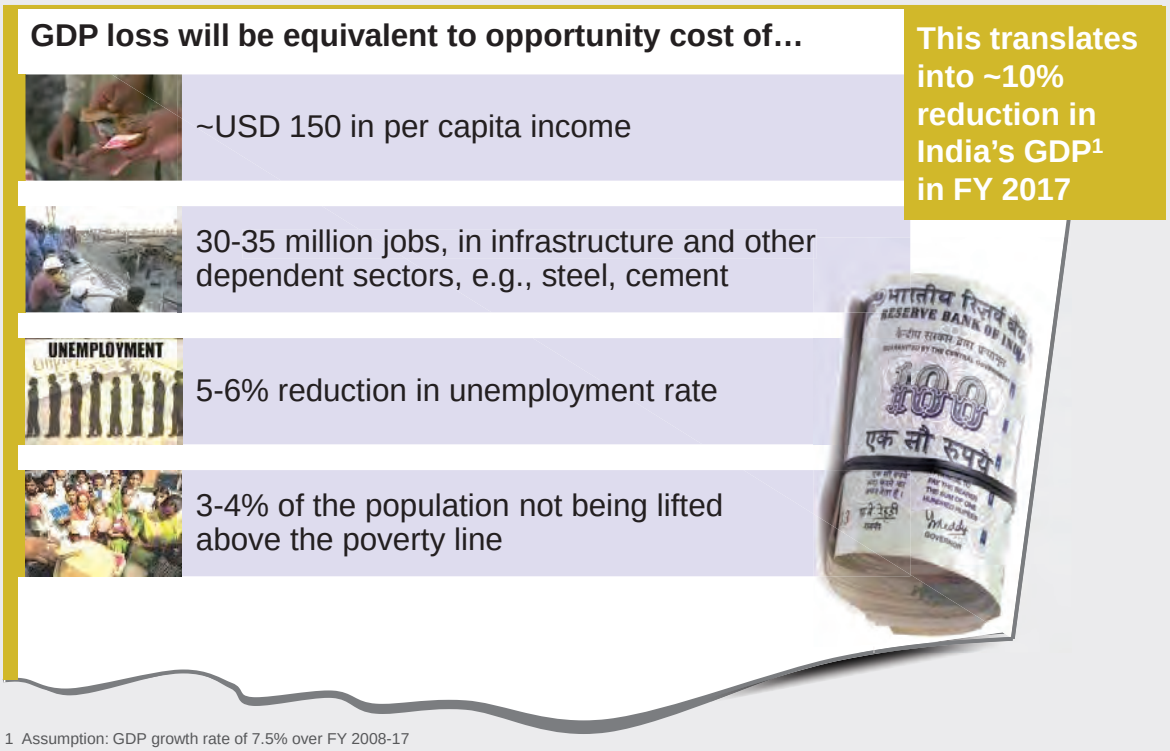
Inefficiencies in implementing infrastructure projects in India occur at every step. This includes awarding projects as per plan, securing financial closure, and executing projects within cost and time (Exhibit 1.3).

Shortfall in Awarding Projects as per Plan

For the first two years of the current Eleventh Plan, on average, projects awarded in the national highways, power and ports sectors have been 30 per cent lower than planned. This is because of two reasons: 1) nodal agencies have not tendered the planned number of projects; and 2) many tendered PPP projects have not

Exhibit 1.2

Under-performance in infrastructure during 2008-17 will result in GDP loss of ~USD 200 billion in FY 2017



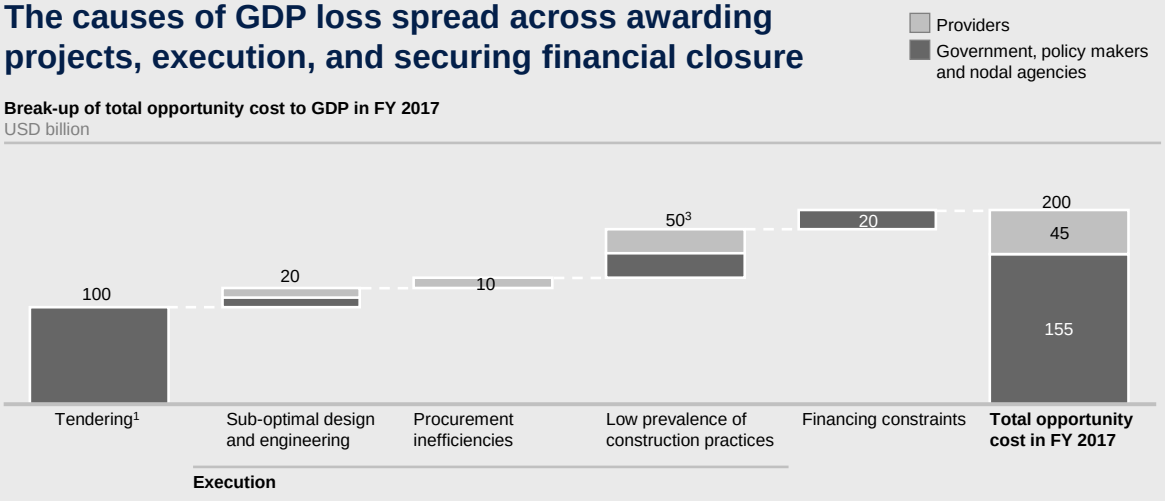
1 Assumption: GDP growth rate of 7.5% over FY 2008-17

SOURCE: Global insight; Planning Commission; McKinsey analysis, *Building India: Financing and Investing in Infrastructure*, 2009

1 The loss of revenues of the upstream industries that supply to the creation of projects, is driven only by the projects that will not be created in fiscal year 2017.

Exhibit 1.3

The causes of GDP loss spread across awarding projects, execution, and securing financial closure



Key assumptions

- Only 70% of planned capacity is awarded
- 5% time and cost over-runs due to scope changes
- 5% cost saving in case of value engineering[5]
- Optimisation opportunity of 10% in procurement cost[4,5]
- 15% time and cost over-run
- 10% time and 5% cost optimisation opportunity by lean construction[5]
- Only 65% of planned capacity gets financial closure

1 Assumes that actual tendering underperformance in 2007-09, which was 30%, will continue from 2009-17
2 As per McKinsey *Building India: Financing and Investing in Infrastructure,* 2009, even if there was sufficient capital, still 30% of projects would not get executed because of under-performance in tendering. Therefore, real impact due to capital constraints is 5% not 35%.
3 Cost and time over-runs on account of customer include delays in land acquisition, approvals, clearances etc.; over-runs due to scope changes have been included in the sub-optimal design and engineering bucket
4 Procurement costs have been assumed to be 50% of the total project cost
5 Assumes that savings from optimisation of design, procurement and construction are reinvested in infrastructure
Note: All the numbers are in 2006-07 prices
SOURCE: Global Insight; industry interviews; Planning Commission; McKinsey analysis

found bidders due to several concerns including project viability and eligibility criteria for bidders (e.g., players, who had been shortlisted for eight or more projects, were restricted from bidding in NHDP Phase 3). If this trend continues, the GDP loss due to the shortfall in awarding projects could be USD 100 billion in 2017.

Notably, the performance varies significantly across sub-sectors. An important reason for this variance is the size and number of projects awarded. A majority of the projects awarded by the roads sector are small, while the airports and power generation sectors have awarded only a few but large projects.

- **Roads:** The roads sub-sector has experienced difficulties in implementing national highway projects as private players chose not to bid for available tenders for various reasons. As a result, only 10 to 15 per cent of planned national highway projects were awarded in financial years 2008 and 2009. For example, of the 60 build-operate-transfer (BOT) road projects offered by the National Highways Authority of India (NHAI) in 2008, only 22 received one or more bidders; 10 of these could not be awarded as the bids did not meet the criteria. Bidders failed to show interest in the projects due to concerns about viability and the embedded risks (e.g., the potential risk of margin reduction due to contract termination if the traffic crosses a threshold value). NHAI's own variable policies on bidding eligibility also dissuaded bidders.

- **Power:** With the award of four Ultra Mega Power plants, the awarding of power generation capacity is on track, though some might argue that the financial closure of some of these projects is doubtful, or inordinately delayed.

- **Ports:** In major ports projects, the award rate has been around 50 per cent of the planned rate. The USD 14 billion National Maritime Development Programme (NMDP) is scheduled for implementation during 2005 to 2015. However, as of February 2009, projects worth USD 10 billion were yet to be awarded.

Inefficient Project Execution

Construction performance in India is not at par with other comparable countries. For instance, while it takes an average of 3.5 years to build a thermal power plant in India, it takes less than 2.5 years in China. Further, a majority of projects are plagued by time and cost over-runs. These inefficiencies could cost India's GDP USD 80 billion in 2017.

Our analysis suggests that, on average, projects across sectors suffer from time and cost over-runs to the tune of 20 to 25 per cent, with some sectors affected by more than 50 per cent. This is based on projects recently completed or under implementation. Over-runs can be attributed both to customers and providers. Customer-driven delays include those in land acquisition, clearances, and frequent changes in the scope of projects. At the providers' end, delays occur due to inadequate manpower, low construction productivity, and insufficient planning. Frequent and long-drawn disputes between customers and providers also slow down the progress of construction work. Of the USD 80 billion GDP loss due to inefficient execution, USD 50 billion is attributable to these time and cost over-runs.

Even in projects that are completed on time and within budget, substantial optimisation opportunities are lost. This is because best practices in engineering, procurement and construction are not widely followed. In item rate contracts, nodal agencies do not take a value engineering mindset to project design. Further, in such contracts, providers have no incentive to optimise since they do not get any share of the savings. In other types of contracts (lump-sum EP&C and PPP), best practices are not prevalent because of the lack of awareness among some providers. A GDP loss of USD 30 billion is attributable to these lost opportunities.

Impending Shortfall in Funding

Structural and regulatory barriers will impede the flow of domestic capital into infrastructure. These include asset liability mismatch and exposure limit issues for banks; high pre-emption of funds from the banking system; investment restrictions on long-term savings mobilisers (insurance, pension and provident funds); the shallowness of the bond market; and constrained supply of external commercial borrowings (ECB). Further, the global economic slowdown and rising interest rates make project funding for infrastructure more expensive.

Driven by these factors, India is on course to a deficit of USD 150 billion to USD 190 billion in financing core infrastructure sectors during 2008 to 2012[2]. This deficit is equal to around 35 per cent of the investment planned in core sectors over the Eleventh Plan period. The sector has not fully experienced this shortage during fiscal years 2008 and 2009 because the slow pace of tendering and uptake of projects has suppressed the sector's demand for capital. Even if the shortfall in the awarding of projects continues, the funding shortfall could contribute USD 20 million to the GDP loss in 2017.

The USD 200 billion GDP loss due to inefficiencies in the sector does not include the loss that the economy would suffer by forgoing the industrial productivity impact of infrastructure. There is no conclusive approach for estimating the value of productivity impact. A common approach is to link the contribution of infrastructure to the total factor productivity to growth in the country's infrastructure stock. Using this approach suggests that lost productivity could cause an additional GDP loss of USD 95 billion to USD 160 billion to in fiscal year 2017.

* * *

Inefficiencies in infrastructure implementation have substantial negative impact on India's economic growth. Eliminating these inefficiencies will require a common understanding of the key bottlenecks that hamper infrastructure implementation during both tendering and construction phases, which we discuss in the next chapter.

2 For details, please refer to McKinsey's report *Building India: Financing and Investing in Infrastructure*, 2009.

“Inefficiencies in infrastructure implementation have substantial negative impact on India’s economic growth”

"Infrastructure in India is plagued with complex issues requiring urgent attention"

Chapter 2

Major Bottlenecks Hamper Infrastructure Implementation in India

Infrastructure in India is plagued with complex issues requiring urgent attention. While the focus on infrastructure growth has led to policy initiatives such as the Committee on Infrastructure and the PPP Appraisal Committee, much more is required to improve the situation. Similarly, while providers of infrastructure have matured from small, unorganised contractors to large, well-organised construction companies, notable skill gaps remain.

Discussions with stakeholders interviewed for this report, including contractors, developers, nodal agencies and policy makers, reveal several bottlenecks that affect different phases of project implementation.

Challenges in the Tendering Phase Affect Viability of Projects, Delaying Implementation

Several bottlenecks in the tendering phase of projects impact their viability and uptake, and create delays during pre-tendering and construction stages. These include poor quality of engineering, tendering of unviable projects, slow approval process, and inefficient contracts.

Quality of planning and engineering design is poor

Nodal agencies in India tend to focus less on design and engineering excellence than their global counterparts. They usually select engineering consultants on a lowest price or L-1 basis, overlooking the quality aspect. This is evident in the fact that the cost of creating a detailed project report (DPR), as a percentage of project cost, is much lower in India compared with global benchmarks. Not surprisingly, this leads to bottlenecks and cost over-runs during the construction phase (Exhibit 2.1).

- **Planning and engineering design lack rigour:** DPRs often suffer from a lack of attention to detail and quality. There is a tendency to cut corners by technical consultants in areas such as field investigation and topographical surveys. Timely completion of hydro power projects, for example, depends on prior knowledge of geological conditions. Inaccurate geological surveys can lead to surprises during construction, subsequent changes in the scope of projects, and re-drawing of plans. All these result in time and cost over-runs in the project.
- **Value engineering mindset missing:** Nodal agencies often do not adopt a value engineering mindset to project design. Over-specification of project designs is common, resulting in high costs that affect project viability. For example, in a thermal power project, the L-1 consultant provided a heavily over-specified design. When the concerned nodal agency had it redesigned using value engineering levers, the project cost decreased by 10 per cent.

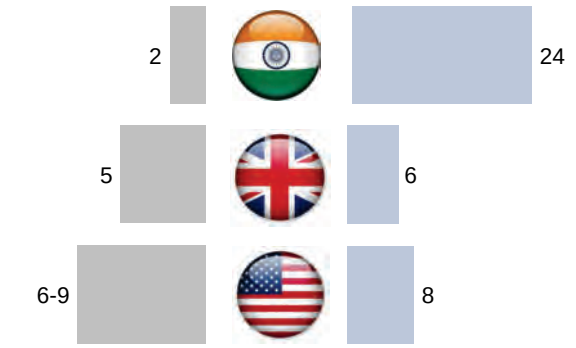
Tendering unviable PPP projects is common

Many examples of unviable projects exist in the national highways segment. NHAI follows a blanket policy to tender projects on a toll basis. However, the

Exhibit 2.1

Low investment in planning and engineering leads to high costs of implementation

Relationship between spend incurred on Detailed Project Report (DPR) & cost over-runs – roads sector



Low DPR spend in India is driven by a pure L-1 based bid process, as against a QCBA[1] process

Illustrations of impact of bad DPRs in India

Scope changes

"In a roads project, a temple was adjacent to the site of a proposed flyover. This aspect was overlooked in the DPR phase. The flyover got built, and subsequently erased due to local pressure, wasting INR 21 crores in the process"

High project costs

"In a thermal power project, the L-1 consultant quoted an abnormally low price, then did not deploy enough resources to prepare the DPR. The resulting design & cost estimate was heavily bloated, and the nodal agency saved 10-20% on it by doing the DPR again"

1 Quality-cum-cost based approval

SOURCE: McKinsey analysis; interviews

complexities of the national highways segment require a more strategic approach to planning wherein projects are tendered on a toll, annuity and cash basis according to traffic estimates and VGF availability. Several times recently, NHAI's toll projects have not found bidders. Discussions with industry reveal that they find many of the projects unviable to execute, even with the 40 per cent VGF offered by NHAI in toll projects.

The lack of viability of these projects is due to:

- **Over-estimating the scope of projects:** In several roads projects, the scope is significantly more than needed for the potential traffic volume. There are instances of 4-lane projects being tendered for stretches that only justify two lanes. This increases project costs and makes the 40 per cent VGF insufficient. The scope of the project is modified only when the project does not attract bidders, wasting 6 to 12 months in the process.
- **Under-estimating project costs:** A McKinsey industry survey suggests that in many cases, NHAI's cost estimates are 10 to 30 per cent lower than bidders' estimates. This is usually attributable to two factors:
  - The time lag (1.5 to 2.5 years) from DPR to tendering and the steep rise in commodity prices (in the last two years)
  - The lack of rigour in DPRs resulting from the frequent omission of peripheral but critical features such as service lanes. Recognising this recently, NHAI increased their project cost estimates by 10 to 20 per cent for projects with old DPRs.

- **Increasing project risks due to contractual terms:** The new Model Concession Agreement (MCA) does not guarantee a fixed concession period. Instead, the concession period is linked to variables such as actual traffic and subsequent capacity augmentation requirements. The concession period can be reduced, for example, if actual traffic crosses a threshold level. Although the agreement comprises some advantages for investors, the potential risks could dissuade those who prefer fixed concession periods.

Contracts in use are inappropriate

There are two distinct issues with the contracts used in India. First, item rate contracts are common as opposed to lump-sum EP&C contracts. Globally, EP&C contracts are considered the ideal format, since they capture private sector efficiencies in execution. Second, nodal agencies use adapted versions of standard contracts, such as those of the International Federation of Consulting Engineers. This approach often results in clauses that are ambiguous and leave room for dispute.

- **Low use of lump-sum EP&C contracts:** Item rate contracts are the norm for cash projects in most sub-sectors. In such contracts, primary responsibility for project execution rests with the nodal agencies. A more efficient approach would be to transfer this responsibility to the providers through lump-sum EP&C contracts that are based on more efficient and robust project designs. Since the profits of providers are dependent on their performance on time and cost, their incentive to perform well is high.

- **Ambiguity and imbalance in contractual clauses:** Nodal agencies use a multitude of contracts that are often ambiguous and unbalanced. Discussions with industry players suggest that the clauses pertaining to variations, price escalation, advances and retention are the most contentious and often cause disputes during construction. Providers have to deal with such contractual risks by pricing them into the total project cost.

Pre-tendering approval process is centralised and slow

Nodal agencies need to obtain several approvals and clearances during the pre-tendering phase. These approvals including the required pre-work, in many cases, take between one to one and a half years (Exhibit 2.2). Despite several plans to introduce single window clearance mechanisms, there have not been any visible improvements. For national highways, the situation has actually worsened in the past few years. During the earlier phases of the NHDP, approval was granted at a programme level and no project-specific approvals were required, which is now the case.

The lack of defined timelines and accountability coupled with the fact that approvals need to be granted sequentially leads to a significantly drawn out process.

Further, state governments and relevant authorities should be better aligned when projects are awarded. This would help to avoid unnecessary friction while seeking clearances from state governments, for shifting utilities and traffic. For a proposed subway project at a busy junction in a metro, for example, local authorities refused to divert traffic or even provide a map of utilities, leading to the project eventually being scrapped.

Construction Phase Beset with Over-Runs and Disputes

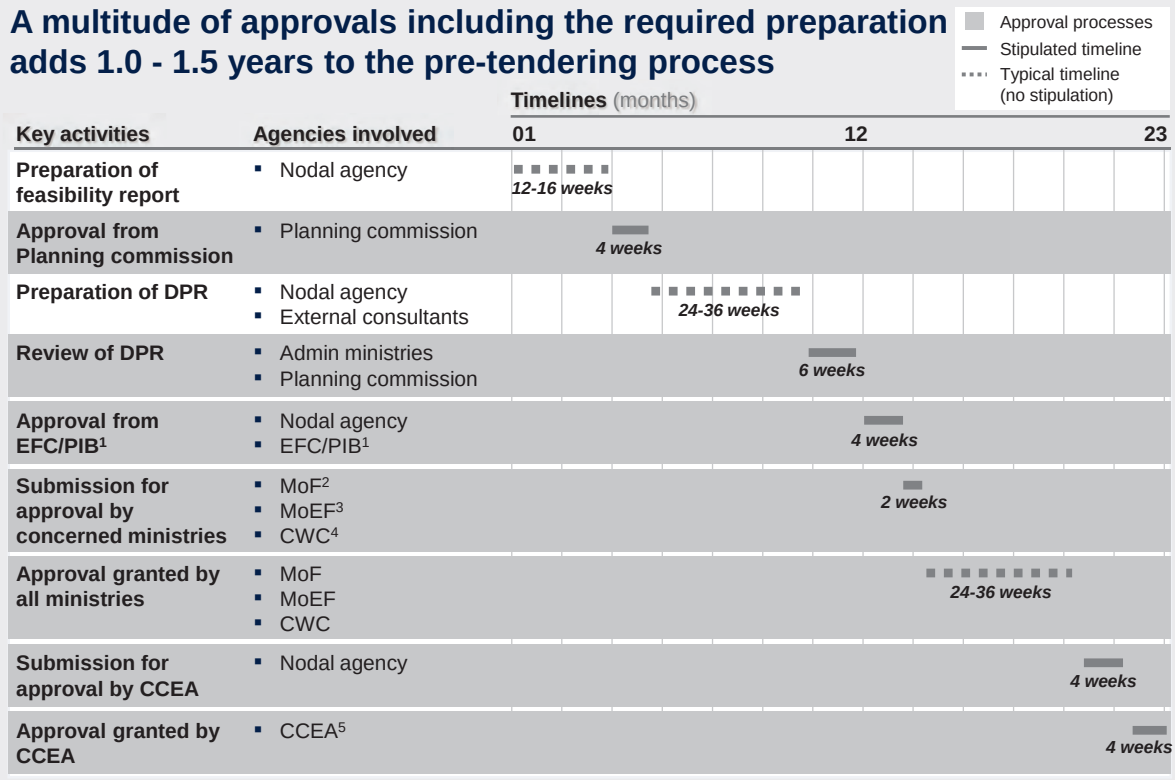
The construction phase faces several challenges including delays due to land acquisition, ineffective dispute resolution, shortage of skilled manpower, and ineffective project management by nodal agencies.

Land acquisition delays are common

In India, nodal agencies award projects with only part of the land acquired, sometimes as low as 30 per cent. This is contrary to the global best practice of completing the land acquisition before tendering projects. Delays in subsequent land acquisition are possibly the

Exhibit 2.2

A multitude of approvals including the required preparation adds 1.0 - 1.5 years to the pre-tendering process



1 External Finance Committee, Public Investment Board
2 Ministry of Finance
3 Ministry of Environment & Forests
4 Cabinet Working Committee
5 Cabinet Committee for Economic Affairs

SOURCE: Guidelines for formulation, appraisal and approval of government funded plans; expert interviews

single largest factor causing project delays. A study commissioned by the Planning Commission, as well as a McKinsey survey of construction companies, suggests that 70 to 90 per cent of road projects suffer from land acquisition delays, a problem that is also very common in other sectors (Exhibit 2.3). Since continuous tracts of land are required for construction to progress at an optimal pace, this delay also increases the project costs due to under-utilisation of deployed labour and equipment.

The delay in acquiring land is due to several factors:

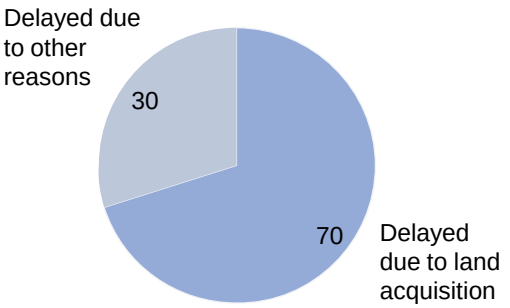
- **Under-valuation of land price:** Determining the value of land through registered sale deeds is the common method for valuation in India. These deeds contain the officially quoted price, which is often much lower than the real price. Using this as a basis causes under-valuation of land and dissuades the owners from selling it.
- **Role of state governments:** State-level authorities such as the district collector are responsible for the valuation, compensation disbursement, and physical acquisition of land. Thus, the state administration process defines the pace of the land aquisition and hence their support for the project is critical.
- **Definition of the term "unencumbered land":** Land is considered unencumbered after a 3D notification is issued as per the National Highways Act. This means the land vests in the central government. A 3D notification in itself does not mean that the land is without physical encumbrance such as human dwellings. There are still several steps

Exhibit 2.3

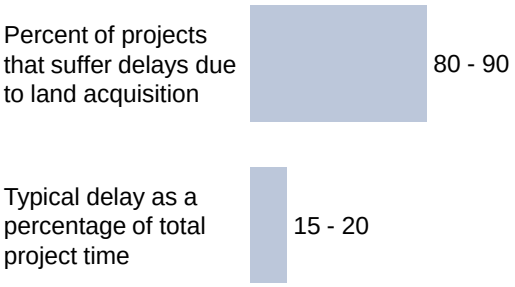
Most roads projects suffer from land acquisition delays after tendering

Both the government and the industry acknowledge that land acquisition delay are rampant

Ministry of Planning study results[1] – projects delayed due to land acquisition
Per cent



Construction industry survey results[2]
Per cent



Start of construction without the requisite land in place leads to
- **Time over-runs**
- **Under utilisation of equipment and manpower**
- **Revenue loss for the developers, in case of PPP projects**

1 Study commissioned by Ministry of Planning, Union government
2 Survey for delays in road sector cash projects, average scores of all respondents

SOURCE: Interviews; web search

that need to be undertaken such as depositing compensation and providing 60-days notice to the land owner.

Dispute resolution processes are ineffective

Construction work in India is prone to disputes. Factors responsible for these disputes include land acquisition and clearance-related delays after tendering and scope changes, among others. Timely and fair settlement of these is essential to maintain progress. An effective dispute resolution mechanism is also essential to attracting foreign players. Global best practice suggests that arbitration is the method of choice for settling disputes. While India's Arbitration and Conciliation Act, 1996, is a commendable regulation, its effectiveness is below expectations. This is because of two main factors:

- **Arbitration awards are invariably challenged in a court of appeal:** The reasons for this are many but the most important ones are:
  - **Ambiguity in the Act:** For example, according to Section 34, an award can be challenged if it is against the country's public policy. Nodal agencies often use this condition to challenge an arbitration award. In many cases where the awards are challenged in courts, the motivation for nodal agency officers is to avoid possible repercussions.

— **No enforcement of arbitration award:** In developed countries such as the UK, the arbitration award is enforced even if it is challenged in the court. For example, if the contractor wins, he gets the payment (generally against a bank guarantee) without having to wait for the court's verdict.

- **Parties are inadequately represented on arbitration panel:** For example, the Railway Board allows the provider to select its nominees only from a panel of gazetted officials of the Railways; the Chief Engineer of the Central Public Works Department appoints the sole arbitrator of the panel.

Performance management at nodal agencies is weak

The performance of a nodal agency can be assessed on the basis of its track record in completing projects on time and within budget. Despite this, the performance management system itself is weak at some of the nodal agencies. The lack of performance orientation is evident in agencies that under-perform on routine tasks such as providing detailed drawings on time and collaborating with the contractor to ensure progress. Exceptions include agencies that have strong leaders who have created an empowered culture.

The main problems include:

- **Lack of transparency** in the performance of teams and individuals
- **Lack of meaningful incentives** (financial or otherwise) to reward the performance of officials
- **Absence of clearly defined consequences** in the event of under-performance.

Availability of skilled and semi-skilled manpower is insufficient

While the infrastructure spend has been growing fast, the pool of skilled and semi-skilled manpower (e.g., welders, fitters) has not kept pace with it. This shortage is causing project execution delays. Structural issues with India's vocational training approach, coupled with abysmal training capacity, pose a threat to the successful execution of infrastructure plans.

- **India's vocational training capacity is inadequate:** While a survey by the National Sample Survey Organisation estimates that 13 million workers enter the market every year, only 3 million of those are trained (Exhibit 2.4). Close to 90,000 man-days of skilled and semi-skilled labour are required for every USD 1 million of construction expense[1]. At this rate, the construction industry alone would need 2 to 3 million skilled and semi-skilled workers to enter the market in 2012. This is after factoring the 35 per cent shortfall in awarding and funding projects.
- **Curriculum is not based on clear standards:** Global best practice suggests that vocational training follows a standards-based approach to define the curriculum. Each skill type is broken up into progressive modules, and a standard skill level is defined for each module. In India, curriculum does not follow such an approach. Further, many Industrial Training Institutes (ITIs) follow dated curriculums, which have limited relevance to current industry requirements.
- **Theory-based certification affects employability:** The current certification process is based largely on theoretical testing, instead of an actual grasp and display of skills. As a result, sometimes even the certified workers lack the skills to be employable, and are rejected at the construction site.

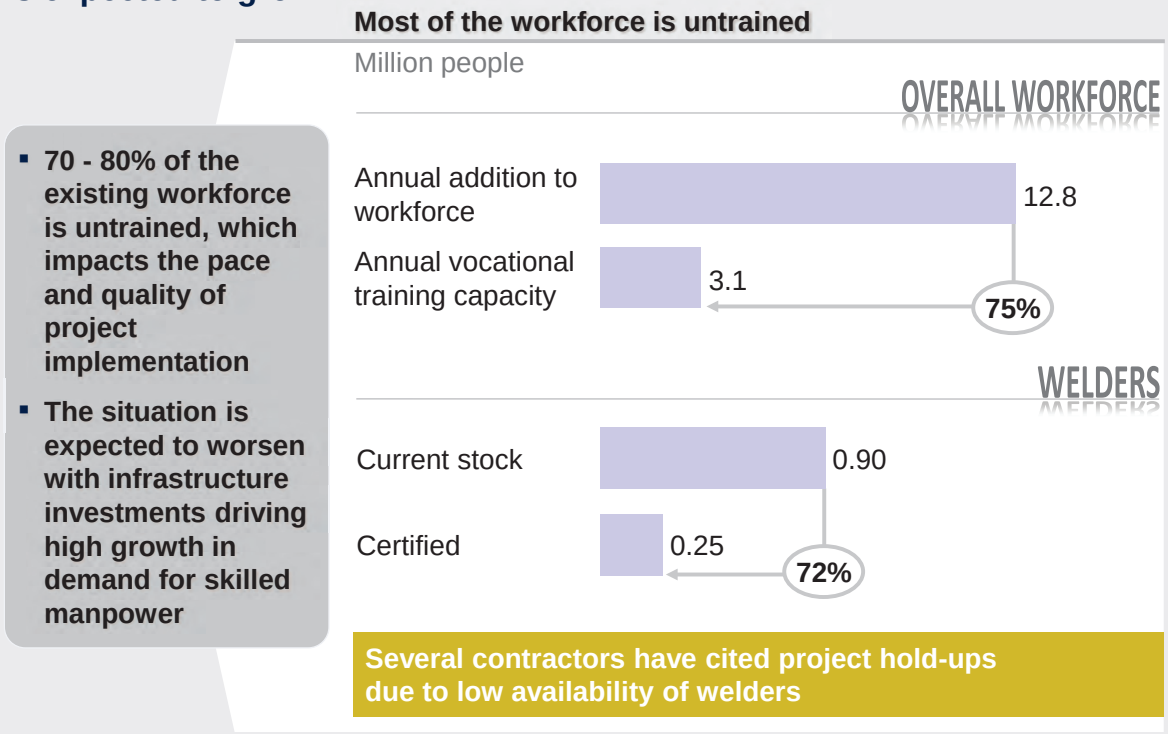
Provider Skills are Weak Across the Value Chain

Indian providers suffer from skill gaps on risk management, engineering, procurement and construction. These gaps affect their competitiveness, and also translate into a higher cost for the country's infrastructure.

1 Paper titled "Challenges before Construction Industry in India", 2004, by Arghadeep Laskar and C.V.R. Murthy, IIT Kanpur.

Exhibit 2.4

The construction industry is facing a shortage of skilled manpower which is expected to grow



- 70 - 80% of the existing workforce is untrained, which impacts the pace and quality of project implementation
- The situation is expected to worsen with infrastructure investments driving high growth in demand for skilled manpower

SOURCE: Planning Commission; World Bank report 2005; FICCI; expert interviews; McKinsey analysis

Weak risk management skills

The Indian construction industry has developed in an environment dominated by item rate contracts. As a result, the skills and toolkit used by providers for assessing and managing risks have stayed weak compared to their counterparts in developed countries. Our assessment of some of the leading construction companies in India reveals a low prevalence of global norms, such as involving all functional experts in risk assessment, maintaining a detailed and comprehensive risk register, tracking and quantifying the residual risks, and systematically reviewing them.

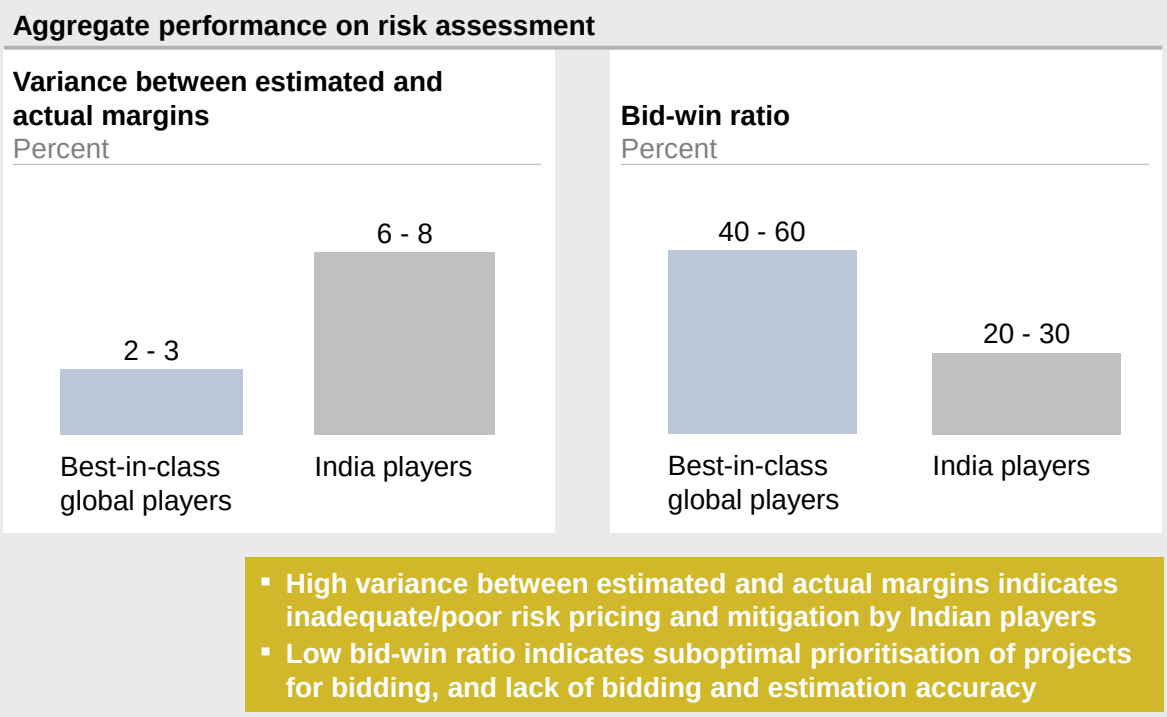
Such weak risk management is evident in companies' poor performance on two important metrics—higher than desirable variances between estimated and actual margins, and lower than desirable bid-win ratios (Exhibit 2.5). Frequently, little known players bid extremely low prices, cut corners during construction, and are not able to complete the project on time and within budget. For example, a hydro-power project in a northern state was awarded to a provider with limited experience. The provider used an old Head Race Tunnel machine for drilling, which subsequently became irretrievably stuck in the tunnel debris. The provider was eventually replaced, but only after considerable time and cost over-runs.

Below par design and engineering skills

Customers control the bulk of engineering decisions in projects based on item rate contracts. However, providers have substantial control over engineering in PPP and EP&C projects. Employing value engineering can reduce project costs significantly in these, even if the

Exhibit 2.5

Indian providers are poor at risk assessment



SOURCE: Expert interviews

projects are relatively simple. However, this opportunity, worth 5 to 10 per cent reduction in costs is under-utilised due to the lack of a value engineering mindset, as well as limited capabilities to actually do value engineering (Exhibit 2.6). The dominance of item-rate contracts is a key factor that sustains this lack of mindset and capabilities.

Most providers do not have value engineering teams to review and modify designs during bidding and construction. Even where such teams do exist, their performance management systems (e.g., value engineering KPIs and incentives) are not in place.

Lack of best-in-class procurement practices

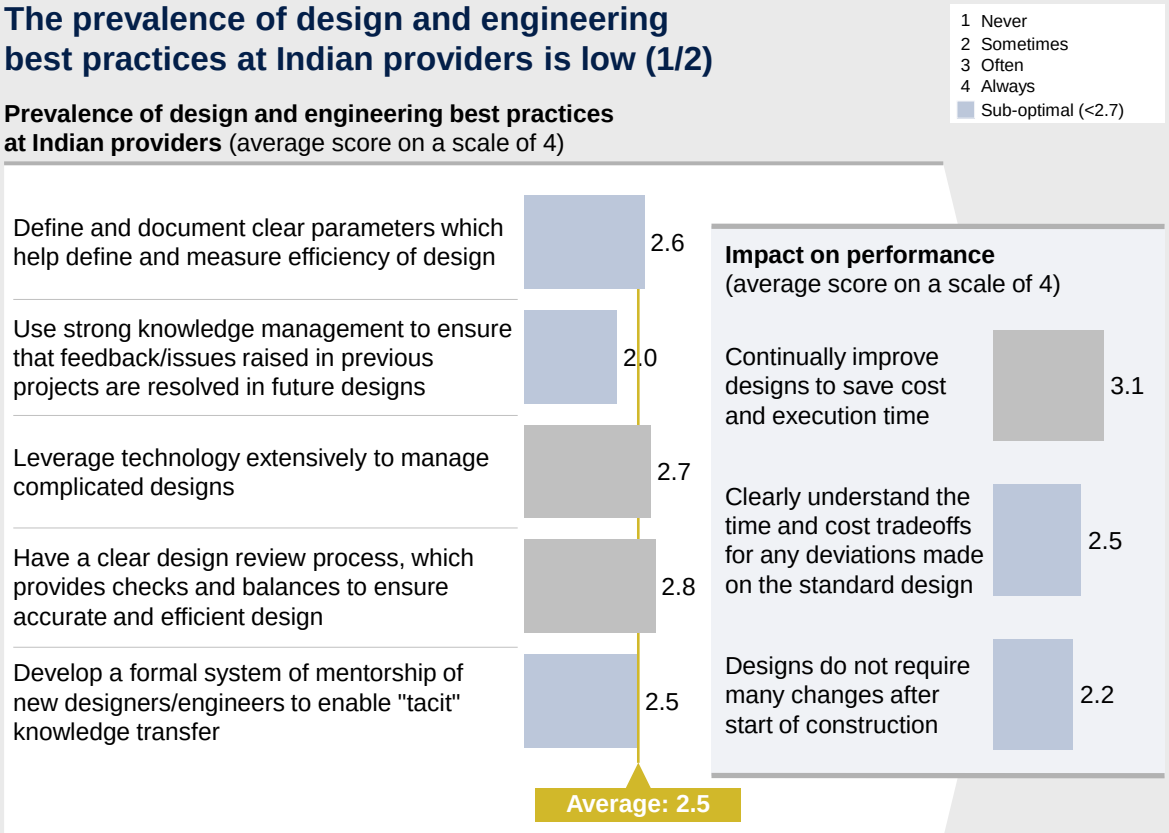
Equipment and material costs comprise 40 to 60 per cent of the total project costs based on McKinsey's industry experience and can be a significant value driver. This is true even for projects where the contractual terms restrict the choice of suppliers. Though most Indian providers optimise procurement in some way, there is a big gap compared with best-in-class global players (Exhibit 2.7). Practices such as demand consolidation across the entire company, new vendor development, preferred relationships through frame contracts and joint cost-reduction with suppliers are not very prevalent in India. As a result, savings opportunities of 5 to 20 per cent of the addressable costs are wasted.

Low prevalence of lean construction principles

Lean construction (i.e., defining construction approaches based on Lean manufacturing principles) is a nascent phenomenon globally. Where it has been deployed, providers have seen 20 to 30 per cent reduction in time and costs, due to better utilisation

Exhibit 2.6

The prevalence of design and engineering best practices at Indian providers is low (1/2)



SOURCE: McKinsey EPC 360 survey

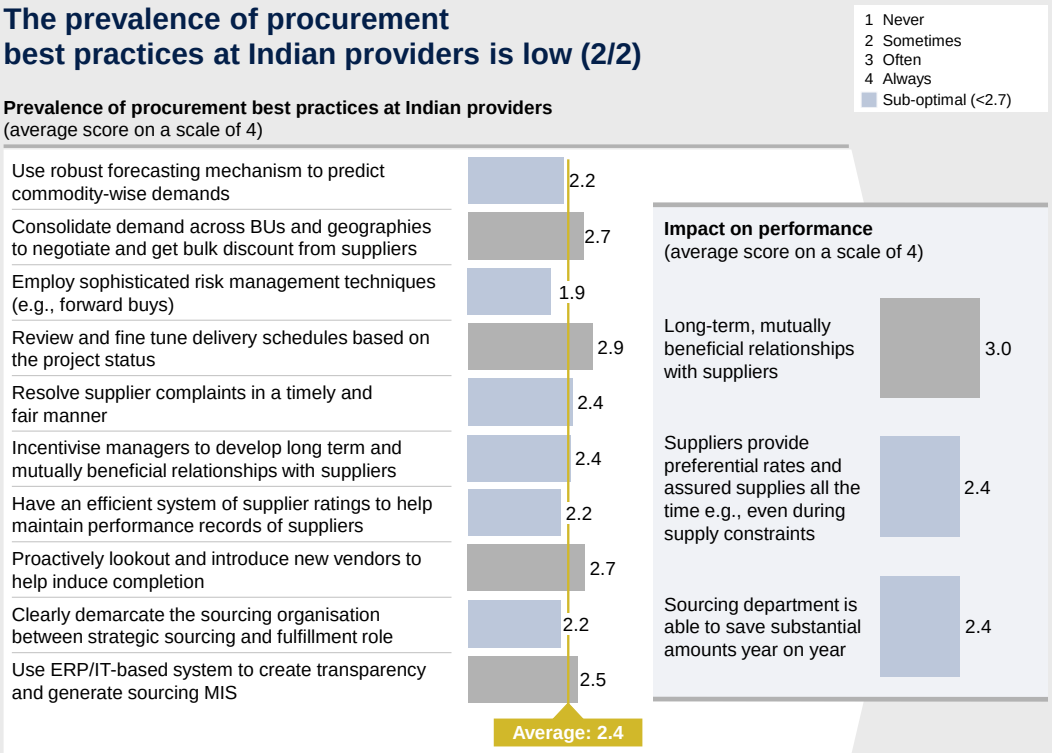
of equipment and manpower. Most providers in India are either unaware of lean construction principles, or have not really adopted them in a meaningful way. Our assessment of construction practices at some Indian providers reveals significant gaps from global benchmarks (Exhibit 2.8).

* * *

Across the infrastructure value chain, major bottlenecks hamper effective infrastructure project implementation in India. These bottlenecks are attributable to all stakeholders, including policy makers, nodal agencies and providers. A concerted effort by all stakeholders can enable India to realise its ambitious infrastructure plans.

Exhibit 2.7

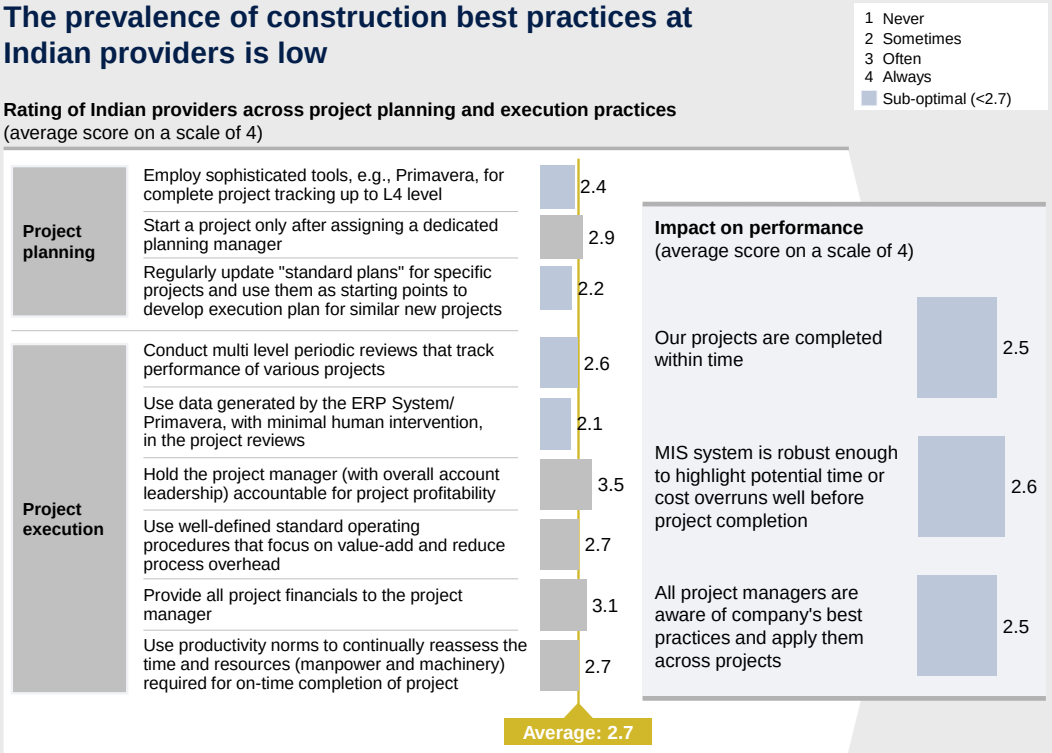
The prevalence of procurement best practices at Indian providers is low (2/2)



SOURCE: McKinsey EPC 360 survey

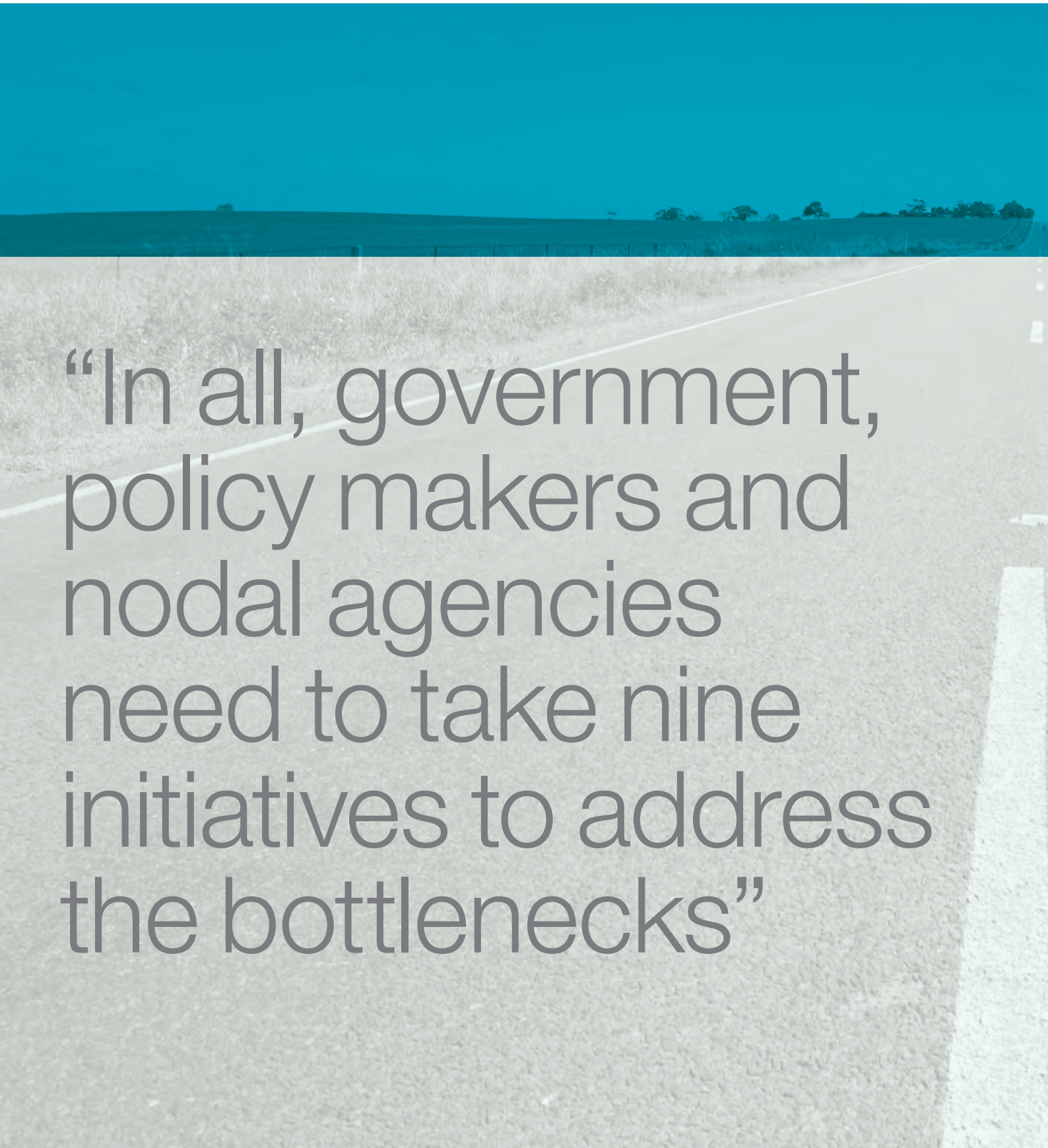
Exhibit 2.8

The prevalence of construction best practices at Indian providers is low



SOURCE: McKinsey EPC 360 survey

“Most providers in India are either unaware of lean construction principles, or have not really adopted them in a meaningful way”



"In all, government, policy makers and nodal agencies need to take nine initiatives to address the bottlenecks"

Chapter 3

Way Forward for Government, Policy Makers and Nodal Agencies

For India's infrastructure to grow as envisaged, stakeholders need to urgently address the implementation bottlenecks described in chapter 2. In our discussions with providers, public sector units, and government officials across nodal agencies and regulators, a common theme emerged for action, which we set out in this chapter.

In all, government, policy makers and nodal agencies need to take nine initiatives to address the bottlenecks. Of these initiatives, five can have immediate impact; four will need sustained efforts over the long term. Independent of how long these initiatives will take to have impact, decisions need to be taken immediately to address the USD 200 billion risk to India's GDP by 2017.

Five Initiatives can have Immediate Impact

Government, regulators and nodal agencies can implement five initiatives immediately, after due deliberation with key stakeholders to ensure alignment.

1. Change land availability norms and tighten contractual penalties for delays

Projects should be awarded only after a sufficient amount of land[1] has been physically acquired. Contractual mechanisms should ensure nodal agencies' continual commitment to land acquisition even after the award.

Acquiring 90 to 95 per cent land, including the tracts that are indispensable for normal progress of construction work, could be made a pre-condition for tendering PPP and EP&C projects. For other types of projects, this limit could be 80 per cent, since the nodal agency continues to hold greater ownership of project completion.

Also, the land should be considered "unencumbered land" only when it is free from any physical encumbrance such as dwellings.

After awarding the project, the nodal agency could be bound by the terms of the contract to acquire the rest of the land. To ensure this commitment, a penalty clause could be included in the contract. The penalty calculation should ideally be unambiguous and could be similar to that of liquidated damages (i.e., a fixed quantum of penalty for each day of delay). The quantum of the penalty clause should adequately cover the typical extension costs, and could be capped in a similar way as liquidated damages payable by the provider.

2. Establish a high-power group to monitor and de-bottleneck infrastructure projects

The existing performance tracking system covers all projects above USD 5 million that are under implementation, but it suffers from several shortfalls. For example, it does not track pre-tendering progress, cost overrun estimates do not include claims under dispute, and causes of over-runs are based entirely on nodal agency inputs.

A high-power group needs to be created to monitor progress, make results transparent, and force decisions to enable progress. This group could be a part of

1 Global best practices suggest that 100 per cent of the land should be acquired before tendering. However, this would be difficult to impose for India, given the high private ownership of land. In cases where it is feasible, acquiring 100 per cent of the land before tendering will increase the attractiveness of Indian projects for foreign institutional investors.

the Prime Minister's Office or of the Committee on Infrastructure, and a minister or a secretary could head it. Other ministries could be involved as necessary. Its scope should include all sectors in infrastructure and cover a small number of larger projects (e.g., over USD 25 million to USD 50 million). The group should:

- **Monitor project portfolio and nodal agency performance** on at least three key metrics: 1) on-time award; 2) actual construction progress against planned milestones; and 3) within-budget completion
- **Consolidate the performance data** on a monthly basis and make them publicly available, clearly showing where delays and over-runs are most common
- **Selectively involve providers of large projects** when the delays and over-runs continue to grow, to understand the bottlenecks and collaboratively develop solutions
- **Escalate inter-ministerial bottlenecks** that are impeding important projects (pre or post tendering) to relevant authorities, and force decisions to enable progress (e.g., by selectively convening ministers and bureaucrats from concerned areas). The group should have the powers to expedite the resolution of bottlenecks.

3. Amend policies and regulation to hasten dispute resolution process

Making the dispute resolution process more effective can accelerate project execution, as well as reduce costs. It can also increase India's attractiveness as a market for global construction companies. However, it will require measures at several levels—arbitration laws, policy, contracts and the judiciary.

- **Strengthen India's arbitration laws**
  - — Amend Section 34 of The Arbitration and Conciliation Act, 1996, under which the arbitration award can be challenged in court. The amendment must remove all ambiguity in interpretation of clauses. For example, there is a clause that deems an award as challengeable if it is in conflict with the public policy of India. This clause could be modified so that it tests only the process followed during arbitration, and not the arbitration award itself, as is the practice in the UK
  - — Enforce arbitration awards even if they are challenged in court. For example, if a nodal agency loses the award, it should make the payment (protected by bank guarantees) as per the award. Such enforceability is already the norm in several countries.
- **Issue policy guidelines to deter frivolous litigation**
  - — Restrict nodal agencies from re-appointing arbitrators whose awards they have challenged in court under the pretext of mala fide intentions
  - — Specify types of disputes and awards that need not be challenged in court, thereby alleviating the concerns of nodal agency officers about vigilance enquiries.
- **Modify some contractual clauses**
  - — Mandate the fair constitution of arbitration panels in all contracts. Ideally, each party should nominate an equal number of members to the panel. These nominees should then jointly select a neutral member
  - — Consider removing the provision of a Dispute Resolution Board because it has not been successful in resolving disputes, but still adds significant delays (6 to 12 months) to the process.
- **Set up a dedicated tribunal for infrastructure cases:** These tribunals should have powers equivalent to high courts. The jury should include qualified judges and industry experts. Countries such as the UK and Australia have successfully used fast-track courts for infrastructure cases (Exhibit 3.1).

Exhibit 3.1

Construction-related cases can benefit significantly from dedicated fast-track courts

Many countries have fast-track courts for infrastructure related cases...

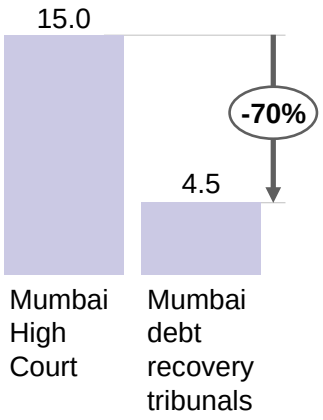
- Dedicated courts for resolving infrastructure and construction related disputes
- The jury includes qualified judges and industry experts
- Have powers equivalent to other civil courts

Australia[1]

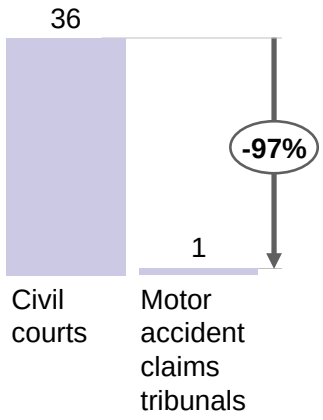
United Kingdom[2]

… and Indian fast-track courts for other issues have done well

Reduction in time taken to issue summons for debt recovery cases
Number of months



Reduction in time taken to solve the motor accident claims cases
Number of months



1 Dedicated court for land acquisition cases
2 Technology and Construction Court

SOURCE: Expert interviews; press search

4. Judiciously adopt delivery mode to increase success rate of tendering PPP projects

India needs a robust mechanism to assess and improve the commercial viability of projects, and to test them for PPP readiness before tendering. The government could:

- **Review and modify the existing standard specifications** for PPP projects to increase their viability. In roads projects, for example, link the number of lanes to the current and future traffic volume
- **Create a think tank with increased decision power** within or outside the PPPAC, with technical and analytical capabilities to test and modify project specifications to maximise their commercial viability (Exhibit 3.2). The recommendations of this cell should form an important input into the PPPAC's decision to approve the project. The project specifications can be modified by using either cost or revenue levers. In roads projects, examples of cost levers would be the number of lanes, frequency and height of over-passes/under-passes. Examples of revenue levers would be the choice of stretches to be included and adding roadside real estate to the scope.
- **Test projects for PPP readiness** before tendering to help select the right delivery mode. Such a process is followed by agencies in several developed countries such as the UK and Ireland. PPP readiness could be tested on the on the basis of:
  - Size: The project should be large enough to justify transactional costs (e.g., litigation) of PPP model
  - Viability: This should define the suitable mode between toll and annuity modes (where

Exhibit 3.2

Delivery mode should be decided before tendering, on a project-by-project basis

Key levers to ensure uptake	Suggested process	Examples of countries/agencies following this approach
Pre-select the delivery mode	▪ Determine the delivery mode for each project prior to tendering – Take the cash vs. concession decision on the basis of size – the project should be large enough to justify the transactional costs (e.g., litigation) of PPP model – Subsequently, assess the revenue potential and projects costs to decide between toll and annuity modes (where applicable), with the agency's funding constraints and VGF limits in perspective	 United Kingdom  Ireland  South Korea
Optimise project scope	▪ Optimise the scope of the project to maximise revenue potential (e.g., include high-traffic stretches) and minimise costs (e.g., reduce number of structures)	 United Kingdom
Collect and incorporate bidders' feedback	▪ For PPP projects, conduct one-on-one consultations with the prospective bidders, to understand their comfort with the risks involved, and their other concerns ▪ Project scope may be changed in light of the feedback received, thus increasing the chances of a good response to the tender	 Canada (Infra-structure Ontario)  USA (FHWA[1])

The entire process takes 1 - 1.5 years, and is generally done in parallel with the approvals process

1 Federal Highways Administration

SOURCE: International best practices; Federal Highways Administration website; expert interviews; McKinsey analysis

applicable), keeping the agency's funding constraints and VGF limits in perspective

— Industry view: One-on-one or group consultations with prospective bidders should be conducted to collect their views on project specifications, risks involved, etc.

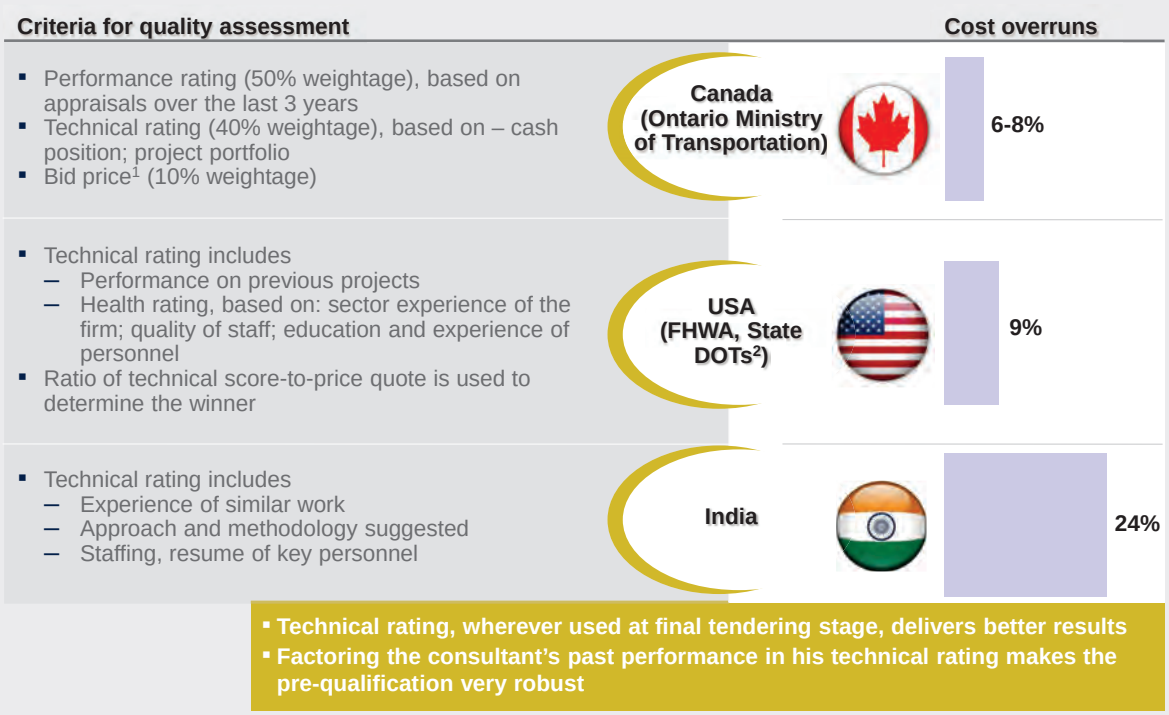
5. Select design and engineering consultants on the basis of quality and cost assessment

Most DPRs are prepared with the help of consultants and their quality has significant impact on time and cost of project execution. Hence it is important to select technical consultants using a quality-cum-cost based approach instead of the traditional L-1 based approach. In evaluating the overall bid, the weightage given to the quality score should ideally be 80 per cent (if not, then at least 50 per cent). Examples of these practices are common in Canada and the US: the state departments of transport (Exhibit 3.3). To increase the relevance and accuracy of the quality assessment, it is equally important to include the consultant's past performance. We suggest:

- **Creating a sector-wise, centralised database** of consultant ratings, based on their performance in recently completed and ongoing projects. This database should take project-level inputs on the performance of consultants from the respective nodal agencies
- **Issuing standard guidelines** with objective scoring parameters (e.g., magnitude of design changes during execution and underlying reasons). Nodal agencies could use these guidelines to assess consultant performance.

Exhibit 3.3

The QCBA approach should be used to select consultants, in line with global norms



1 10% weightage at RFP stage. Increases to 50% at RFQ stage
2 Departments of Transport
SOURCE: Press search; expert interviews; McKinsey analysis

Four Initiatives will need Continued Efforts for Impact

To effectively implement these initiatives, long-term commitment is imperative. This will entail the gradual development of the right capabilities, systems and processes.

1. Reform contracts

Nodal agencies need to consider reworking their contracts to capture private sector efficiencies, accelerate project execution, and distribute risks across parties in a more balanced manner. Towards this end, nodal agencies could:

- **Move from item rate contracts to lump-sum EP&C contracts:** The suitability of EP&C contracts varies by project type and is determined by project size, complexity and provider sophistication (Exhibit 3.4):

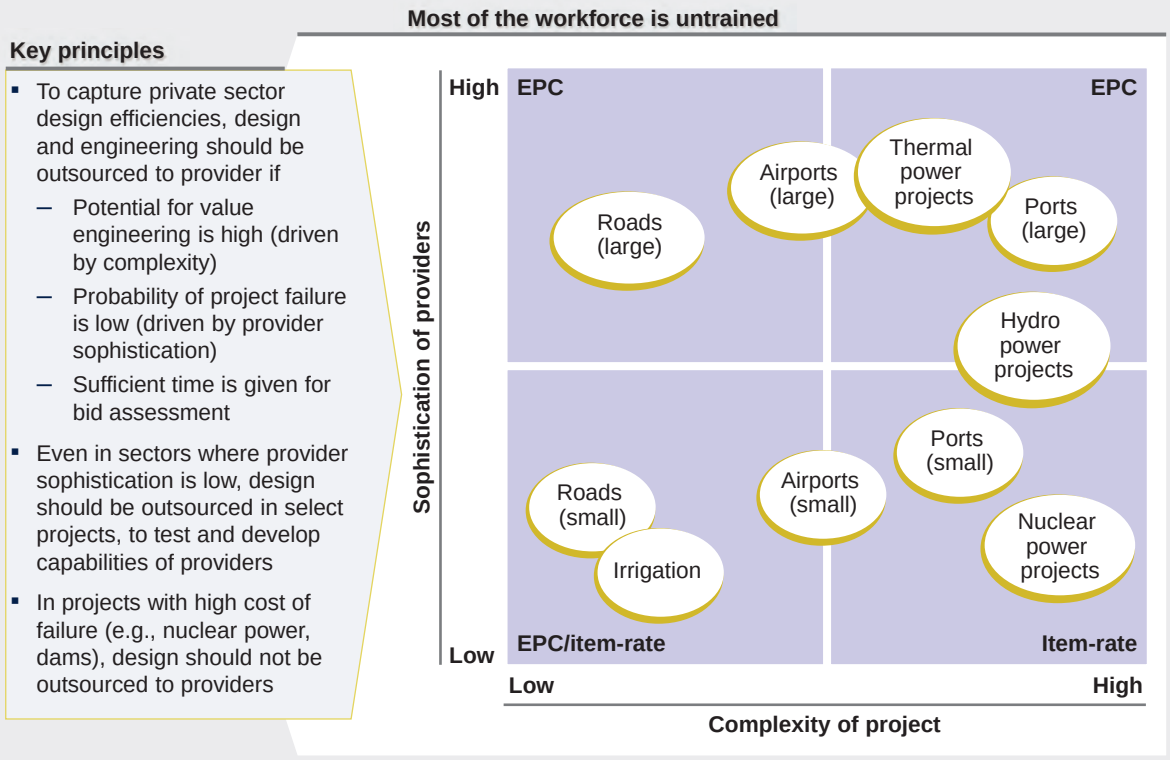
  — Large, complex projects usually attract sophisticated providers and could be executed using lump-sum EP&C contracts; projects in this category include national highways, thermal power, hydro power and greenfield airports

  — Medium-sized and less complex projects that usually attract providers of medium sophistication could also be executed using lump-sum EP&C contracts. Projects in this category include state roads, water supply and sanitation

  — Small projects in any sector (e.g., rural roads) typically attract providers with low sophistication.

Exhibit 3.4

Sophistication of providers and complexity of projects will determine the choice between EPC and item-rate contracts



SOURCE: Expert interviews; McKinsey analysis

These projects can continue to use item rate contracts, until provider sophistication improves.

- **Adopt contracts used in multi-lateral agency-funded projects:** This will distribute the risks in item rate contracts in a more balanced away, and will make them less prone to dispute. Our discussions with diverse stakeholders suggest strong approval for these contracts in the Indian context. Clauses that would improve by this adoption are those related to price escalation, variation, advances and retention of payment. For example, the optimal way of ascertaining price escalation would be to split material costs into major commodities and to link the price of each commodity to an appropriate index (Exhibit 3.5). Cement can be linked to the actual price of cement (average across 30 cities), available from the Cement Manufacturers Association.

2. Carve out programmes of national importance as SPVs with world-class governance

Recent experiences suggest that programmes that capture national attention have better chances of success, e.g., Ultra Mega Power Plants. Therefore, government could create a list of a few large programmes, each spanning a few high-impact projects of national importance. Subsequently, it could set up new, independent entities to own these programmes. Such new entities have better chances of creating high performance orientation within their respective organisations. The government should strengthen the governance and management of these entities by instituting autonomous boards, headed by strong chairmen with stellar records of building high-performing organisations. The entity could be designed as a lean organisation with complete accountability and

Exhibit 3.5

In the price escalation clause, the key commodities can be linked to indices that reflect the movement in their prices

	Suggested index	Comments
Cement	Average of the district level prices published by CMA (Cement Manufacturer's Association)	CMA data is published on a monthly basis, draws on the prevailing market prices in each district, for several brands
Steel	Average of zonal monthly steel prices published by JPC (Joint Plant committee)	JPC tracks and publishes prices for all kinds of steel products (pig iron, HRC, steel wires, etc.) on a monthly basis across four major cities (i.e., Delhi, Mumbai, Chennai, Kolkata)
Bitumen	Average of zonal bitumen prices published by BPCL (Bharat Petroleum Corporation Limited) and IOCL (Indian Oil Corporation Limited)	BPCL and IOCL publish prices for bitumen on their websites across four major cities (i.e., Delhi, Mumbai, Chennai, Kolkata)

SOURCE: Expert interviews; McKinsey analysis

have programmatic approvals, as against project-level approvals.

Some projects that could be set up in this manner are[2]:

- **Six dedicated freight corridors (DFCs) with last-mile connectivity roads:** DFCs are the lowest total cost freight option (one-twelfth the cost of making new roads). This is due to factors such as higher speeds and axle loads. McKinsey estimates suggest that freight traffic in India is set to grow more than two and a half times over 2007 to 2012. DFCs can be instrumental in absorbing this traffic growth. At least five of the six DFCs (North-East, East-West, North-West, North-South, and West-South) could be started in parallel. The success of these DFCs will depend significantly on last-mile road connectivity.
- **Six expressways:** Expressways are much more cost effective than other roads. Also, building expressways on select high traffic stretches would have more impact since roads have the highest share of India's freight traffic. McKinsey estimates suggest that the priority expressways include Biora to Shivpuri, Nasik to Shirpur, Ghaziabad to Bareilly, Yewat to Solapur, Jalandhar to Beas, and Hyderabad to Zaherabad.

3. Institute strong performance management systems at nodal agencies

While external governance (the high-power group and programmes of national importance) will go a long way in improving the performance of nodal agencies, they will also need to enhance performance orientation

2 Based on a perspective McKinsey's Infrastructure Practice is evolving on how India should develop its future logistics infrastructure.

internally. Some state departments of transport in the US have institutionalised systems and processes that work to this effect, and present a good example to follow for Indian agencies. Broadly, this will entail three distinct steps:

- **Develop comprehensive quantitative performance metrics (Exhibit 3.6)**
  - — Determine nodal agency's value drivers that are linked to its vision and goals (e.g., timely execution of projects)
  - — Prioritise value drivers and define specific performance metrics (e.g., average time over-runs)
  - — Cascade metrics (and corresponding targets) down to every individual in the organisation.
- **Establish performance tracking mechanisms**
  - — Set up an independent performance monitoring committee, reporting directly to the Chairman. The committee can either be nodal agency specific, or a common committee across nodal agencies
  - — Introduce multi-level periodic performance review process for individuals
  - — Create periodic dashboards to increase transparency of performance.
- **Set up incentives and consequence management systems**
  - — Link incentives (financial or non-financial) explicitly and transparently to meeting/exceeding expectations on milestones and targets

Exhibit 3.6

The key objectives of a nodal agency should determine its performance metrics

US STATE DOT EXAMPLE

	Objectives	Metrics	Definition of measure
Vision: Connecting people and places – safely and efficiently, with accountability and environmental sensitivity	**"Make our transportation network safer"**	Fatal accident (incident) rates on DOT transportation network	Number of fatal accidents on the DOT transportation system per miles traveled
	"Make our transportation network move people & goods more efficiently"	Travel time	Average speed limit per mile, frequency of service for buses, ferries, etc.
		Congestion (level of service)	Numerical indicator of level of service experienced at peak travel times
	"Make our infrastructure last longer"	Existing system conditions ▪ Road ▪ Bridge ▪ Other	Numerical indicator of quality of construction and maintenance
		Book value of transportation network	Dollar value of assets in the DOT transportation network
	"Make our organisation a place that works well"	Delivery on schedule	% of projects constructed on schedule in a given year
		Delivery on budget	% of projects completed on budget in a given year
	"Make our organisation a great place to work"	Employee satisfaction index	Numerical index of employee satisfaction, as determined by survey results
		Employee safety incidents	Number of safety incidents involving DOT staff while on duty

SOURCE: McKinsey experience in performance transformation at a state Department of Transportation in US; McKinsey analysis

— Define clear consequences for consistent under-performance relative to expectations.

4. Kick-start a construction-focused vocational training programme

Vocational training in India has recently seen progressive measures such as the Modular Employability Skill Development Scheme (MESS)[3]. However, these measures alone may not be enough to tackle the shortage of manpower. The construction industry needs skilled and semi-skilled manpower at a rate that can match the intended pace of growth.

The government needs to create additional training capacity to generate 2 million to 3 million more skilled workers per year by 2017. To build such scale, private capital will need to participate through commercially viable PPP models. The government could contribute partial equity and real estate for these projects to enhance their viability.

The government should also secure the construction industry's commitment for its participation in five distinct areas:

- **Set progressive, modular standards for each skill type:** For example, a panel with representation from players, industry bodies, academia and NGOs could set standards for each skill type. These standards should have broad-based relevance, and should become a reference point for setting the curriculum
- **Improve faculty training:** Given their experience and capabilities, industry players and associations would be best poised to run courses that can generate adequate faculty for this programme
- **Provide apprenticeship:** On-the-job training should be an integral part of the course curriculum, in line with developed countries. Institutes can have formal tie-ups with local providers for systematically providing apprenticeship
- **Improve certification:** A panel such as the one described above should set certification standards and guidelines. Emphasis should be on actual skill displayed, as against theory-based testing. Further, the industry should help conduct the actual certification process to ensure quality
- **Place trained candidates in employment:** The location and capacity of training centres under this programme could be decided on the basis of local requirements. Ideally, the government should secure commitments from the industry for absorbing a major proportion of the trained workers.

* * *

Policy makers and nodal agencies can significantly improve infrastructure implementation by pursuing a set of initiatives. However, it is imperative that these efforts go hand-in-hand with the providers' efforts to upgrade their skills and become truly world-class.

3 MESS was introduced by the Ministry of Labour and Employment, the objective of this scheme is to provide vocational training and certification to school dropouts, existing workers and ITI graduates to improve their employability.

"Capabilities and practices of Indian providers are below par compared with best-in-class global providers"

Chapter 4

A Call to Action for Providers

To improve the quality of infrastructure implementation, India needs a high-performing group of providers in the sector—particularly developers and construction companies. To become truly world class, providers will need to upgrade their capabilities and practices, and also make some long-term strategic choices about their business models to help them build the right skills required to win sustainably in chosen spaces.

Furthermore, construction companies should collectively take a set of measures to become more professional and competitive, safeguard the interests of their employees, and enhance the industry's reputation. All these measures will result in a much better industry performance in the mid to long term. A well-organised industry association with committed participation will enable the implementation of these measures.

Improve Capabilities and Practices

The capabilities and practices of Indian providers are below par compared with best-in-class global providers. Bridging this gap would reduce both the time taken and the costs incurred in projects. Providers need to upgrade practices and capabilities in four areas—risk assessment and management, engineering, procurement and construction.

Improve risk assessment and management

As efforts to meet India's infrastructure needs gain momentum, government and nodal agencies will increasingly offer larger projects thereby transferring a majority of risk to providers through PPP and EP&C modes of project delivery. Accordingly, providers will need to upgrade their risk assessment and management capabilities. For an effective risk management system, providers should:

- **Set up an independent organisation to assess and manage risk:** This unit should report directly to the Board of Directors and provide them with quarterly updates on the extent of risk embedded in the business at any point in time. It should also suggest actions to the Board to mitigate those risks. Most importantly, this organisation should be staffed with some of the best project managers and functional specialists in the company. In addition, risk assessment during bidding should be done by a cross-functional risk team including senior representatives from engineering, procurement, construction, segment specialists, and finance departments.
- **Institutionalise processes:** Risk should be assessed and managed at multiple stages through well-structured processes as follows:
  - Opportunity approval process: All opportunities should be adequately screened through well-defined risk-return filters before they are actively pursued. Such assessment should focus on larger factors of business development including customer (e.g., solvency) and country risks
  - Bidding process: A cross-functional bidding team should use the risk register to identify and prioritise all the relevant risks, calculate the

exposure from each risk and decide on the best possible options, e.g., hedge, take exposure, price in to the bid

— Risk monitoring and mitigation process: Project teams should be trained to identify, report, and mitigate risks during project execution. In addition, for overall governance, a risk committee should consolidate risks across the portfolio, evaluate exposure every 3 to 6 months, and take corrective actions, if required.

- **Develop sophisticated tools and systems:** These would help to accurately identify, prioritise and quantify risks. To illustrate, such systems and tools would include:

  — A risk register that lists the main risks for each segment, acceptable risk limits, options to mitigate risks and guidelines to estimate the value of risks

  — Standard Operating Procedures (SOPs) and checklists to institutionalise the process of identifying, prioritising, quantifying, and treating risks

  — Modelling techniques (e.g., Monte Carlo simulation) to generate likely scenarios and their implications as a way to guide decisions on costs and prices.

Upgrade design and engineering capabilities

As the PPP and EP&C projects become more prevalent, providers will increasingly play a design and engineering role. Accordingly, they will need to upgrade their engineering capabilities. In particular, it will be important to capture the full impact of value engineering, not only in complex projects but also in simple ones (Exhibit 4.1).

In doing so, providers will need to:

- **Build strong in-house value engineering teams:** Providers should establish dedicated value engineering teams comprising experts with significant experience in design, engineering and procurement. They should also provide world-class training to these teams on value-engineering tools and levers, e.g., clean sheet or zero-based costing, design benchmarking. Establishing partnerships with leading global engineering institutes and firms would help providers to tap into the latest global expertise on the topic.

- **Put in place the right performance tracking and incentive mechanisms:** Providers must define specific KPIs to measure performance of the value engineering team, e.g., percentage cost saving identified at different design stages. They should also ensure clear demarcation of performance between value engineering, design engineering and procurement teams. The right incentives should also be offered to boost the team's performance, e.g., a share of realised savings as bonus.

- **Enforce value engineering outcomes in all three steps of design process:** These include: 1) front end engineering design; 2) detailed engineering and drawing; and 3) field engineering.

- **Aggressively use the value engineering toolkit:** Providers should avoid gold plating by challenging all assumptions and subjecting the designs and specifications to rigorous tests. A railroad in the US, for example, avoided several tunnels in the mountains by increasing the gradient of the rail marginally above its conventional value. Providers should also benchmark costs and specifications against best-in-class players. In addition, they should explore opportunities to standardise design modules for replication across multiple projects and across multiple modules in a large project, e.g., the culverts used in roads can be standardised across several projects.

Make procurement and sub-contracting world class

Several levers can make procurement and sub-contracting world class, thereby helping improve on-time project delivery at lower costs. These include:

- **Adopting a total cost of ownership approach to optimisation:** In many cases, a TCO approach

Exhibit 4.1

Value engineering can deliver substantial cost savings in all types of projects

DISGUISED CLIENT EXAMPLES

Case example	Complexity	Project cost savings[1]	Illustrative ideas
Large power plant in India		3-4%	▪ Reduced liner thickness in ash dyke from 750 microns to 500 microns ▪ Used 4 pneumatic conveying streams instead of 10 for fly ash ▪ Reduced thickness of condenser tubing from 0.7 mm to 0.5 mm
Brownfield expansion of an Asian airport to increase passenger capacity by 2.5X		~3%	▪ Used alternate materials for HVAC piping ▪ Reduced chilling capacity of HVAC in-line with the requirement ▪ Optimised safety factor for baggage handling system, based on baggage load
Large scale real estate (office) project in India		8-10%	▪ Optimised the glass type to reduce HVAC load ▪ Reduced glass usage to areas where glass was adding value above the regular brick walls ▪ Optimised the size of individual vehicle cells to improve utilisation

1 Dependent on the extent of project scope covered by the value engineering exercise

SOURCE: McKinsey

can fundamentally change procurement decisions (e.g., to buy more expensive equipment because its lifecycle cost is lower). While this may be less relevant for EP&C projects, it is crucial for BOT projects. However, making this transition within procurement teams is not easy.

- **Managing supplier base proactively through preferred relationships:** More than 80 per cent of procured items should come from preferred supplier relationships where priority in delivery and joint-cost reduction becomes the norm. This would also mean systematic performance tracking for all suppliers and continuous weeding out of under-performing suppliers.

- **Developing high quality construction sub-contractors:** Providers should invest in developing high-performing construction sub-contractors, which are difficult to find in India. Taking a long-term relationship view of these business partners is crucial, and the provider should invest in enhancing sub-contractor skills through workshops, trainings, and tools.

- **Sourcing from low-cost countries:** Providers should identify suppliers in low-cost countries such as China, Russia, and those in Eastern Europe, who can provide equivalent quality at prices lower than those in India. This is usually effective only when the provider establishes purchasing offices in these countries with local personnel to create local knowledge, screen suppliers based on rigorous on-site visits, and control quality and delivery schedules.

- **Consolidating demand to benefit from scale efficiencies:** Providers should set up organisations and systems to consolidate demand for large spend categories centrally. This would allow commodity-

specific experts to analyse the price outlook and decide the procurement approach centrally, which might lead to establishing regional or global contracts as well.

Adopt lean principles in construction

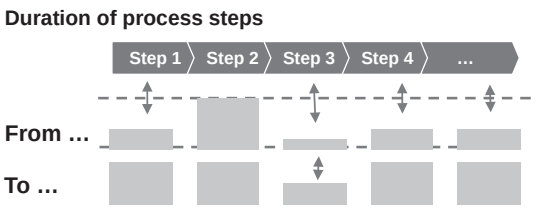
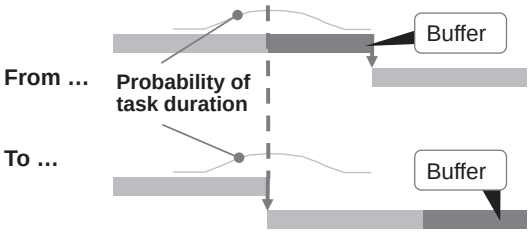
Most Indian construction sites have several improvement opportunities, which are quite apparent during a two-day site visit. Such improvements include:

- **Establishing basic construction management practices:** Some providers lack basic construction management practices. At the very minimum, they need to put the following in place immediately: 1) start construction only after detailing plan to L-5/L-6 level; 2) translate plans into daily activity schedules for construction managers and supervisors; 3) cascade daily activity plans to workers and ensure robust supervision; 4) track productivity every day and link worker and supervisor incentives to the same; 5) ensure use of automated construction equipment and tools; and 6) proactively manage material and equipment availability (to reduce waiting time).

- **Upgrading construction management using lean principles:** Lean techniques focus on eliminating waste and are particularly relevant for repetitive activities. Contrary to popular belief, most construction projects have several repetitive activities (e.g., constructing a power plant boiler has 80 per cent activities that are repetitive). Our experience with large Indian construction companies suggests that only 20 per cent of worker time is value-adding and the rest is wasted. Best-practice construction sites can get to 40 to 50 per cent value-added time, which is effectively a 100 per

Exhibit 4.2

Lean construction employs 3 primary levers to optimise project execution

	Description	Illustration
Process Step Productivity Enhancement	▪ Reduce time taken by each activity in the process, e.g., maximise ground pre-assembly of equipment	
Construction Flow Balancing	▪ Balance time taken by different steps in the process through proper resource allocation, so that no step becomes a bottleneck ▪ Perform these steps in parallel	
Critical Chain Project Management	▪ Optimise the critical path to reduce overall project duration, e.g., protect the completion of a wide range of dependent tasks with a final buffer, instead of protecting each task with a buffer	

SOURCE: McKinsey

cent jump in productivity. Three levers typically help capture this improvement (Exhibits 4.2 and 4.3):

— Process step productivity enhancement: Reduces time taken for each activity in the construction process. For example, maximising the use of pre-fabricated material to reduce on-site installation time, or using small cranes and carts to transport material

— Construction flow balancing: Balances the time taken by different steps in the process through proper resource allocation, so that no step becomes a bottleneck and parallel processing is maximised. For example, if welding a joint takes twice as long as grinding then ensure a ratio of two welders to one grinder in every team

— Critical chain and project management: Identifies and optimises the critical path to reduce overall project duration and plans resources to reduce risks of over-run. Unlike the common practice of buffering each task, lean construction mandates planning the completion of a wide range of dependent tasks with a final buffer to make it transparent.

- **Strengthening planning and construction organisation:** To accomplish the aforesaid effectively, providers need to substantially strengthen their planning and construction organisation. Planners need to have the capabilities to manage detailed plans, update them based on daily progress, and identify opportunities. Revamping the construction organisation would include establishing a manageable worker-to-supervisor ratio (unlike common perception, a higher ratio is not necessarily better), training supervisors so that they can become better personnel managers, enabling

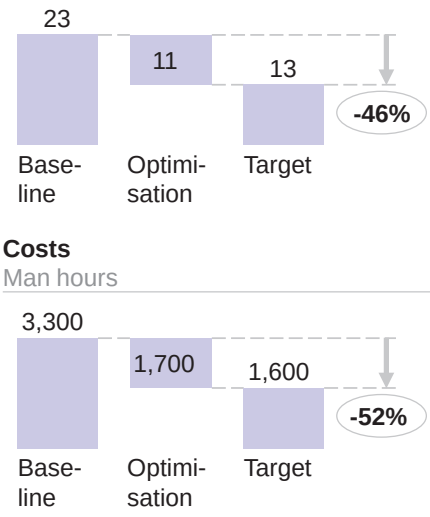
Exhibit 4.3

Employing lean techniques can result in substantial cost and time savings

DISGUISED CLIENT EXAMPLE

Illustration: assembly of cage serpentines in a coal-based power plant

Levers	Actions	Impact
Process Step Productivity Enhancement	▪ Pre-assemble 2 serpentines together in the prefabrication area ▪ Improve ground operations with a more effective frame ▪ Improve winch speed ▪ Introduce a faster frame/serpentine fastening system ▪ Increase the number of serpentines lifted per cycle	**Duration** Days: 23 → 11 → 13 (-46%)
Construction Flow Balancing	▪ Balance the work flow with dedicated teams working in parallel	
Critical Chain Project Management	▪ Plan subsequent steps critical to serpentines assembly (e.g., manifolds, welding, X-ray inspection) based on "critical chain" principles	**Costs** Man hours: 3,300 → 1,700 → 1,600 (-52%)



SOURCE: McKinsey

them with simple tools that help them in their daily jobs, and enforcing daily performance dialogues at sites focused on progress and productivity.

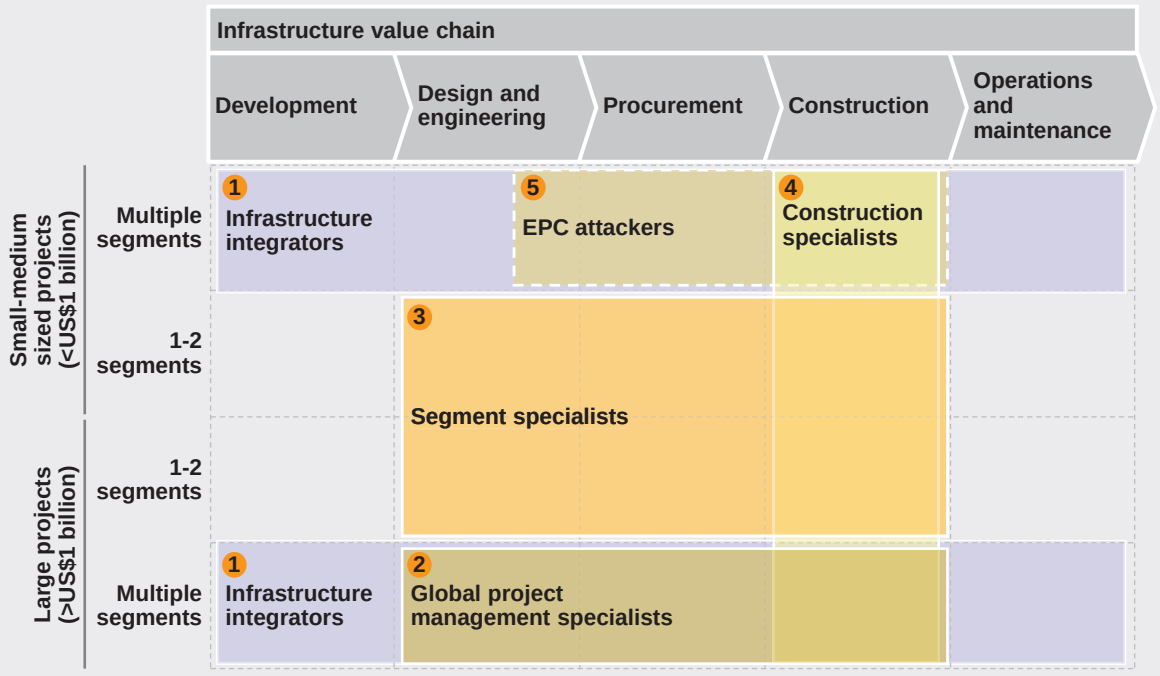
Make Strategic Choices Consciously

India's large spend on infrastructure and the changing nature of opportunities (e.g., more PPP projects, increase in usage of lump-sum EP&C contracts) will force providers to make strategic choices along several dimensions. In particular, decisions about a provider's footprint across the infrastructure value chain and which segments to participate in will define its business model, strategic direction and posture (Exhibit 4.4). Depending on the model, providers will need to prioritise the capabilities to focus upon:

- **Making decision about the value chain footprint:** Providers can participate in one or more of the five steps of the infrastructure value chain, namely, development, design and engineering, procurement, construction, and operations and maintenance. Each step requires a different set of capabilities and offers a different risk-return profile
- **Selecting segments for participation:** The segments of infrastructure are significantly different from each other in terms of the nature of projects and nodal agency practices. Hydro power projects, for example, require significantly more complex engineering than roads; operating ports is entirely different from operating airports; and water projects are fragmented across several state-level agencies, whereas national highways are all with NHAI.
- **Prioritising capabilities, depending upon the model chosen** (Exhibit 4.5). Some globally prevalent models include:

Exhibit 4.4

The business model of providers will be defined by the choices made in key segments



SOURCE: Expert interviews; McKinsey analysis

— Infrastructure integrators: Manage and construct PPP projects in an end-to-end manner, in many cases with in-house EP&C, and operations and maintenance (e.g., global giants such as Ferrovial and Vinci)

— Global project management specialists: Be the overall project manager that oversees EP&C management of multi-billion dollar projects across several segments and geographies (e.g., Bechtel, Fluor)

— Segment specialists: Perform the EP&C of projects in niche segments; those that suit this model require complex design and engineering, such as refineries and ports (e.g., Keppel corporation specialises in marine and offshore segment)

— Construction specialists: Focus on construction component of projects of all types. These companies typically have limited geographic presence (e.g., Granite, FCC)

— EP&C specialists: Perform detailed design, engineering, procurement, and construction for medium to large but not multi-billion dollar projects. Some of these specialists are on the brink of entering the league of global project management specialists.

Take Collective Action

For better industry performance in the mid to long term, construction companies will need to collectively act to become more professional and competitive, safeguard the interests of their employees, and enhance

Exhibit 4.5

The capabilities to focus upon will depend on the business model adopted

		Business models for construction players				
Infrastructure value chain	**Source of competitive advantage**	**Infrastructure integrators**	**Global project management specialists**	**Segment specialists**	**Construction specialists**	**EPC attackers**
Development	1 Robust risk assessment	✓	✓			✓
	2 Creative project financing	✓				
Design and engineering	3 Design and engineering for complex projects	✓		✓		
	4 Value engineering		✓	✓		✓
Procurement	5 Best-practice procurement		✓	✓		✓
	6 Mega-project management		✓			
Construction	7 Contract management	✓	✓			✓
	8 High construction productivity				✓	✓
	9 Regulatory management	✓				
Operations and maintenance	10 Operational and commercial excellence	✓				

SOURCE: Expert interviews; McKinsey analysis

the industry's reputation. We suggest that the industry should collectively take the following actions:

- **Drive the framing and adoption of the latest health, safety and welfare standards for employees**
  - — Revise norms and standards: Drive the revision of the archaic Building Construction Workers Act, 1996, and initiate discussions on challenges that players could face due to non-compliance of norms
  - — Create awareness: Help small and medium-sized construction companies understand norms and their importance, and adopt global best practices such as better labour camps on construction sites
  - — Build health and safety-related skills: Work in conjunction with government to address the shortage of occupational health specialists.
- **Work with industry participants and government for enhancing the availability of skilled and semi-skilled workers**
  - — Define standards: Facilitate the development of commonly agreed standards and define certification levels vocational training
  - — Support the delivery model: Mobilise finances for construction-focused training institutes, encourage industry participants to provide faculty training and apprenticeship opportunities to students
  - — Attract talent: Benchmark career paths, compensation levels, and incentive plans within industry and across industries. Organise discussions to make these elements more attractive.
- **Increase awareness among industry participants about important issues such as demand patterns, risks and technology evolution**
  - — Assess and communicate industry status annually: Launch an effort to gather and manage important statistics for the industry, and capture technology advances, government policies and structural shifts in markets. Circulate white papers and conduct seminars to discuss the insights
  - — Improve business orientation of construction sector professional: Work with leading institutions (e.g., National Institute of Industrial Engineering, IITs) to conduct executive development programmes, to develope the managerial and functional skills (e.g., lean construction, risk management) skills of the participants.

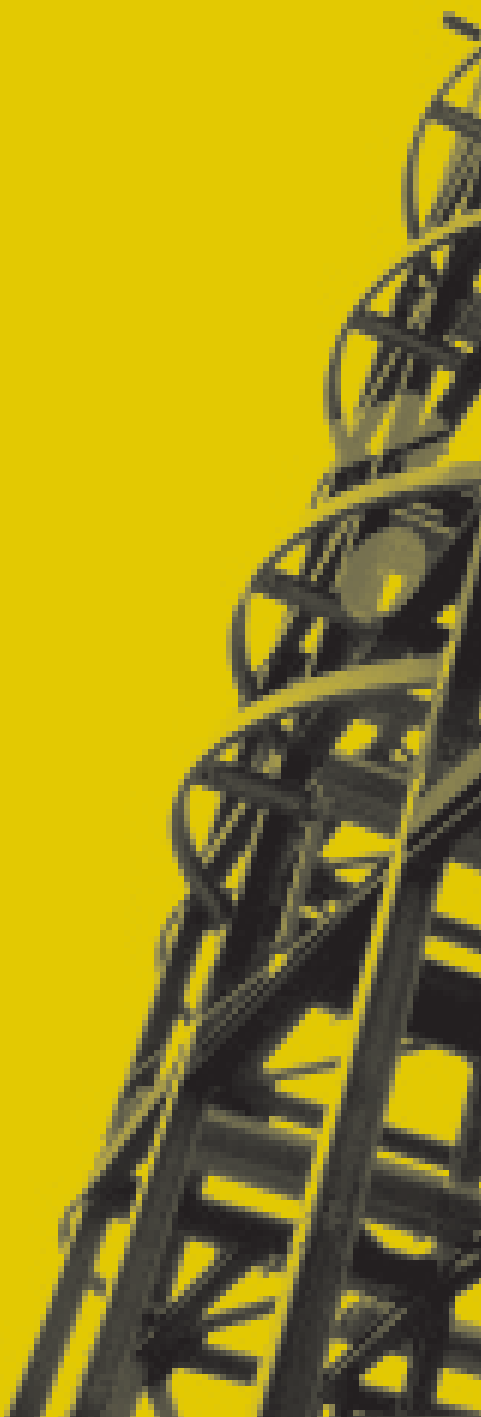
These efforts will require the industry to be much better organised and pursue a common, yet aspirational agenda.

* * *

Globally, infrastructure is regarded as a key driver of growth, and India is no exception. The Indian government has taken a commendable step by recognising this and setting an ambitious target for infrastructure investment. A glance at the track record of performance against such plans, in both the recent and distant past, raises concerns about the realisation of this plan. Several inefficiencies, cutting across various stakeholders, hamper infrastructure implementation. These inefficiencies could potentially lead to a GDP loss of USD 200 billion by fiscal year 2017.

Averting this loss can significantly boost the country's overall prosperity. The government has taken some positive steps in this direction over the past few months, and the new government has reiterated its commitment to infrastructure. However, more concrete steps are needed to realise India' infrastructure growth aspirations. All stakeholders (government, policy makers, nodal agencies, and providers) will need to come together and play their part. It will be important for each stakeholder to act now instead of waiting for others to take the first step. A sustained effort by all holds the key to India fulfilling its infrastructure needs.

“A sustained effort by all holds the key to India fulfilling its infrastructure needs”



"Infrastructure investments impact a country's economy in two ways: direct and indirect revenue impact, and productivity impact"

Annexure

GDP Impact of Inefficiencies in Infrastructure Implementation

Infrastructure investments impact a country's economy in two ways:

- **Direct and indirect revenue impact:** This is the direct effect on the output of the infrastructure assets themselves and the indirect effect on revenues of the upstream industries that supply for their creation and operation, e.g., steel, cement, fabrication.
- **Productivity impact:** This is the effect on the productivity of downstream industries (e.g., logistics) that use the infrastructure assets.

To estimate the revenue impact of infrastructure, we have used the well-established approach based on the Incremental Capital Output Ratio (ICOR) and GDP multiplier.

Estimating productivity impact is difficult because economists globally have not been able to agree on any one robust approach. The underlying reason is that the relationship between investment in infrastructure and productivity improvement is not yet conclusively established. The estimate can vary significantly depending on the approach used. That said, given the widespread interest that we have observed in all stakeholders during our research, we have chosen to illustrate the size of the productivity impact using one of the more prominent approaches.

Revenue Impact

To estimate the revenue impact in 2017, we have extrapolated from the actual performance during the first two years of the Eleventh Plan, which is the most recent data on cost and pace of infrastructure creation.

Three factors impact revenues negatively (see chapter 1): 1) shortfall in awarding projects as per plan; 2) shortfall in funding; and 3) inefficient project execution. Shortfalls in awarding pre-empts asset creation and cause loss of revenues of those assets, contributing USD 100 billion to the GDP loss in 2017. Similarly, shortfall in funding contributes USD 20 billion to the GDP loss. Inefficient project execution during engineering, procurement and construction steps causes time and cost over-runs in asset creation. Time over-runs lead to delays in the revenues of those assets, and cost over-runs imply less assets for each unit of capital deployed, effectively reducing the revenue generating potential of that capital. This contributes another USD 80 billion to the GDP loss (Exhibit 1).

We have estimated the negative impact on revenues of each of these factors using the ICOR approach. Subsequently, we have broken up this loss into components that the different stakeholders can address, by:

- **Estimating three steps to negative impact of revenues:**
  1. **Estimate the lost revenues of infrastructure asset shortfall using ICOR:** An industry's ICOR is the ratio between capital deployed and output generated in the industry. For India, the average ICOR of electricity, gas, water, transport,

Exhibit 1

Illustration of the approach used for GDP impact estimation – power plant example

Steps	Description	Illustration
Investment	▪ Investment in infrastructure	▪ Assume USD 100 is invested to build a power plant
÷		
ICOR	▪ Invested capital to output ratio – measures the incremental investment required for producing the next unit at output	▪ If ICOR for power generation is 4, incremental gross output as a result of USD 100 investment will be USD 25
X		
Output multiplier	▪ Output of other industries (suppliers, suppliers' suppliers and so on) due to output of infrastructure	▪ Power plant will increase output of other industries like cement, coal, equipment manufacturers etc. ▪ If output multiplier is 2, total incremental output will be USD 50
X		
GDP multiplier	▪ Ratio of "value added to GDP" to "gross output" (since the entire output cannot be considered as addition to GDP)	▪ If GDP multiplier for power generation is 0.4, incremental GDP will be USD 20
=		
GDP impact	▪ Impact of incremental investment in infrastructure on GDP	▪ USD 100 investment in infrastructure will result in USD 20 increase in GDP

SOURCE: McKinsey analysis

communications and storage sectors is 2.93, based on the median values of the ratio during the last 5 years. The shortfall in asset creation due to fewer than planned awarding of projects amounts to USD 400 billion (30 per cent of Eleventh and Twelfth Plans). Dividing this by the ICOR, we arrive at USD 140 billion as the lost revenue of these assets in 2017 (the year in which all these assets would have been operating).

2. **Estimate the lost revenues of upstream industries:** The lost revenue of infrastructure assets is multiplied with the output multiplier to estimate the lost revenues of all the upstream sectors. The output multiplier for a sector is defined as the total incremental output of all upstream sectors for a unit incremental output of the sector. In India, the weighted average output multiplier for infrastructure sectors is 2.3. Multiplying the USD 140 billion lost revenue (of infrastructure) with the output multiplier, we arrive at a total USD 320 billion lost revenue (of all sectors), due to fewer than planned awarding of projects.

3. **Convert both these revenue losses into GDP impact by using the ratio of value added to output for each industry:** Only the value-added component of the revenue contributes to GDP. In India, the ratio of value added to revenue of infrastructure and upstream sectors is 0.3 (weighted average basis). Multiplying the USD 320 billion lost revenue due to sub-plan awarding of projects with 0.3, we arrive at USD 100 billion GDP impact of that lever.

- **Attributing total GDP impact of USD 200 billion to stakeholders, primarily for the purpose of highlighting the need for action by all:**
  - **Policy makers and customers can address USD 155 billion of this loss:** The USD 100 billion loss due to shortfall in awarding projects and the USD 20 billion loss due to shortfall in funding are included here. Further, the impact of engineering driven time and cost over-runs (USD 12 billion) is also included. Lastly, 60 per cent of the impact due to time and cost over-runs during construction (USD 23 million), which can be addressed by policy makers and customers, is included.
  - **Providers can address USD 45 billion of this loss:** The USD 8 billion loss due to lost value engineering opportunities and the USD 10 billion loss due to sourcing inefficiencies are included here. Further, 40 per cent of the impact due to time and cost over-runs during construction (USD 15 million) and the entire lost optimisation opportunity during construction (USD 12 million), which can be addressed by providers, are included.

Productivity Impact

The growth in a country's GDP growth is a function of the growth in its capital and labour stock, and of the growth in its total factor productivity (TFP). The growth in TFP is attributable to the various sectors of economy, such as infrastructure. One of the approaches of growth accounting[1] links the growth in a sector's contribution to TFP, to the capital creation in that sector.

This approach can be used to estimate the productivity impact:

- **Contribution of infrastructure to India's TFP growth:** India's TFP growth is estimated to be 3.7 per cent currently[2]. Studies in India and abroad[3] estimate that 30 to 50 per cent of the TFP growth is attributable to infrastructure. Thus infrastructure contributes 1.1 to 1.8 per cent to India's TFP growth.
- **Impact of inefficiencies on the capital creation rate:** McKinsey estimates suggest that the value of India's infrastructure stock in fiscal year 2007 was USD 390 billion. If infrastructure is implemented as per the Eleventh and Twelfth Plans, this stock would grow at an annual rate of 16 per cent. However, it would only be 8 per cent if the current inefficiencies continue. Thus, the inefficiencies can reduce the capital creation rate in infrastructure by 8 percentage points.
- **Linkage of TFP growth with capital creation rate:** Considering the proportion between capital creation rate and TFP growth in fiscal year 2007, the 8 percentage points reduction in capital creation rate during 2008 to 2017 can translate into 0.8 to 1.3 per cent loss in TFP growth.

Since TFP growth is a component of GDP growth, the 0.8 to 1.3 per cent loss in TFP growth is effectively a loss in GDP growth. This implies USD 95 billion to USD 160 billion loss of GDP in 2017. This loss is the productivity impact on GDP.

* * *

We have estimated the productivity impact only for illustrative purposes. It is not included in our estimate of the GDP impact, which is pegged at USD 200 billion.

1 'The Impact of Public Infrastructure on Canadian Multifactor Productivity Estimates' - Wulong Gu and Ryan MacDonald (2009).
2 Oxford Economics.
3 'The Impact of Public Infrastructure on Canadian Multifactor Productivity Estimates' - Wulong Gu and Ryan MacDonald (2009); 'Infrastructure, Externalities, and Economic Development: A Study of the Indian Manufacturing Industry' - Charles R. Hulten, Esra Bennathan, and Sylaja Srinivasan (2006).

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