

# Revamping Project Management

**Assessment of infrastructure  
projects and corrective  
recommendations for performance  
improvement**

A joint study conducted by PMI and KPMG in India  
on infrastructure projects in India, supported by  
Ministry of Statistics and Programme  
Implementation (MoSPI)

June 2019

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performance improvement**



**प्रवीण श्रीवास्तव**  
सचिव एवं भारत के मुख्य सांख्यिकीविद  
**PRAVIN SRIVASTAVA**  
Secretary & Chief Statistician of India



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## MESSAGE

I am happy to note that the Project Management Institute (PMI) and KPMG India have conducted a study on "**Revamping Project Management Practices and Corrective Recommendations**" in consultation with MoSPI.

The creation of infrastructure assets plays a vital role in the development of the economy. The Government has undertaken several initiatives such as e-Suvidha, India Investment Grid (IIG) etc to promote infrastructure growth. These initiatives will facilitate investment in infrastructure sector, acquisition of land, obtaining regulatory approvals etc. Niti Aayog has also recommended implementing model agreements for improving contractors procurement.

The report highlights key recommendations that can improve management of these infrastructure projects, like strengthening internal processes to build capabilities, broadening the culture and mind set, improving stakeholder management for land acquisition and regulatory approvals, dispute resolution mechanism between private players and government agencies and establishing robust project governance. Leveraging technology for efficient and effective project delivery has also been highlighted as a key recommendation. The report recommends creation of a National Level Project Evaluation and Control Cell for continuous evaluation of projects.

I am confident that the report and its recommendations would be useful for policy makers, Public Sector Enterprises, developers and other key stakeholders to promote successful implementation of projects time and cost overruns to a great extent within the scheduled time and cost. The Ministry looks forward to suggestions and comments on the findings.

**(Pravin Srivastava)**

NEW DELHI  
JUNE, 2019





## FOREWORD

The Indian economy has emerged as the fastest growing economy as per the Central Statistics Organization (CSO) and International Monetary Fund (IMF). Going forward, India is poised to become one of the top three economic powers over the next 10-15 years, on the back of macroeconomic policies as well as few growth oriented reforms unleashed in recent years. In order to sustain this growth momentum, timely development of country's infrastructure is critical. The Union Budget 2018-19 earmarked considerable spend in building infrastructure of our nation which is vital for achieving a double-digit GDP growth. Moreover, the work is on to build mega projects across the vital sectors of the economy such as Smart Cities mission, Sagarmala program, Housing for All, Swachh Bharat Mission, Atal Mission for Rejuvenation and Urban Transformation (AMRUT), Power for All, et al to name a few. However, the emphasis has to be on timely and on-budget completion of projects.

As per the Ministry of Statistics and Programme Implementation (MOSPI)'s March 2019 Flash report, it has been observed that more than 27% of the central sector projects are delayed beyond their scheduled date of completion thereby reflecting substantial cost overruns. Managing these complex projects has always been a challenge, especially when these projects involve multiple stakeholders, new or unproven technologies, and constrained resources.

With an objective to understand the reasons for these over-runs , an assessment of their root-causes and the in-house project management capability and maturity level of key Public-Sector Enterprises (PSEs) is imperative. This study involved revisiting the earlier study done in 2012 and gauge the progress of select projects as per the flash report, do the gap analysis, identify key success factors and leading practices which should be leveraged for efficient project delivery, along with addressing the key reasons behind projects time and cost overruns. In order to facilitate the study, MOSPI's Flash report of January 2018 was taken as the basis, which included 1,304 infrastructure projects. Further, focused interviews were conducted with 31 participants across 25 Public Sector Enterprises (PSEs) and 4 participants across 4 private contractor organizations. Simultaneously, case studies were conducted for 9 projects across five sectors namely Roads (2), Power (2), Petroleum (2), Railways (1) and Civil aviation (2) in different parts of the country.

The analysis and findings presented in the report have been gathered and validated through face to face consultations with concerned stakeholders engaged in projects execution, site visits etc.

The recommendations suggested in the study will go a long way towards improved project performance and delivery.

  
(Dinesh Kumar)

NEW DELHI  
JUNE, 2019



# Foreword from Project Management Institute®

The economic growth of any country is primarily dependent on the development of its infrastructure and India is no exception. Today, India has emerged amongst the fastest growing economies of the world and is poised to grow at 7.5 percent in 2019 and 7.7 percent in 2020 as per International Monetary Fund (IMF). With investments envisaged amounting to INR 50 Lakh crore, there has been a considerable impetus to effectively deliver projects and programs in the country.

While project discipline is country agnostic, that is, structured project management practices of project delivery are crucial regardless of geographic location. However, challenges remain in terms of maturity in adoption of these global best practices, complexity of projects and skilled workforce. As per the 2018 edition of PMI's annual Pulse of the Profession survey, it was found that nearly 10 percent of every dollar is wasted due to poor project performance, which translates to USD 99 million for every USD 1 billion invested.

The Government of India has launched various critical infrastructure projects like Power for All, Smart Cities Mission, Swachh Bharat mission, and many more with an objective to build world class infrastructure in the country. However, as per Ministry of Statistics and Programme Implementation's (MoSPI) Flash report of January 2018, it is observed that around 20 percent of the central sector projects are delayed beyond their scheduled date of completion.

Managing these complex projects has always been a challenge, especially since these projects are long-term, involve multiple stakeholders, bring-in new technologies, and constrained resources. Accordingly, PMI in consultation with MoSPI and KPMG has conducted a study on "Revamping Project Management - Assessment of infrastructure projects and corrective recommendations for performance improvement" which is a continuation of the earlier study done in 2012.

As a standard practice world over, most of the infrastructure projects are delayed primarily due to regulatory approvals, issues on land acquisition, shortage of skilled resources, ineffective dispute resolution mechanism, and geological challenges. However, if one comprehends these issues proactively, the project leader can plan more effectively and ensure that the project is efficiently managed.

The report underlines the need for heavy investment in project pre-planning, to strengthen processes and capabilities in terms of reforming procurement and strengthening contract management, bringing in lean construction methodologies for improving productivity, incorporating a culture of risk management, bolstering people management processes, augmenting organizational skill-sets, and deepening stakeholder management for land acquisition and regulatory approvals related challenges.

The implementation status of most projects points out the gaps in the application of project management practices. A trained project manager is capable of making a holistic assessment of all the risks embedded in a project which not only help in forecasting problems that may cause delays beforehand but also offer ample opportunities to mitigate the risks. Therefore, systematic adoption this discipline and implementation of project management techniques are crucial for a country like India, especially to continue on its high-growth trajectory in the coming years. It is now universally recognized that project management plays a vital and decisive role in effective and transparent program implementation. It also significantly contributes towards creating a culture of performance

governance. Almost all the major world economies are now increasingly relying on project and program management skills to improve the impact of government programs through a focused, result-oriented approach. This trend is equally, if not more, relevant for India, more so in the current context of raised expectations from the present Government.

We at Project Management Institute (PMI) strongly believe that project management helps to bridge the chasm between high-level strategic vision and successful outcomes. Implementation of project, program and portfolio management framework, tools and techniques can thus be the enablers for successful execution of crucial public projects and programs.



*Murat Bicak*

**Murat Bicak**  
**Chief Strategy & Growth Officer (CSGO)**  
**Project Management Institute®**

June 2019

# Foreword from KPMG in India

India has been witnessing an unprecedented economic growth and infrastructure construction is at the heart of this wave. Approximately INR 50 lakh crore of investment is required over the next four to five years (2019-23) to sustain this growth; a strong pipeline of upcoming and ongoing projects and large programmes are underway across sectors, presenting us with an unparalleled and never seen before opportunity. Several big ticket initiatives were rolled out by the Central Government in its first term. The 100 day agenda for Modi 2.0 clearly calls out the need for building physical infrastructure for the country to revive key sectors that lead to employment generation, and until private investment picks up, public expenditure in asset creation to remain as the driving force. The business of building infrastructure is one that involves long gestation periods, and often closely intertwined with public opinions impacting the project outcomes. Given this backdrop, it is important to focus on the core industry issues, and the opportunity that lies therein, because the road to growth cannot happen without putting in place the infrastructure backbone, which then has a multiplier effect on which way the economy, and we, go as a nation.

Additionally, the infrastructure development in India is prone to dependency on external factors (land, environment, socio-economic, community, regulatory, market forces etc.) and has its fair set of challenges. Added to that are the sectorial nuances – with project types that are geographically spread / linear and those that are area based. While there may have been a few success stories, but as a whole, our performance falls short significantly, and on a consistent basis.

This study titled “Revamping Project Management” is built on a structured approach based on qualitative discussions and interviews, relevant project level case studies, impact assessment of the last MoSPI-PMI-KPMG study of 2012 and its recommendations, analysis to ascertain thematic root causes for time and cost overruns and forward looking recommendations along with a ready reckoner for Implementation Agencies to address the primary causes.

The case studies and interviews were conducted by taking a deep dive approach with our technical teams interacting with project teams based at construction sites at remote locations and then calibrating and reconciling data points over multiple discussions with various stakeholders involved with the projects based across locations and at headquarters. Given the broad nature of infrastructure sector, it was imperative that we took a sectorial approach and in detailed discussions with MoSPI, PMI, we focused on five sectors for case studies– Roads, Power, Oil and Gas, Railways, and Civil Aviation.

The recommendations section identify specific actions such as 1) the importance of pre-planning and site readiness before you mobilize construction on your project, 2) collaborative and agile planning, 3) reforming public procurement and contract management, 4) strengthening stakeholder management for land and regulatory issues, 5) improving governance, processes and people capabilities, 6) introducing and enabling lean construction principles and 7) gearing up to fully leverage technology.

This study is not to be read as a definitive one size fits all solution for solving infrastructure project delivery, but is meant to be a ‘point in time, deep reflection’ that would lead to increasing awareness amongst a wider section of professionals sitting across the project delivery value chain. As a nation, we need to overcome what has slowed us down in the past. There are a number of fundamental positives. We are a nation that has no dearth of engineering talent with decades of project delivery experience residing in pockets that needs to be tapped into to help improve the overall average performance levels. Deep techno-commercial expertise, robust contractual and legal systems, a passionate and driven workforce, with a strong entrepreneurial culture, leading technology advancements and disruptions– these are some of the favorable factors that should be leveraged.

The study recommendations would require various stakeholders including key ministries, nodal GoI think tanks including but not limited to NITI Aayog, Department of Public Enterprises, some recently created units like the India Investment Grid under Ministry of Commerce and Industry and key central as well as state PSUs that are implementing these programs and projects, engineering and contracting firms in the country, to address and adequately respond to the suggested measures, and organize themselves potentially using this platform as a call to action.



A handwritten signature in blue ink, appearing to read "Puneet Narang".

**Puneet Narang**  
**Partner, Major Projects Advisory**  
**Infrastructure, Government and Healthcare**  
**KPMG in India**

June 2019

# Key Notes and Disclaimer

This study focuses on the performance of infrastructure projects in India (valued more than INR 150 crore), which are centrally monitored by the **Ministry of Statistics and Programme Implementation (MoSPI)**.

MoSPI database of infrastructure projects consolidated for the Flash Report of **January 2018** has been considered for the purpose of this study, which represents a sample of the infrastructure projects in India. The report has also undergone value addition through multiple discussions and brainstorming sessions held by PMI and KPMG with MoSPI, NITI Aayog, Project Monitoring Group (PMG), India Investment Grid (IIG) and Department of Public Enterprises (DPE) up to March 2019.

Basis the flash report, subject organizations for interviews and projects for case studies were selected with the guidance of MoSPI for conducting the current state assessment. The report findings are based on the information provided to us during interview discussions with multiple Public Sector Undertakings (PSUs) and private contractors in pre-defined questionnaires, and from the data provided by respective PSUs pertaining to their projects for case studies.

We have not independently verified the data provided and accordingly express no opinion or make any representation concerning its accuracy and completeness.

The recommendations are based on the limited reviews of case study projects and interviews conducted. The study is not intended to detect any fraud or irregularities neither it is designed to conduct audit of any project's performance. The report is not directed to any particular organization but is intended towards improving the performance of infrastructure projects in India. However, the report does not diminish the responsibilities of respective PSUs and their contractors/vendors.

The information contained herein is of a general nature and is not intended to address the circumstances of any particular individual or entity. Although we endeavour to provide accurate and timely information, there can be no guarantee that such information is accurate as of the date it is received or that it will continue to be accurate in the future. No one should act on such information without appropriate professional advice after a thorough examination of the particular situation.

This report is solely for the use of Project Management Institute (PMI) India and that it shall not be quoted or referred to, in whole or in part, without the prior written consent of PMI-India and KPMG in India.

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# Executive Summary

## What are we dealing with?

The global infrastructure industry is grappling with few pervasive issues that impact capital project outcomes, and Indian infrastructure projects are not insulated. Yet, our country continues to witness an unprecedented infrastructure development fueling the economic growth.

The Government of India has ambitious growth plans and committed massive investment of close to **INR 5.97 lakh crore<sup>i</sup>** in the infrastructure sector in the current fiscal and the GDP contribution of the construction sector stands tall at **INR 2.49 lakh crore<sup>ii</sup>**. Further, it is estimated that approximately INR 304 lakh crore<sup>iii</sup> of investment is required in the Indian infrastructure sector till 2040 in order to sustain the country's development.

Recently, few projects have reported to set new benchmarks in timely completion such as the Delhi-Meerut expressway (Phase-1), the Statue of Unity and Delhi Metro (multiple phases). Additionally, infrastructure focused initiatives launched by the Central Government such as **PRAGATI and eSuvidha** have facilitated in debottlenecking critical projects, especially in the roads, power, and aviation sectors. Moreover, India's recent giant leap of **23 positions in the Ease of Doing Business list** as per the latest Doing Business Report (DBR 2019) released by World Bank, is a testament of a more seamless and efficient process of procuring construction permits.

However, improvement opportunities exist on a macro scale, and key stakeholders such as the Implementation Agencies, state governments, and contractors need to optimize their project management processes. According to the Ministry of Statistics and Programme Implementation (MoSPI) project database as on January 2018, 345 projects have incurred a cost overrun of **INR 2.19 lakh crore** and 354 projects have an average delay of **45 months**.

Multiple factors contribute to the reported overruns, mainly; lack of comprehensive upfront planning and risk management, non-collaboration across stakeholders, uncertainties in land acquisition process and regulatory approvals, scarcity of skilled labour, and above all, lower maturity of project management processes to adequately plan for such factors.

Furthermore, ahead of us is a strong pipeline of large programmes such as Bharatmala, Sagarmala, Green Energy Corridor and multiple oil and gas projects. In order to stay on course, it is essential to re-evaluate the core issues and address them adequately.



i. Union budget 2018-19 report

ii. Tradingeconomics.com, Central statistical organization, India

iii. Economic Survey 2017-18, Ministry of Finance, Govt. of India

## What is working well?

For a balanced view, the successful practices were identified during interviews and case studies, which should be leveraged by Implementation Agencies for wider application. These practices range from proactive application of technology during project lifecycle to an effective contractor/vendor management system with contractor rewards, vendor scorecards, and regular performance reviews.

Additionally, in order to serve the exceptional infrastructure growth and address the associated challenges, the Central Government has launched several initiatives. Such initiatives have been successful to an extent, in easing out some of the core issues such as land acquisition and regulatory approvals. In addition, NITI Aayog has recommended implementing model agreements for improving contractor procurement, which advocate adopting EPC contracting, incentivizing contractors for early project completion, and stage payments that can potentially align the interest of both clients and contractors to the project and reduce the number of claims.

Further, leading practices were witnessed from select projects in roads and power sectors, which are being monitored under PRAGATI (**Pro-Active Governance And Timely Implementation**) system.

These successful practices and initiatives have also contributed in shaping the study recommendations, especially around embedding a risk management culture, having a robust project governance, and improving overall procurement and contract management.

## How are we performing?

The current state assessment has been conducted in three (3) stages.

### Stage 1

Interviews were conducted with participants from **25** Public Sector Undertakings across **09** sectors

<b>8</b> Maharatna	
<b>5</b> Navratna	
<b>7</b> Miniratna	
Majority of the respondent organizations have annual turnover of more than <b>INR 5000 crore</b> and have between <b>50-150</b> ongoing projects of cumulative value of INR~35,000 crore	

Railways	AAI	BHEL	BPCL	CCL	CIL
Road Transport					
Civil Aviation	DMRC	EIL	GAIL	HPCL	IOCL
Coal					
Steel	MBPT	NBCC	NEEP CO	NHAI	NHPC
Power					
Shipping and Ports	NTPC	ONGC	PGCIL	RINL	RITES
Oil and Gas					
Urban Development	RVNL	SAIL	SCCL	SECL	THDC

Multiple private contractors in the above mentioned sectors were also interviewed for this survey

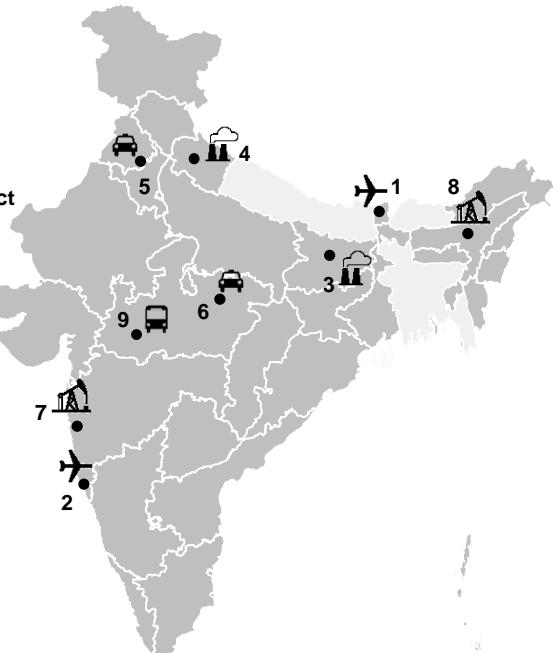
### Stage 1a

Conducted impact assessment of recommendations from the previous KPMG-PMI Study Report 2012 to understand implementation progress and challenges

**Stage 2****09** case studies were conducted across **05** sectors

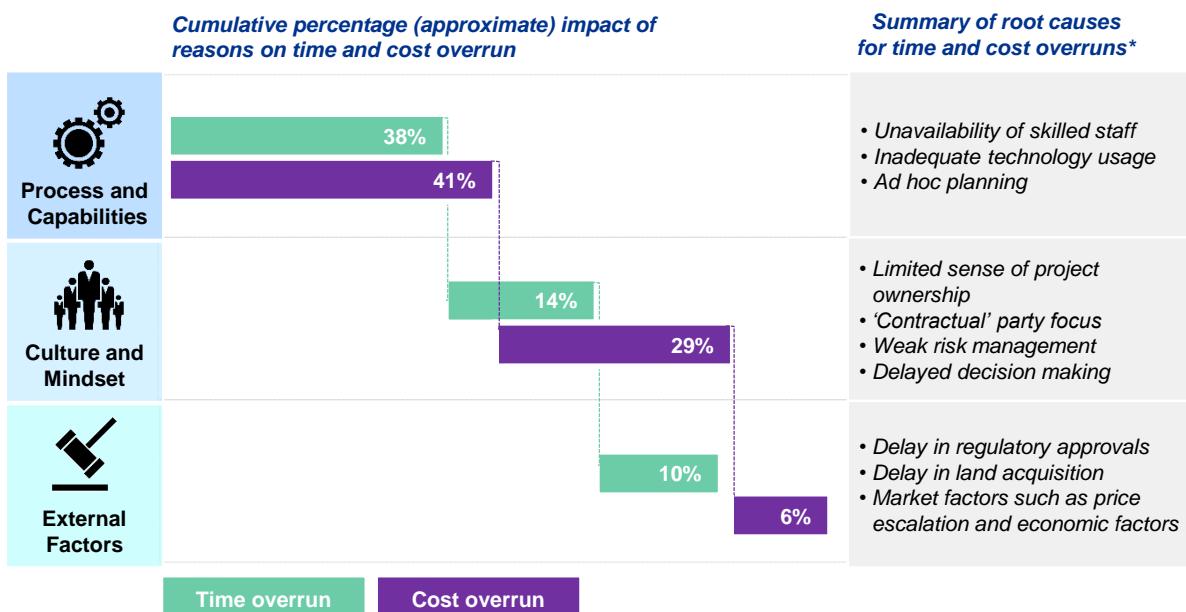
- Civil Aviation**
- Power**
- Road and Highway**
- Oil and Gas**
- Railways**

1. New Airport at Pakyong
2. New Terminal Building at Goa Airport
3. Barh Stage 1 Thermal Power Station
4. Tapovan- Vishnugarh Hydro Power Project
5. Six laning of Panipat-Jalandhar (NH-1)
6. Four laning of Gwalior-Shivpuri (NH-2)
7. Development of B-127 Fields
8. Assam Renewal Project
9. Lalitpur- Satna- Rewa- Singruli

**Stage 3**

Basis the interviews and case studies, the root causes of overruns point to three key areas which warrant improvements:

- 1. Process and Capability,**
- 2. Culture and Mindset, and**
- 3. External factors**



\*Note: Only key issues have been captured here. For detailed list of issues and further details, refer Section 4 of this report.

## How should we improve the performance?

Infrastructure sector in India is experiencing a major growth wave and it is imperative that the required improvements do not create hindrances in project progress. While few recommendations are low hanging opportunities for improvement, others require a transformational perspective. On the whole, the study recommendations can lead to improved project management capabilities. The recommendations address causes that contribute to above **60% of time overruns and above 70% of cost overruns**.



### 1. Invest heavily in pre-planning and site investigation

A sound start to a project is dependent upon the level of effort and accuracy in scoping and planning of the project. Significant efforts should be invested in project pre-planning to reduce uncertainty during execution and enhance reliability on project budget and schedule. Few of the suggested measures are-

- **Adopting a stage-gate based project delivery framework**
- **Shifting from the 'Contractual' perspective to 'Investigation and Preparedness' perspective**
- **Leveraging technology**
- **Preparing well-defined scope of work at bidding stage to limit scope change and risks**
- **Setting bidder pre-qualification criteria to ensure Best Available Technology (BAT) is employed in the project**



### 2. Implement collaborative and agile planning

The prevailing command and control planning practice should transform into a more collaborative approach, involving the downstream players (contractors/subcontractors) and key stakeholders (various departments, local communities etc.) in early project stages for effective buy-in that leads to realistic targets. Few measures towards bringing in this paradigm shift are-

- **Involving contractors and other stakeholders for setting realistic targets**
- **Introducing milestone based payment along with incentivizing early achievements of targets and penalizing non-performance of contractors**
- **Bringing agility and keeping the plan up to date through regular contact sessions**
- **Considering total cost of ownership while planning**
- **Factoring in 'cost of delay' or 'opportunity loss'**





### **3. Reform procurement process and strengthen contract management**

Procurement process and contract management, being a large contributor to project overruns, require revamping. Contractor procurement is crucial for any large project spanning multiple years, and the relationship between the Implementation Agency (IA) and contractor is critical for project success. Few measures to strengthen this area are-

- Project development and procurement may be considered with a waterfall approach of project structuring i.e. moving from PPP (BOT) to PPP (Annuity) followed by EPC/ Lump sum/ Turnkey contracts. The waterfall approach may be combined with agile approach in a hybrid model for managing uncertain aspects of the project such as land acquisition and regulatory approvals
- Implementation of model contracts advocated by NITI Aayog
- A robust Two-Stage bidding process comprising of a RFQ for shortlisting of bidders and thereby obtaining competitive financial proposal from the shortlisted bidders
- Supplement institutional capacity
- Customized contracting strategy
- Propagation of internationally accepted contract formats such as FIDIC and NEC
- Institute project management training and certification requirements for contractor/vendor onboarding



### **4. Implementation of lean construction principles for productivity improvement**

Lean construction, a globally accepted leading practice for large projects, improves work flow, reduces process waste and leads to optimization at whole (not in parts).

Few select lean construction methods listed below should be considered to address the productivity issues-

- Moving from dates to commitments; implementing the Last Planner® System
- Removing wastes and variability from site operations



### **5. Embed a culture of risk management; from concept to commissioning**

Projects are to be dealt as businesses and risks are to be considered as inevitable aspects, not as bi-products. Many organizations interviewed in the study do not have a documented process of risk management and the case studies were also devoid of risk registers and mitigation planning. The Implementation Agencies should proactively plan for managing risks and then transfer the select risks to the parties who can best shoulder those risks. Some key steps that agencies should take to identify and manage risks are-

- Institutionalize a risk management policy
- Implement a framework of risk management –
  - Considering internal/external risks at enterprise/strategy, projects, and operations level
  - Risk weighted planning



## 6. Strengthen people management processes

Slow decision making and lack of structured project communication are two critical issues, leading to time and cost overruns. For improving this scenario, the decision makers need to be motivated, well trained, completely informed and adequately empowered. Few measures to improve these aspects are-

### **Process related recommendations**

- Clear responsibility charter with delegation of decision making process
- Adopting technology
- Overcoming legacy challenges

### **People related recommendations**

- Enhancing HR policy -
  - Specialized skill based hiring, requirement based flexibility in hiring process
  - Merit based performance evaluation
- Creating project specific organization structure
- Manpower/succession planning



## 7. Augment organizational skillsets

Capacity of resources or availability of skilled resources have traditionally been a major bottleneck for the infrastructure industry. The following measures would help the industry reduce the skill gap and increase capability of the existing and future manpower.

- **Conducting skill gap assessment**
- **Setting up institutional tie ups**
- **Encourage formal training with certification in project /program management for professionals**
- **Setting up multi level learning programs for executives**
- **Skilling workers for construction industry**





## **8. Deepen stakeholder management for land acquisition and regulatory approvals**

Certain issues such as delays in land acquisition, obtaining regulatory approvals from various levels across multiple Government bodies, shifting of utilities and delays due to stoppage of works and local agitations impact the project budget, time and operational life of the asset. The following measures adopted both at strategic/policy and operation levels can address these issues-

- **Implement a stakeholder management plan**
- **Linking project sanctioning and award with regulatory processes**
- **Implement social cost benefit analysis**
- **Advance buy-in of competent authorities**
- **Digitization of land records and workflow for land acquisition and explore technology such as blockchain**
- **Market rate database for land**



## **9. Establish robust project governance structure**

With involvement of multiple stakeholders in large projects, both at state and central level, setting up of a national level multi-tiered governance framework for quick resolutions and decisions is essential to make the projects run smoothly on a day to day basis while also allowing boards to take the right decision at the right time. Following measures should be implemented for a sound governance structure-

- **National Level Project Evaluation and Control Cell**
- **Expanding the role of MoSPI in monitoring program implementation**
- **Collaboration between State and Central Government**
- **Leverage technology enablers**
- **Setting up project specific organizations**

## Extent of overruns that can be potentially addressed

The implementation of suggested recommendations can lead to debottlenecking of infrastructure projects by incrementally addressing the root causes of time and cost overruns. Exhibit (i) and (ii) depict this build up from each recommendation.

The percentages shown are indicative, which are derived from the root causes' quantified impacts. These percentages also suggest the relative importance of recommendations for implementation, though the effort level may vary across organizations.

**Exhibit (i)**

Category	Recommendations	Time overrun % to be potentially addressed
Process and Capabilities	Invest heavily in pre-planning and site investigation	4%
	Collaborative and agile planning	15%
	Reforming procurement and strengthening contract management	14%
	Lean construction implementation for productivity improvement	5%
Culture and Mindset	Embedding a culture of risk management	5%
	Strengthening people management processes	5%
	Augmenting organizational skillsets	4%
External Factors	Deepening stakeholder management for land acquisition and regulatory approvals	10%
Total Potential		62%

**Exhibit (ii)**

Category	Recommendations	Cost overrun % to be potentially addressed
Process and Capabilities	Invest heavily in pre-planning and site investigation	7%
	Collaborative and agile planning	12%
	Reforming procurement and strengthening contract management	16%
	Lean construction implementation for productivity improvement	6%
Culture and Mindset	Embedding a culture of risk management	12%
	Strengthening people management processes	11%
	Augmenting organizational skillsets	6%
External Factors	Deepening stakeholder management for land acquisition and regulatory approvals	6%
Total Potential		76%

# Section 1

# Overview of

# Indian

# Infrastructure



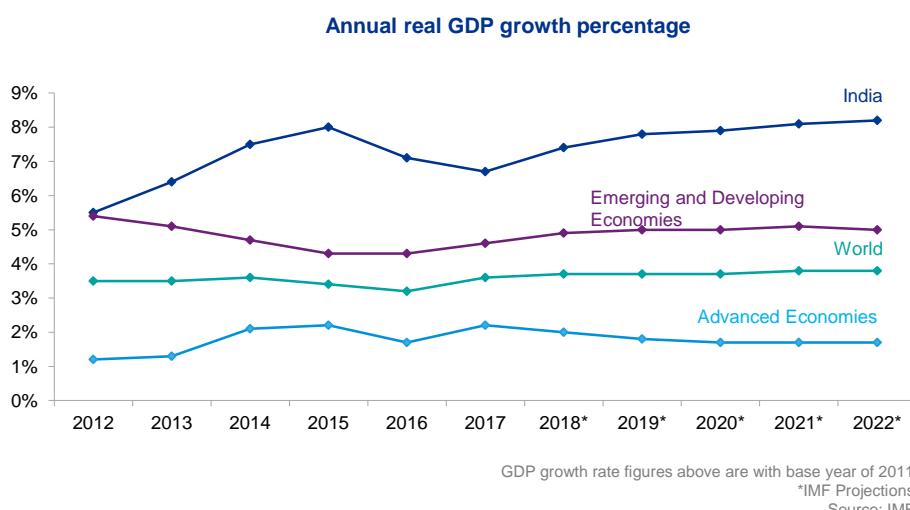
# Background of the Indian Economy

Indian economy is one of the fastest growing economies in the world today. Despite an uncertain global outlook where major economies have shown gradual progression, the Indian Economy has continued to grow upward of 7% level since 2014. Despite a slowdown in FY 2016-17, India's GDP has grown at 8.2% annually in Q1 of 2018-19 and as per IMF projections, it is expected to grow at around 8% in 2019-20 and 2020-21<sup>1</sup> making it the world's fastest growing economy.

India's resilient economic fundamentals and the ongoing reforms agenda make it attractive for foreign investors. It is also owing to the country's policy actions, sustained focus on innovation, continued fiscal consolidation and an anti-inflationary monetary policy that it continues to move towards macroeconomic stability. While this is an exciting time for the country, it also presents a different set of challenge for the nation's infrastructure, which is to grow at an extraordinary pace and support the economic activities as a growth catalyst.

In the early 1990s, India embraced liberalization, globalization and privatization, and opened the economy to market forces and extensive competition. This needed extensive change in taxation, reduction in government's control, removal of barriers, allowing large scale privatization and welcoming foreign investors. The impact was quite visible for the country as the growth rate increased from 1.25% in the 80s to 7% by 2006. In this period, the portion of population living under the poverty line declined, large improvements were seen in service sectors such as IT, communication, insurance and banking along with increase in FDIs and FIIs.

The growth weakened slightly after the Global Economic Recession as it reached 5% after having achieved rates of 8% for 3 years preceding 2008<sup>2</sup>. However, the Indian economy stood tall against hostile global economic conditions and has emerged stronger in the last few years to become one of the frontrunners. The current regime has also witnessed implementation of GST and other reforms, which are expected to further boost the growth.



1. IMF Projections, <https://www.imf.org/>

2. "Impact of 2008 Global financial Crisis", [www.springer.com](http://www.springer.com)

# Infrastructure and Economy

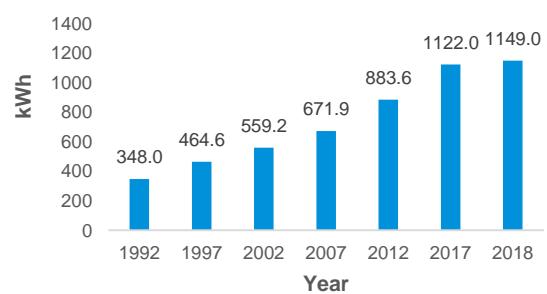
A country's economic development is reflected and frequently assessed by its state of infrastructure. Alternatively, a developed state of infrastructure facilitates economic growth by attracting investments. High transaction costs arising from inadequate and inefficient infrastructure can prevent the economy from realizing its growth potential regardless of progress on other fronts. Physical infrastructure covering transportation, power and communication through its backward and forward linkages facilitates growth of social infrastructure including water supply, sanitation, sewage disposal, education and health and have a direct impact on the quality of life.

Hence, the pace of infrastructure development and quality of infrastructure services are critical for ensuring that the country can sustain its economic growth at a healthy rate. Analyzing the growth path of the country over the last two decades, few key parameters of infrastructure growth and associated changes have been highlighted below.

## Power

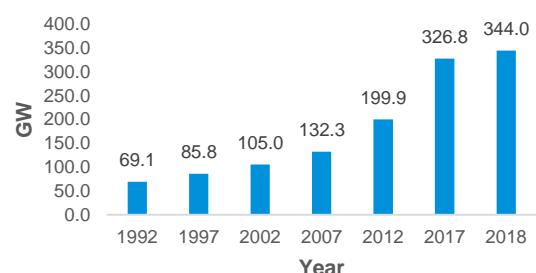
Electricity consumption is a key indicator of economic growth. India's per capita power consumption has increased from 348 kWh in 1992 to 1149 kWh in 2018, with a CAGR of 4.79%. To keep up with this pace, the power generation capacity has increased at a CAGR of 6.42% from 69.1 GW in 1992 to 344 GW in 2018.<sup>3</sup> However, the sector now faces challenges due to the financially stressed assets, constraints in supply of fuels, financial health of distribution companies and vast number of under-utilized assets.

**Electricity consumption in India (kWh)**



Source: CEA report 2018

**Growth of installed generation capacity in India**

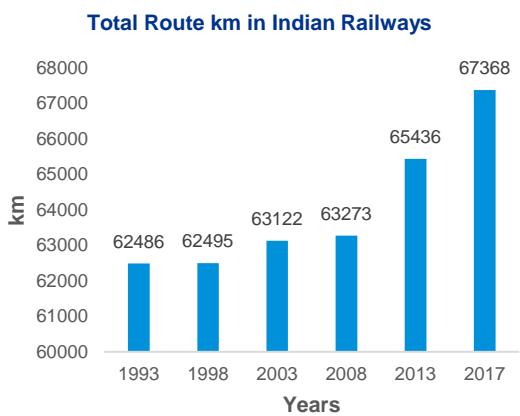
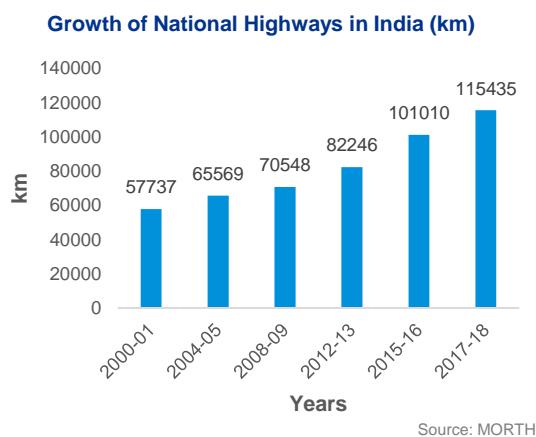


Source: CEA report 2018

3. CEA report, 2018

## Inland Transport

Road and rail infrastructure form the core of inland transport and their development is a key for physical connectivity across the country. Smooth and efficient inland transport of freight and passenger is critical for businesses to thrive and economies to grow. The network of roads in India has been on an upward trend, with an increase in the route length of national highways from less than 60,000 route km in 2001 to more than 1,00,000 route km in 2016 at a CAGR of 3.7%. The growth of railway route expansion has been at the rate of 0.25% per annum.<sup>4</sup>



## Aviation

Indian aviation sector has come a long way since liberalization. India is set to become the 3<sup>rd</sup> largest aviation market in the world by 2026. With government initiatives such as allowing FDI up to 49% under automatic route in air transport systems, investment plans of close to \$15.56 billion in the next 5 years, increased private participation through PPP and plans to increase number of airports to 250 by 2030, the sector is poised to become one of the largest infrastructure sectors in the country.<sup>5</sup>



\***Registered carrier departures** are domestic takeoffs and takeoffs abroad of air carriers registered in the country.



4. MoRTH, KPMG analysis  
5. IBEF, May 2018

These indicators suggest that India has witnessed an overall positive growth in the infrastructure capacity addition over the last two decades, though some sectors have not seen much growth. There are a few other sectors where the growth has spurred in the last four to five years such as renewables and power transmission.

**The current outlook for next five years in certain sectors such as transmission, roads, and railways warrants that the capacity addition has to outpace the work done in all previous years and/or rejig the project delivery methods for sustaining the growth.**

### Cement

Another indicator of infrastructure growth is cement, being the primary raw material for construction. The Indian cement industry is the second largest producer of cement in the world, just behind China but ahead of USA and Japan. It is considered to be a core sector employing over 0.14 million people.<sup>6</sup>



# Mega Trends Driving the Infrastructure Sector

Impetus to industrial activity in the economy with significant investment announcements and inflows on the back of a **liberalized FDI** regime, “**Make in India**” initiative and an improved business environment.



Thrust on urban infrastructure development with Indian urban population growing rapidly and projected to reach **583 million** by 2030.<sup>7</sup>

**India's emerging middle class and increase in median income**  
- By 2030; the country's median income per household is expected to reach **INR 0.68 million** which would lead to more spending capacity.<sup>8</sup>



**Disruptive changes** in Indian construction industry with new materials, innovative building technologies, digitization, automation and artificial intelligence are evolving the way to conceptualize, build and operate infrastructure assets.



**Funding in logistics startups** in India increased by **205%** in 2017,<sup>9</sup> signifying the strong boost to the transport and logistics sector.



Massive shift towards sustainable development with aims to achieve **175 GW** of renewable energy by 2022<sup>10</sup> and shift to only electric vehicles by 2030.<sup>11</sup> The adoption of such green mobility solutions would imply transformational changes in the power and automobile sector, with respect to job creation, technological advancements, and manufacturing capabilities.

India jumps up 23 positions, moving from 100<sup>th</sup> position in 2017 to **77<sup>th</sup> spot** in 2018 in the world ranking for **ease of doing business**.<sup>12</sup> This improvement represents the reforms undertaken and puts focus on continual infrastructure growth.



7. "India Soars Higher", KPMG in India, 2018

8. "India Soars Higher", KPMG in India, 2018, Conversion rate - 1 USD = INR 67.675

9. "2017 In Review: The 8 Hottest Sectors In The Indian Startup Ecosystem", Dailyhunt, December 2017

10. Press Release, Ministry of New and Renewable Energy Year End Review, December 2017

11. "India to sell only electric vehicles by 2030: Piyush Goyal", The Hindu, 18 August 2017

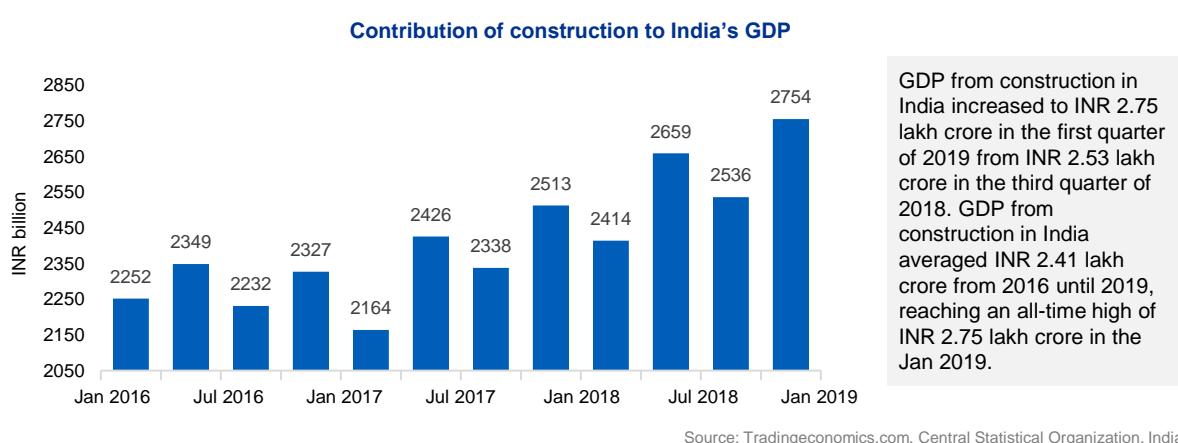
12. Press Information Bureau, Government of India, Ministry of Commerce and Industry, 31 October 2018

# Current Infrastructure Outlook

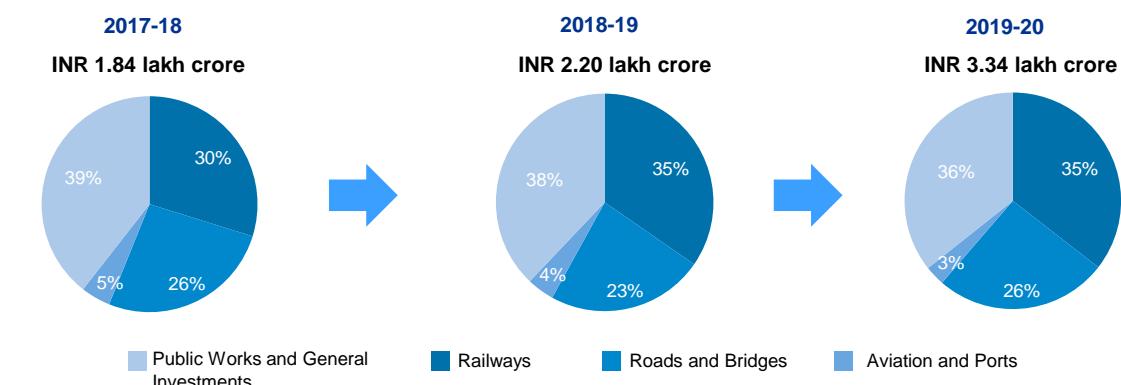
The budgetary allocation for infrastructure for the FY2018-19 is set at INR 5.97 lakh crore.<sup>13</sup> Some of the key announcements for infrastructure sector in the Union Budget 2018-19 are:

- Railways received the highest ever budgetary allocation of INR 1.48 lakh crore.<sup>13</sup>
- Around 35,000 km of road construction approved under Phase-1 of the Bharatmala Pariyojana at an estimated cost of INR 5.35 lakh crore.<sup>14</sup>
- INR 4,200 crore allocated to increase the capacity of Green Energy Corridor Project along with other wind and solar power projects.<sup>15</sup>
- INR 4,500 crore allocated towards revival of 50 airports.<sup>16</sup>

The Government's recognition of the need to invest in infrastructure is in line with the fact that an infrastructure gap may inhibit India's planned growth.



**NITI Aayog's Three Year Perspective for capital expenditure development (2017-18 to 2019-20)**



Three year capital expenditure perspective in lakh crore	2017-18	2018-19	2019-20
<b>Railways</b>	0.55	0.77	1.17
<b>Roads and Bridges</b>	0.48	0.51	0.87
<b>Aviation and Ports</b>	0.09	0.08	0.10
<b>Public works and general investments</b>	0.72	0.84	1.20

Source: NITI Aayog Three Year action agenda, 2017-18 to 2019-20, KPMG analysis

13. Union Budget of India (2018-19), IBEF, [www.ibef.org](http://www.ibef.org), February 2018

14. Union Budget of India (2018-19), IBEF, [www.ibef.org](http://www.ibef.org), February 2018

15. Infrastructure sector in India, IBEF, [www.ibef.org](http://www.ibef.org), April 2018

16. Government okays Rs 4,500 crore project to revive 50 airports, airstrips, The Economic Times, March 2017

# Required Progress Rate of Infrastructure Development

The nation in recent times has witnessed short term economic disruption. However, considerable measures adopted in the last few years have significantly bolstered India's medium term outlook. With investment planned for large capital projects in different sectors, it is essential to establish the aggressive, yet warranted pace of work in order to achieve the planned targets. Investments across few key sectors are listed below with their indicative required rate of progress.

Renewable Energy	Urban Development	Power Transmission
<b>Target:</b> <b>175GW<sup>17</sup></b> by 2022. <b>Progress Rate:</b> <b>~3 GW/month</b>	<b>Target:</b> <b>2 crore<sup>18</sup></b> Houses by 2022 under Housing for All <b>Progress Rate:</b> <b>~7.64 Lakh houses/month</b>	<b>Target:</b> <b>100,000 ckm<sup>19</sup></b> of transmission lines until 2022. <b>Progress Rate:</b> <b>~1,666 ckm/month</b>
Roads and Highways		Railways
<b>Target:</b> <b>61,000 km<sup>23</sup></b> by 2019 under PMGSY. <b>Progress Rate:</b> <b>167 km/day</b>  <b>Target:</b> <b>16,420 km<sup>24</sup></b> highway length in 2018-19 under Bharatmala Pariyojana <b>Progress Rate:</b> <b>46 km/day</b>		<b>Target:</b> <b>14,000 km<sup>21</sup></b> until 2032 <b>Progress Rate:</b> <b>~77 km/month</b>  <b>Target:</b> Electrification of <b>4,000 km<sup>22</sup></b> between 2017-2020 <b>Progress Rate:</b> <b>~111 km/month</b>
Oil and Gas	Ports	Civil Aviation
<b>Target:</b> <b>13,760 km<sup>25</sup></b> of gas pipeline until 2019 <b>Progress Rate:</b> <b>~13 km/day</b>	<b>Target:</b> <b>3,130 MMT<sup>20</sup></b> of port capacity until 2020. Cargo capacity at major and non major ports as on FY17 is ~2,493 MMT.  <b>Progress Rate:</b> <b>~18 MMT/month</b>	<b>Target:</b> <b>INR 4.5 Lakh crore<sup>26</sup></b> is required to build <b>55</b> new airports by 2030.  <b>Investment spend rate:</b> <b>~INR 375 crore each year</b>

17. Press Release, Ministry of New and Renewable Energy Year End Review December 2017

18. "Indian Real Estate", KPMG, August 2017

19. Central Electricity Authority, January 2017

20. IBEF report on port sector, April 2018

21. Niti Aayog

22. Indian railways vision and plans, 2017-2019

23. Times of India article, 26 April 2018

24. Road Transport and Highway Minister, Mr. Nitin Gadkari's address to reporters, 17 April 2018

25. Energy World article, 08 February 2018

26. Time of India article, 26 April 2018

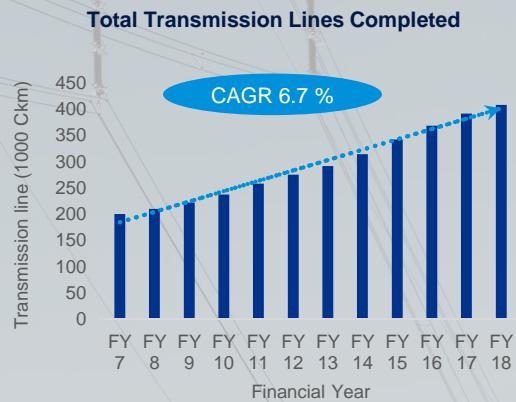
# Our Point of View

## Power Transmission sector

Over past two decades in India, the total power transmission capacity has witnessed exceptional growth, with more than 4 lakh circuit km transmission line<sup>27</sup> and 7.9 lakh MVA transformation capacity<sup>28</sup> currently installed. It is estimated that around **1 lakh circuit km transmission line and 2 lakh MVA transformation capacity** is required for the planned installed generation capacity of 388 GW by 2022.<sup>29</sup>

According to the Central Electricity Authority (CEA) report, transmission projects of 220 kV and above in India typically take around five to six years<sup>30</sup> from concept to commissioning stage, which is below the global benchmarks.

Based on our experience, select measures can substantially truncate the project delivery time. To name a few; technology intervention such as real time monitoring, satellite imaging, land records digitization, lean construction methods such as pre-assembly strategy, policy/regulatory reforms such as single window clearance, active stakeholder management for RoW management, organizational changes such as a dedicated authority for resolving RoW and other clearances such as PTCC, forest clearance etc., and provision of land for substation construction during town planning of new sub urban and industrial areas. Additionally, GIS substations (occupies 30% less land) and Monopole structures for towers should be promoted, as they would reduce the RoW issues. GIS analytics should be utilized for understanding changing patterns in population and demand assessment.



Source: CEA Annual reports and KPMG analysis

27. CEA Report on Completion of Transmission Lines (220kV & above) as on 31 January 2019, <http://www.cea.nic.in/monthlytrans.html>

28. <http://nppi.in/download/NEP%20Transmission.pdf>

29. Draft National Electricity Plan, Volume II, Government of India, Ministry of Power, CEA - December 2016

30. [http://cea.nic.in/reports/others/pspa2/tr\\_pig\\_criteria\\_manual\\_jan13.pdf](http://cea.nic.in/reports/others/pspa2/tr_pig_criteria_manual_jan13.pdf), [http://iecclinspdocument/20311/power-transmission-report\\_270913.pdf](http://iecclinspdocument/20311/power-transmission-report_270913.pdf)

# Our Point of View

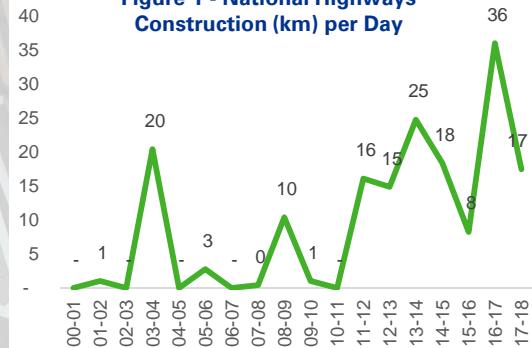
## Road sector

In the past five years, the road sector in India has seen multiple progressive and timely interventions by the Union Government. Budgetary outlay for the sector has increased and the rate of road project award by the Ministry of Road Transport and Highways (MoRTH) has gained momentum in the last decade.

However, going by the projections of Central Government's large road building programs announced in October 2017<sup>31</sup>, 83,677 km is targeted for completion by 2022 with an asking rate of 46 km/day (assuming calendar year 2022) – an increase of over 2.7 times over the last year's rate.

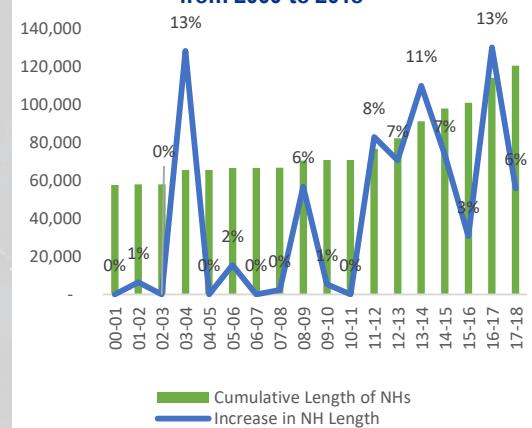
Improved fiscal situation of the Central Government since early 2014, when the price of crude oil dropped to USD 26 per barrel from USD 110 per barrel a year earlier<sup>32</sup>, allowed a deflation in prices of motor fuels and bitumen, which enabled more Government financed projects to be bid out to push the road building drive in times of muted Public Private Partnerships or Toll or Annuity based bid participation.

**Figure 1 - National Highways Construction (km) per Day**



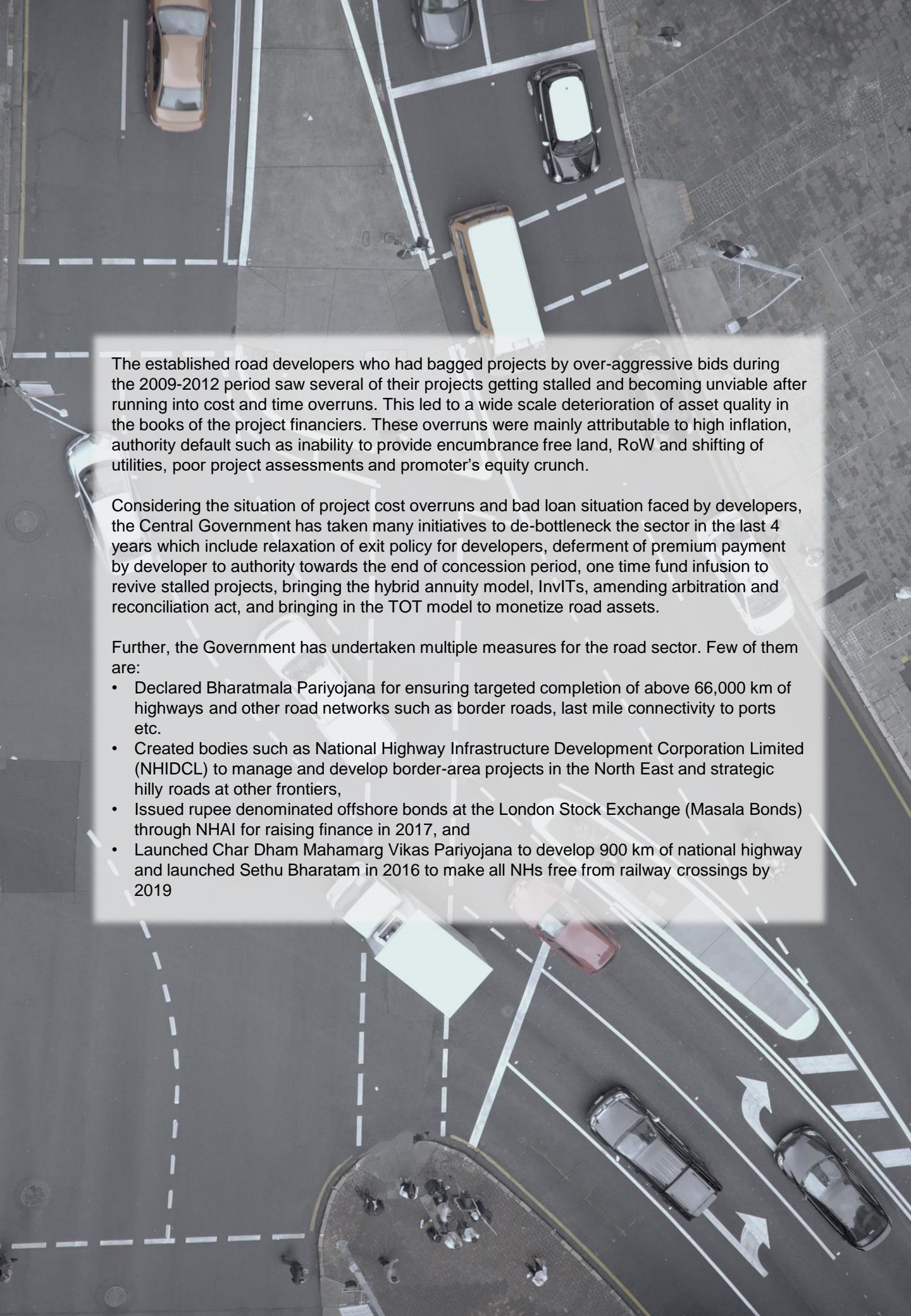
Source: Ministry of Road Transport and Highways (MoRTH) reports

**Figure 2 – National Highways Lengths (km) from 2000 to 2018**



Source: Ministry of Road Transport and Highways (MoRTH) Annual Report, December 2017

31. Press Information Bureau (PIB) notice on Bharatmala Priyogana, October 2017  
32. <http://www.macrotrends.net/1369/crude-oil-price-history-chart>



The established road developers who had bagged projects by over-aggressive bids during the 2009-2012 period saw several of their projects getting stalled and becoming unviable after running into cost and time overruns. This led to a wide scale deterioration of asset quality in the books of the project financiers. These overruns were mainly attributable to high inflation, authority default such as inability to provide encumbrance free land, RoW and shifting of utilities, poor project assessments and promoter's equity crunch.

Considering the situation of project cost overruns and bad loan situation faced by developers, the Central Government has taken many initiatives to de-bottleneck the sector in the last 4 years which include relaxation of exit policy for developers, deferment of premium payment by developer to authority towards the end of concession period, one time fund infusion to revive stalled projects, bringing the hybrid annuity model, InvITs, amending arbitration and reconciliation act, and bringing in the TOT model to monetize road assets.

Further, the Government has undertaken multiple measures for the road sector. Few of them are:

- Declared Bharatmala Pariyojana for ensuring targeted completion of above 66,000 km of highways and other road networks such as border roads, last mile connectivity to ports etc.
- Created bodies such as National Highway Infrastructure Development Corporation Limited (NHIDCL) to manage and develop border-area projects in the North East and strategic hilly roads at other frontiers,
- Issued rupee denominated offshore bonds at the London Stock Exchange (Masala Bonds) through NHAI for raising finance in 2017, and
- Launched Char Dham Mahamarg Vikas Pariyojana to develop 900 km of national highway and launched Sethu Bharatam in 2016 to make all NHs free from railway crossings by 2019

# Sectorial Outlook

## Urban Development

**Development of metro rail:** 18 major cities envisage investment of **INR 1.91 lakh crore** towards metro rail development.

**Development of SEZs and Industrial parks:** The demand for commercial real estate has been growing at a **CAGR of 5.25%** leading to an increased requirement for operationalization of the **202 approved SEZs**.

## Power

### Non-renewable

**Increasing investment:** Approval of 100% FDI in the sector and GoI's planned investment of **INR 3 lakh crore** in power transmission and distribution will boost the sector growth.

**Increased industrial activity:** Power consumption is estimated to increase by over 63% between 2016 and 2022 mainly driven by increased industrial activity, which is led by various initiatives by Government of India including Make in India, Smart Cities, GST etc.

### Renewable

**Ultra mega solar power projects and solar parks:** **40GW** of solar parks are to be developed by 2022, for which GoI has provided a financial assistance of **INR 8,100 crore** backed by a mandatory offtake of minimum 20% by host states of these solar parks.

**Government assistance:** Includes VGF mechanism, Payment Security Fund to protect solar power producers from payment delays, bidding mechanism for wind energy sector and land availability for solar parks approved SEZs.

## Civil Aviation

**Focus on infrastructure development:** The GoI has approved construction of **18 Greenfield airports** in the country at an estimated investment of **INR 30,000 crore**. Further, GoI has approved the proposal to revive **50 un-served and under-served airstrips** in three financial years starting from 2017-18 at an estimated cost of **INR 4,500 crore**.

## Major programmes in each sector

### Housing for All (HFA)

HFA proposes for construction of 2 crore affordable houses for LIG and EWS by 2022 through a financial assistance of INR 2 lakh crore by central government.

### Smart Cities Mission

The mission plans for sustainable development and urbanization of 100 select cities.

### Deen Dayal Upadhyaya Gram Jyoti Yojana (DDGJY)

DDGJY aims to provide continuous power supply to rural India. The scheme has electrified 83.4% of the identified 18,452 villages countrywide since April, 2015. The scheme has an outlay of INR 76,000 crore.

### Green energy corridor

The corridor aims to develop intra-state and inter-state transmission networks for renewable energy projects. With an investment of about INR 2.8 lakh crore, it will provide impetus to renewable energy integration in the overall power generation mix.

### UDAN-Regional Connectivity Scheme (RCS)

The scheme aims to develop new and enhance the existing under-served or unserved regional airports to increase the number of operational airports to 150.

# Sectorial Outlook

## Roads

**Increased investments:** Budgetary allocation to the road sector has grown from INR 30,798 crore in FY13 to about **INR 64,900 crore in FY18**. The Government of India has succeeded in providing road connectivity to **85%** of the **178,184** eligible rural habitations in the country under its Pradhan Mantri Gram Sadak Yojana (PMGSY) since its launch in 2014.

## Railways

**Rising demand for urban mass transportation:** India's urban population over the last 20 years has increased to 377 million and is expected to reach 600 million by 2031.

**Growth of freight traffic:** Growth in industrialization and increased investments in freight terminals by Indian Railways is expected to increase the freight traffic at a CAGR of 5.4% till 2022.

## Oil and Gas

**Increase in domestic demand:** Oil demand in India is expected to grow at a CAGR of 3.6% to 335 million tonnes by 2030. Gas consumption is projected to reach 216 Billion Cubic Metres (BCM) by 2021-22.

In **FY17**, India had **234.5 MMTPA** of refining capacity, making it the **second largest refiner in Asia**. In March 2018 the oil refining capacity of India reached **247.6 million tonnes**.

## Ports

**Strong trade growth:** Growth in trade through ports would be led by petroleum refineries, textiles and garments, consumer electronics, iron-ore and automobiles in the coming years.

**Untapped inland waterways:** The cost of transporting goods using roads accounting for ~55% of the total logistics in India is INR 2-3/ton, compared to INR 0.2-0.3 using waterways. This differential cost is expected to boost development of inland waterways and ports in the country

## Major programmes in each sector

### Bharatmala

Bharatmala is an umbrella programme for the highways sector that focuses on optimizing efficiency of road traffic movement across the country by bridging critical infrastructure gaps. The programme will provide 50 national corridors, 44 economic corridors and connect 550 districts.

### Railway station redevelopment plan

Under the INR 1.07 lakh crore redevelopment plan, Indian Railways plans to revamp 400 railway stations by monetizing 2,700 acres of spare railway land.

### Barmer refinery

The project is set to be the first of its kind in Rajasthan and is being developed by a Joint Venture between HPCL and the Government of Rajasthan. The new refinery and petrochemical complex worth over INR 43,000 crore, will have a total processing capacity of 9 MMTPA and is the first of its kind in the country, capable of producing BS VI products.

### Sagarmala

Includes a series of 400 projects to leverage the country's coastline and inland waterways to drive industrial development including; port modernization and new port development, connectivity enhancement, port-linked industrialization and coastal community development. The project has a total outlay of INR 8 lakh crore.

# Government Policies for Infrastructure Sector

The Government has outlined several initiatives and policies that have provided the needed push for a positive growth rate in the infrastructure sector. Mentioned below are some of the key policies implemented by the Government.

**1**

## Goods and Services Tax (GST)

The tax came into effect from July 2017 and replaced existing multiple cascading taxes with a unified tax, levied by the Centre and States.

- Act will regulate unorganized industries and render the economy more productive in the long run.
- It is expected to be transformational for the currently-fragmented logistics sector. It will incentivize providers to redesign supply chains and centralize hub operations to take advantage of scale economies.
- GST seems to be a mixed bag for the infrastructure sector — transparency and efficiency being the key advantages, while non-inclusion of some sub-sectors and higher tax rates may pose challenges.

**2**

## Public Procurement Order 2017

The Public Procurement (Preference to Make in India) Order 2017 defines purchase preference (linked with local content) in government procurements, wherein preference will be given to local suppliers, in line with the Make in India policy.

- The minimum local content is ordinarily set at 50% and the margin of purchase preference is set at 20%
- The policy favors domestic manufacturing, service provision and employment and is expected to stimulate flow of capital and technology through tie-ups between international and local firms

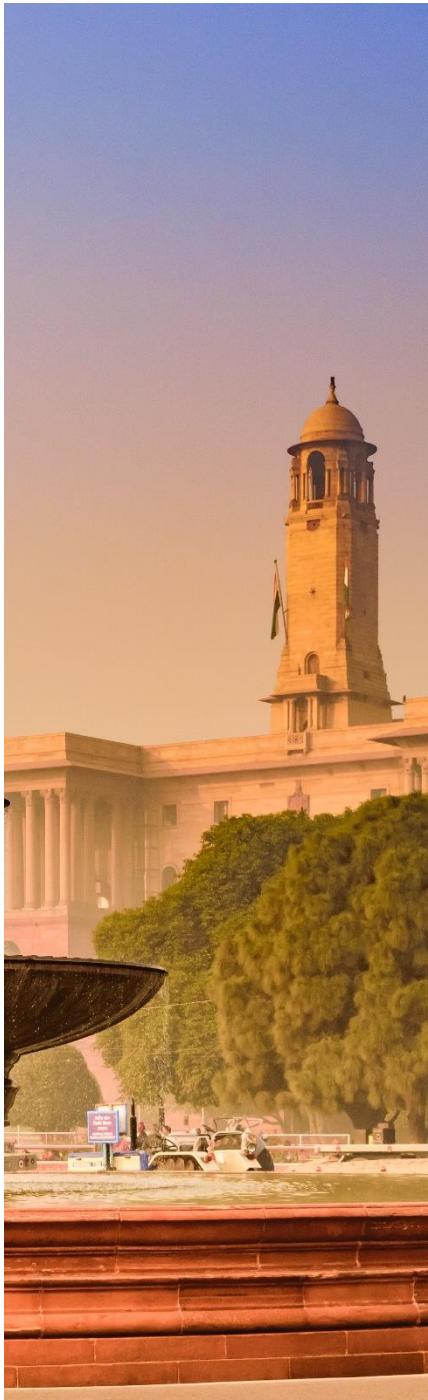
**3**

## New Metro Rail Policy

Approved in August 2017, the policy aims to address difficulties in funding metro projects. Specifically, it emphasizes greater private participation to alleviate heavy reliance on grants from the central government. Key highlights include:

- Participation of private investment across a range of metro operations is necessary to avail central government's financial support
- Replacing Financial Internal Rate of Return criteria with Economic Internal Rate of Return which considers all economic costs and benefits while evaluating projects
- It mandates setting up of Urban Metropolitan Transport Authority for cities to ensure complete multi-modal integration





## The Arbitration and Conciliation Act (Amendment) Bill, 2015

4

Approved in December 2015, the bill aims to make arbitration a preferred mode of settlement of commercial disputes and make India a hub of international commercial arbitration. Key highlights include:

- Arbitration Council of India: The report recommended the creation of an independent body to accredit arbitral institutions and arbitrators. The recommendation has been accepted and an independent body will be set up, namely, the Arbitration Council of India to enable formal evaluation and accreditation.
- Appointment of Arbitrators: As per the amendment, the Supreme/High Court may designate specific arbitral institutions that will make the relevant appointments. This obviates the need to file a formal application for appointment in court, thus speeding up the process by taking away some of the burden from the court.
- Length of Arbitral Proceedings: The amendment provides that an award should be made within 12 months from the Tribunal entering upon reference, extendable to a period of 18 months by party consent, failing which the mandate would terminate. Any extension over 18 months can only be obtained with the Court's permission.

## Insolvency and Bankruptcy Code

5

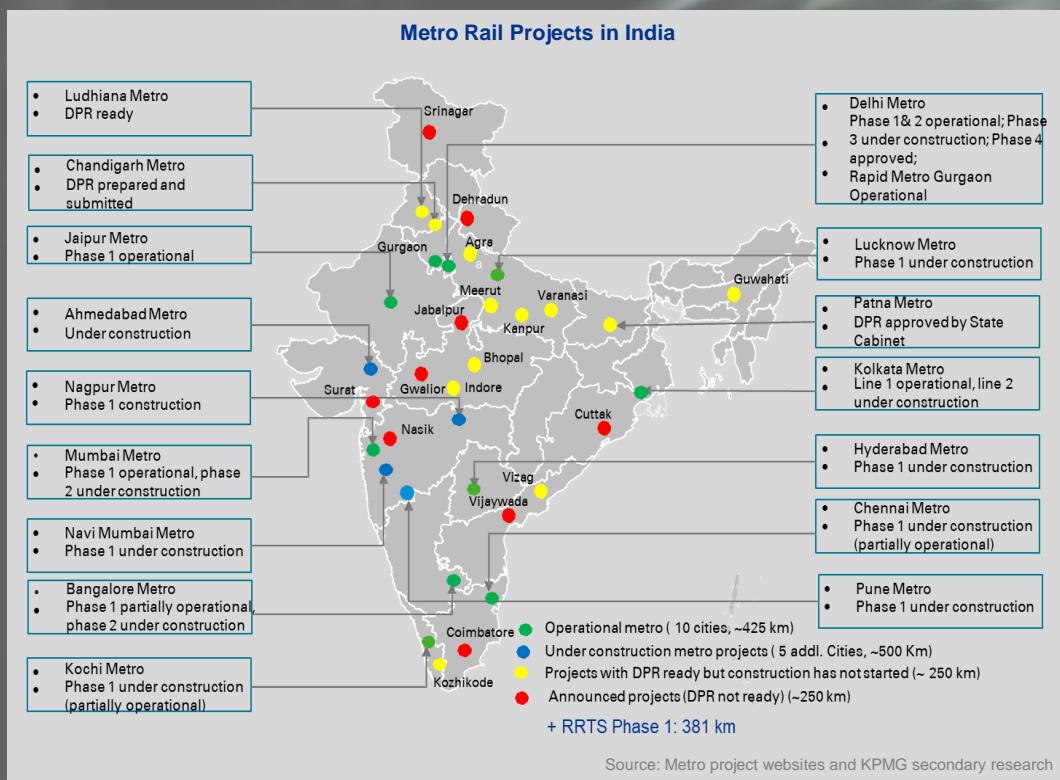
In 2016, GoI enacted the code to consolidate multiple insolvency-related regulations and to provide a time and cost-effective resolution mechanism to protect investors' interest. Key highlights include:

- It is expected to reduce non-performing assets in the banking system and aid development of a robust corporate debt market
- Coupled with the recapitalization of Public Sector Banks (PSBs), the policy is expected to push up credit growth
- It will also encourage bidders to carry out their own assessments of liquidation value while submitting a resolution plan, hence aiding better recovery rates

# Our Point of View

## Metro Rail Policy 2017

The last two decades in India witnessed about 400 km of metro network development. In contrast, China builds about the same scale of metro network every year. This disparity underscores the need for accelerating the pace of implementation of metro rail projects in the country.



The Metro Rail Policy 2017 released in August-2017 by the Government of India is a directional document for the development of metro rail sector and meets the following key objectives:

- Accelerate the implementation of metro rail projects in the country,
- Ensure that the apt urban transport system is selected for implementation based on the need of a city, and
- Reduce the burden of budgetary support on the Central Government by encouraging innovative means of finance and private sector participation.

The policy also substantiates that mass transit projects lead to urban transformation. The policy envisages compact and dense urban development around the metro rail alignment to reduce travel distances and to ensure efficient land use in urban areas. The policy stresses on promotion of seamless and integrated transport with provisions for last mile connectivity; much like the successful integrated urban transport systems in Singapore and Hong Kong. To support the vision of seamless transport, the policy stipulates a mandatory requirement of formation and operation of Unified Metropolitan Transport Authority (UMTA) to be eligible for Central Government funding for Metro Projects.

While the policy provides much needed enhancement to the development of the sector and provides the guidelines for metro rail projects to proliferate across the major cities in a responsible manner, the state governments would need to work out the viability and sustainability of metro rail projects, as these projects are capital intensive.

The policy lays the onus on the state governments to identify and structure projects appropriately to make them economically viable and attractive enough for the private sector to participate. For raising funds and improving viability, the state governments can formulate rules and regulations including provision for land value capture mechanism, setting the tariffs and inclusion of Transit Oriented Development (TOD). The new funding regulation under the policy is expected to give a boost to the upcoming metro projects by attracting private funds to finance at least a part of the capital to be invested.

# Our Point of View

## Stressed Assets

### What is the NPA issue?

In spite of the positive outlook of the infrastructure industry, project financing has seen an accumulation of stressed assets in the last few years. This has put the infrastructure sector financing under tremendous stress. Non-performing assets (NPA) have crossed an overall amount of INR 8 lakh crore<sup>33</sup> and this is impacting the lending capability and operational performance of banks. The maximum percentage of the NPA are loans to industries, much of which might have been for capacity expansion or growth programs. These industries or companies are now in a difficult situation with their balance sheets completely leveraged as they have not been able to convert the projects to operational assets or have not been able to profitably run the assets.

### Who is affected?

Power and Metals sectors have been impacted the most, due to numerous challenges faced in the last five to seven years. Few of these challenges include; rising coal and other input prices, project time and cost overruns, overleveraged balance sheets, unpredictability in the revenue streams, and fluctuating commodity markets. Additionally, companies in various other sectors have been plagued by either bad market externalities or incoherent decision making. These NPAs have been building up over the last few years, which has eventually led the banks to declare more and more bad loans and provide for them as per the provisions of the law.

### What has been done so far?

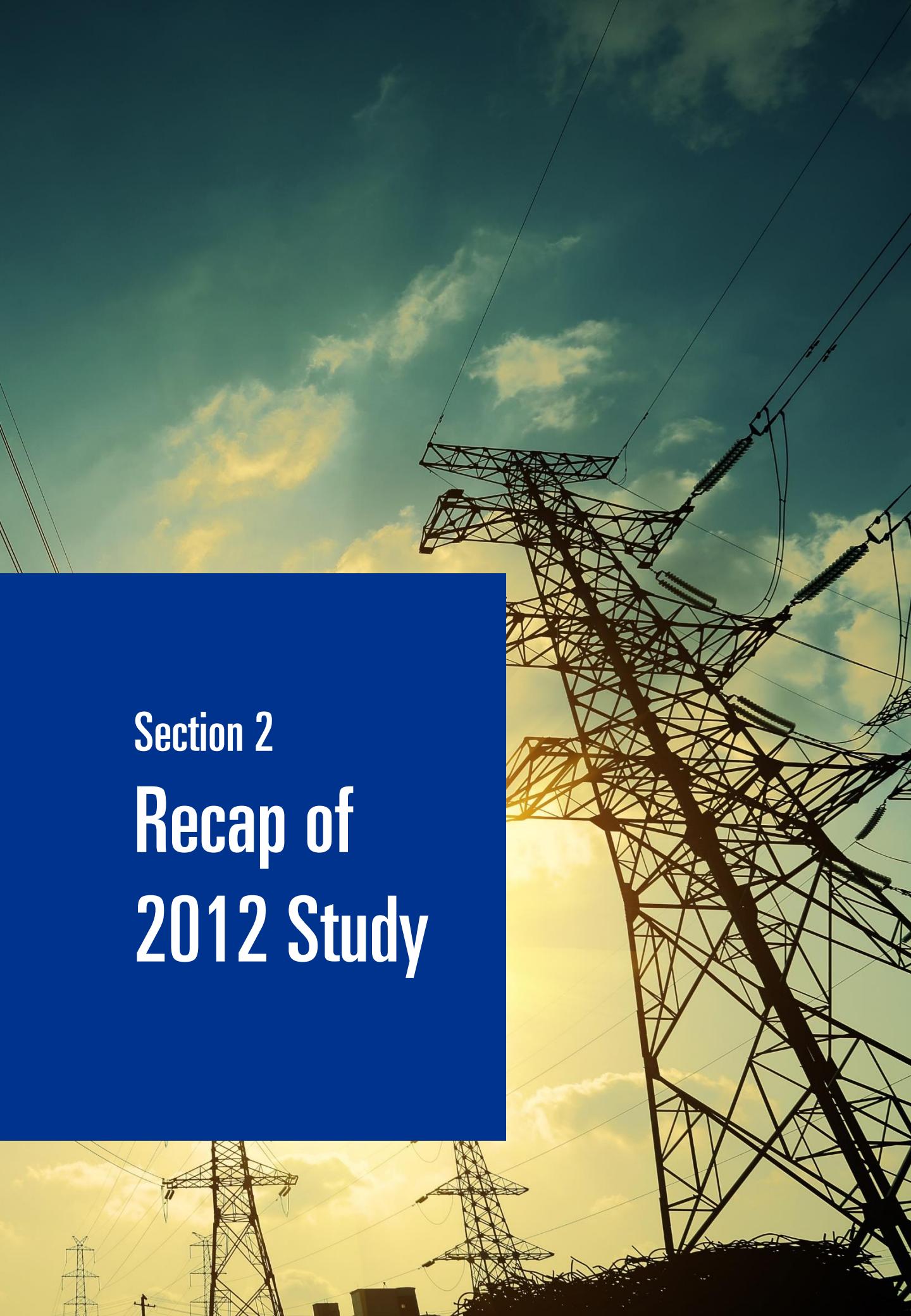
To resolve this crisis, the Government of India has taken a slew of steps over the last 2-3 years including the passing of Insolvency and Bankruptcy Code 2016, implementing the NCLT in June 2016 and forming the Insolvency and Bankruptcy Board of India in 2016. Time limits have been fixed for submission and approval of resolution plan, beyond which liquidation of assets will be taken up. Further, India's central bank has identified 12 key accounts, which had been admitted to NCLT for resolution planning. Similarly, many other financial and operational creditors have taken the NCLT route to initiate resolution planning. In addition, India's central bank has revamped rules and regulations for declaring a loan as a NPA to ensure that bad loans are discovered and declared as soon as possible and are put up for resolution appropriately.

### The road ahead...

The NCLT has been hearing the key cases which cover large portion of the NPAs at utmost priority. Some traction has been achieved lately, when two of the first 12 major cases reached the final stage, with the resolution plans and bids being accepted and implemented. However, the road to resolving this issue would be long and tedious. There are many issues which are cropping up such as conflict of interest, valuation by prospective bidders, structure of resolution plans, taking care of interests of varied group of stakeholders and appeals to judiciary during or after the hearing process.

However, there are continued and multi-pronged efforts initiated by the Government, central banks and various affected parties to resolve the issue and minimize the losses, while also ensuring that the assets, which have been funded by these loans become operational. The idea of a major Asset Reconstruction Company with specialized staff and focus on specific physical assets has also been proposed.

In a nutshell, resolution planning and implementation is a complex process and would require extensive stakeholder engagement, due health check of the assets/project, hawk-eye like oversight on project cost and time to complete and tie-ups across supply chains to ensure complete operational assets.



## Section 2

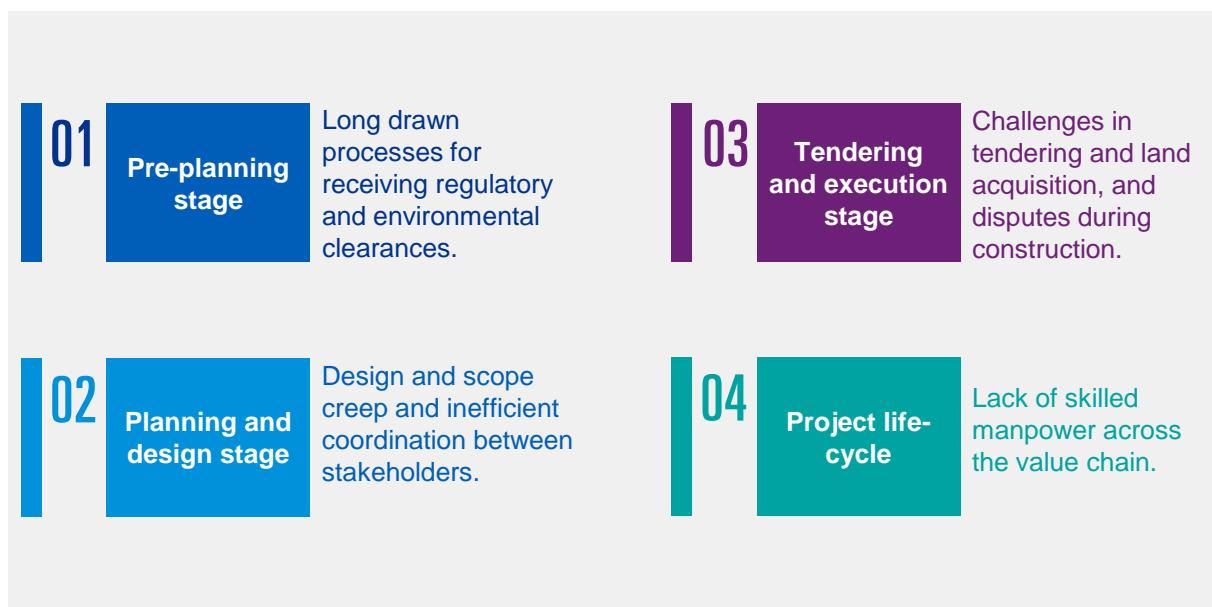
# Recap of 2012 Study

# About the 2012 Study

India's Twelfth Five Year Plan (2012-17) had clearly focused on infrastructure development. The plan envisaged an estimated investment of USD 1 trillion in the sector, up from USD 500 million under the Eleventh Five Year Plan.<sup>34</sup> Despite the huge investment, cost and schedule overrun issues had consistently plagued infrastructure delivery in the country. KPMG and Project Management Institute (PMI) conducted a study for the Ministry of Statistics and Programme Implementation (MOSPI) to outline challenges faced by project stakeholders and recommend steps to expedite infrastructure projects.

- The 2012 report on '**Study on project schedule and cost overruns**', incorporated observations from interactions with senior personnel from 25 public sector projects and leading companies in Power, Petroleum, Coal, Steel, Railways, Roads and Highways, Civil Aviation, Ports and Shipping, and Telecom sectors.
- The chosen projects were at different stages of implementation and experienced varying magnitude of schedule and cost overruns. KPMG also developed detailed case studies of five projects outlining the planned versus current project status, specific challenges being faced and measures that had been employed for expediting delivery.
- The experience from these projects was then benchmarked with global leading practices that emerged from KPMG's Global Construction Survey.

Reasons for cost and time overruns for infrastructure projects were categorized into external and internal factors. External factors are beyond the control of implementing agencies, but internal factors can be curtailed to an extent by the implementing agencies. Some of the key issues highlighted in the report are listed below-



34. Twelfth Five Year Plan, Eleventh Five Year Plan, Planning Commission, KPMG analysis

# Key Findings and Recommendations

Delays in land acquisition and site handover were the primary reasons for schedule overruns in pre-execution phase, followed by delays in regulatory approvals.

During execution and closing phase, projects were affected majorly on account of insufficient management of project design and inadequate availability of skilled resources. Other factors include non-availability of funds etc.

In the pre-execution phase, cost overruns were noted to be majorly on account of frequent changes in design and weak procurement planning.

In subsequent stages, absence of contract administration, escalation of material costs beyond projections, high transport costs and unavailability of sufficient skilled labour were major contributors.



Time overruns



Cost overruns

## Recommendations to improve infrastructure project delivery



Introduce a single window clearance mechanism to make the regulatory approval process more effective.



Develop a robust process for fast and efficient dispute settlement.



Institutionalize Project Management Training for professionals.



Reform India's vocational education and training program to create a large pool of employable workforce.



Optimize the procedures for transparent bidding criteria to ensure bids are not kept low by compromising on quality and reported timelines.



Develop efficient transport and logistics system in the country to enable faster project implementation.



Establish a three-tier project/program management office structure throughout the country to independently monitor infrastructure projects and ensure project management excellence.



Create an exhaustive list of empaneled vendors at central level for infrastructure projects. This will improve competition and vendor performance and also cut down on pre-execution time delays.



Promote public-private partnership in infrastructure sector and joint evaluation of project design between owners and contractors for value engineering.

# Impact Assessment of Key Recommendations

Based on the KPMG-PMI survey 2018 responses, case studies and multiple discussions conducted with various project stakeholders across sectors, the impact of key recommendations made in KPMG-PMI report 2012 have been assessed and elaborated below.

## Recommendation:

**Set up a single window clearance mechanism to simplify the regulatory approval process**



### Implementation status of recommendation

In an initiative by the Ministry of Environment and Forest (MoEF) to promote transparency and efficiency in the environment, forest and wildlife approval processes for infrastructure projects, the Ministry:



- ✓ Rolled out a single window system for submission and monitoring of application, at the central level in July 2014.
- ✓ Rolled out a single window system for submission and monitoring of application in State Environmental Impact Assessment Authority (SEIAA) at the state level in July 2015.
- ✓ Rolled out a single window system in the District Environment Impact Assessment Authority (DEIAA) at the district level on 18<sup>th</sup> June 2016.

In another initiative by the Ministry of Urban Development, the introduction of a single window clearance system in the revised unified building bye-laws for Delhi, 2016, was a positive step towards streamlining the process by including more accountability and reducing human interference.

In the above system, Government agencies were integrated including the Airports Authority of India, the Delhi Fire Services, the National Monuments Authority, the Delhi Metro, the Delhi Urban Arts Commission, the Delhi Jal Board, the power distribution companies, and Central ministries such as those of defence, forests and railways. The portals automated the tracking of proposals while facilitating online submission of a new proposal and editing/updating existing proposals.

A unified single window online system for all green clearances has enabled fast tracking the approval process and has improved transparency and accountability in the system. In addition, MoEF also launched the web portal for obtaining coastal regulation zone clearances by project proponents in March 2017.

As per KPMG-PMI study 2012,

**62%**

respondents felt that delay in regulatory approvals lead to project schedule overrun.



## Impact Assessment

During the interviews and discussions, held with industry stakeholders from various PSUs for the KPMG-PMI study 2017-18, a unanimous opinion on the need to have a robust system of single window clearance mechanism surfaced. The survey revealed that 37% respondents from various PSUs have benefitted from one or the other of Government's initiative of single window mechanism and few respondents also stated that the average turnaround time to attain approvals has reduced by approximately 26%.

Supporting these positive numbers and vouching for the benefits of single window clearance mechanism, the survey revealed that 52% of the respondents stated there is a strong need to implement this system across departments in order to reduce turnaround time in obtaining various statutory approvals and permits.

**“Our organization has been benefitted by the Government initiative of single window clearance for projects in Delhi/NCR where the approval time has been considerably reduced by almost 30%. ”**

**Chief General Manager of a Public Sector Undertaking**

**56%**

respondents stated they require single window mechanism for their projects.

**37%**

respondents stated they are benefitted from single window clearance mechanism.



On the contrary, 48% of the respondents stated that single window clearance is not required or may not be effective. While few respondents felt that the mechanism will not impact their project schedule as their project zero date is counted from the day all clearances and approvals are obtained, others said that since the approvals are required from several agencies at multiple levels of administration, consolidating all on a single platform would be a challenge. Further findings also indicate that although approvals from MoEF are consistent across infrastructure projects, there are certain sector-specific or project-specific approvals that require additional time.

The implementation of single window clearance has also helped promote ease of doing business in the country. With India's ranking improving and moving to the 100<sup>th</sup> spot on the World Bank's Ease of Doing Business global rankings and more investors turning to India as a favourable destination for exploring investment opportunities, this progress can be credited to the introduction of single window clearance mechanism in many Government departments.

To summarize the impact, it would be prudent to say that the system of single window clearance is yet to mature entirely and penetrate in all sectors. For example, port projects require certain approvals from competent authorities which can be integrated together and same is with the projects in coal sector. However, major benefit accrued by the rollout of single window mechanism has been enhanced responsiveness through workflow automation and availability of real time information.

## Recommendation:

### Develop robust process for fast and efficient dispute resolution



#### Implementation status of the recommendation

In a major step towards changing the dispute resolution mechanism in infrastructure projects in India, the Government amended the Arbitration and Conciliation Act, 1996 by introducing the Arbitration and Conciliation (Amendment) Ordinance in 2015. The Ordinance has brought in various amendments to expedite hearing as well as disposal of arbitration proceedings in a time bound manner, along with others. The amendments in the Act of 1996 will facilitate achieving the goal of improving institutional arbitration by establishing an independent body to lay down standards, make arbitration process more friendly, cost and time effective.

As per KPMG-PMI study 2012,

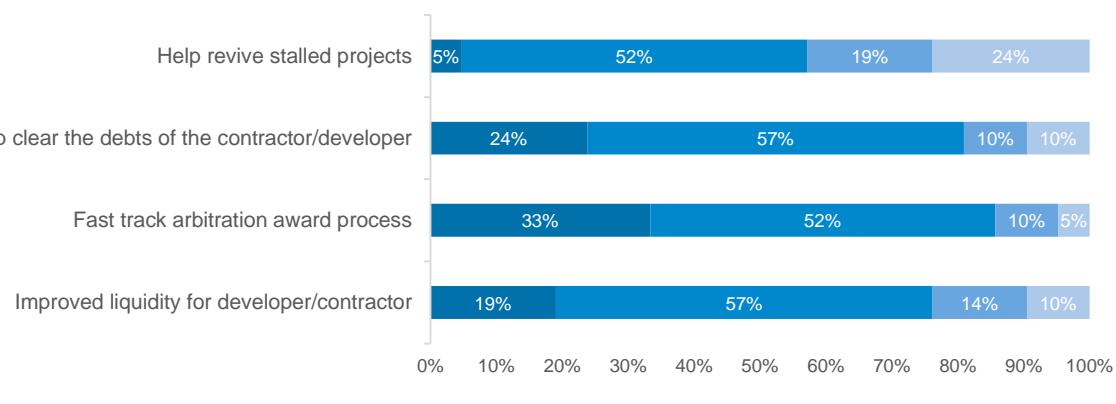
**58%**

respondents stated that the contractual disputes are one of the main reasons for projects schedule overruns.



#### Impact assessment

According to the KPMG-PMI survey 2018, respondents indicated a positive impact spurred by the implementation of the new guidelines in the Arbitration Act. PSUs unanimously agreed to the benefits of the amendment to contractors, where the government departments and PSUs have challenged arbitral awards rendered against them. In such cases, 75% of the amount of the award shall first be deposited by the government departments/PSUs into an escrow account against a margin-free bank guarantee from the contractor which has ensured improved liquidity and clearing of debts for the contractors. Another visible benefit that surfaced from the responses is reduction in the turnaround time for arbitration award as a major development in the dispute resolution landscape. The impact of the amendment has been mapped across four clear benefits identified through the KPMG-PMI survey 2018 responses and discussions in the graph below:

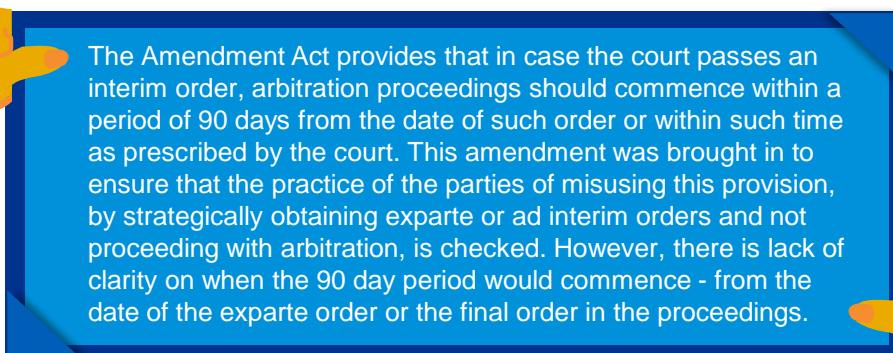


■ High ■ Medium ■ Low ■ Disagree

Source: KPMG-PMI survey 2018

Despite infrastructure industry applauding the new arbitration guidelines, a few respondents suggested the following improvements that can help make the system more efficient and robust:

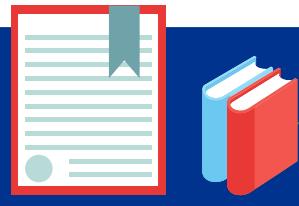
- Improve the independent monitoring mechanism
- Relax bank guarantee requirement
- Set-up provision to convert existing arbitration (under the old act) to the new act in order to ensure time bound rendering of award
- Accord special status to arbitration proceedings: Arbitration Act should specify that proceedings should be conducted in sittings of not less than 4 hours each during the week days, to ensure that the proceedings are accorded seriousness of participation and are not reduced to a secondary occupation by the arbitrators and lawyers involved in private practice before courts.
- Set-up provision for remittance of fees to arbitrators with the following criteria:
  - The fees on claim to be paid by the Claimant only and similarly fees on counter-claim to be paid by the counter-claimant only. This will ensure filing of realistic claims and discourage frivolous claims.
  - Half/one fourth of arbitrator's fees determined at the outset shall be payable only after the deliverance of award. This would help keep a check on arbitrators (in matters continuing under the old Act) who conclude the sittings, take the fees and keep the award reserved.
  - Specify strict action such as blacklisting of any arbitrator who reserves the award for prolonged duration after conclusion of final arguments.
  - Incorporate provision in Act for the recovery of fee paid to defaulting arbitrators with interest.
  - Fee of lawyers to be regulated to ensure that the objective of arbitration i.e. justice to the aggrieved party is not lost.
- Act to specify the age of retirement of arbitrators in line with of retirement age of judges in courts, considering that the retirement age of Supreme Court judges in India is 65 years i.e. an age where one is deemed to be mentally and physically fit to continue in a position which requires application of law.



The Amendment Act provides that in case the court passes an interim order, arbitration proceedings should commence within a period of 90 days from the date of such order or within such time as prescribed by the court. This amendment was brought in to ensure that the practice of the parties of misusing this provision, by strategically obtaining ex parte or ad interim orders and not proceeding with arbitration, is checked. However, there is lack of clarity on when the 90 day period would commence - from the date of the ex parte order or the final order in the proceedings.

## Recommendation:

### Institutionalize project management training for professionals



#### Implementation status of recommendation

According to the KPMG-PMI study 2012, the Indian infrastructure sector is likely to have a shortage of around three million project professionals by 2022 including project managers, civil engineers, planners, surveyors, safety professionals etc. Pre-empting this, many industry players have set up their own institutes for infrastructure and project management.

While there have been some institutes such as NICMAR, CEPT and the IITs, where construction and project management has been the focal point of curriculum, and these institutes set up by the industry giants are adding to the collective wisdom and knowledge by contributing to the training needs to young professionals in the infrastructure industry.

As per KPMG-PMI study 2012,

# 72%

respondents stated internal training programs such as developing in-house Project Academy/'Centre of Project Management Excellence' for training and certifying project managers as a pertinent step to enhance the quality of talent available in the near future.



However, the professionals from these institutes are typically engaged by private sector for their project delivery needs, but not many go into the public sector organization which run most of the infrastructure sector. Hence, a gap remains for availability of project management professionals in public sector organization.

A leading PSU in the oil and gas sector has recognized this as a strategic imperative and has set up centers of learning and research in its various work-centers, to implement this strategy. All learning and development activities are coordinated centrally by corporate HRD and the academy. With this set-up, this PSU provides world class learning opportunities to all levels of executives in different disciplines including project management training and leadership development programmes through a planned calendar of training programmes with pre-identified training partners.

With growing technological interventions in the infrastructure industry and project delivery, PSUs and government implementing agencies have realized the importance of desired proficiency in project management at the managerial levels. Government organizations have also pushed a requirement in their tenders for setting up project management units for various projects, where specialized project management certifications such as PMP, Prince, CPPP etc. form a mandatory requirement for professionals being provided by the bidding party.

## Impact assessment

Recognizing the benefits of imparting project management trainings to their employees, 77.4% respondents of the KPMG-PMI survey 2018 said that their organization has some project management training system in place for their employees. In addition, 68.42% respondents revealed that their organization is not facing shortage of project management delivery staff. This positive percentage is a reflection of the growing awareness and initiatives that organizations have taken towards meeting the training needs of their staff and meeting the project management skill gap in the industry to ensure excellence in capital projects delivery.

Respondents indicated that the companies are turning to a mix of on-the-job training and third-party certifications to ensure project management training to their employees. Several global players encourage their employees to opt for third-party certifications by reimbursing the cost of certification upon successful completion while in-house training modules provide organizations with the flexibility to modify content to suit their business/sector context. External certifications, on the other hand, provide a measure of standardization of competencies for industry professionals.

When asked to rate the effectiveness of some key strategies that are adopted or should be adopted to address skill set deficiency and inefficiency in imparting project management knowledge to employees, 84% respondents stated that developing structured training programs is the most effective strategy to build strong project management professionals. In addition, 71% respondents also said that organizations should focus on increasing investments towards human resource development as an effective strategy to improve organization performance.

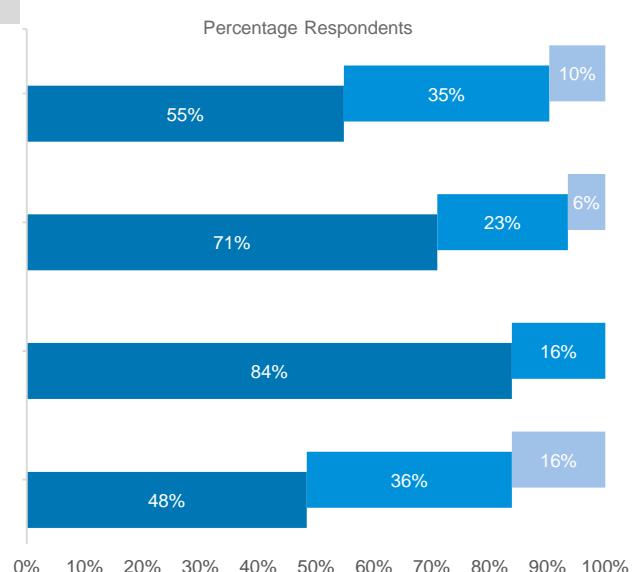


Increase cooperation with Educational Institutes to set up special academies, encourage internships and offer scholarships

Increase investment in human resource management with greater focus on training, flexibility in working hours, benchmarking, employee focused initiatives and increasing compensation

Develop structured training programs and succession plans to build strong professionals

Develop in house Project Academy/Centre of Project Management Excellence for training and certifying Project Managers and other key people involved in executing projects



# Recommendation:

## Reform India's vocational education and training program to create a large pool of employable workforce



### Implementation status of recommendation

The foundation work for catalyzing the skills landscape in India was laid in 2008 with the establishment of the National Skills Development Council (NSDC), a public private partnership company, with an aim to narrow the existing gap between demand and supply of skilled labour in focused sectors (such as construction, manufacturing, engineering, telecommunication, retail, security, and others) and streamline the identification and mapping of skill requirements, facilitate private participation through grants, gap funding, etc.

Realizing the need to address the skill gap, the current Government launched an ambitious National Skill Development Mission with NSDC as one of its executive arm to implement its objectives. The Mission has been developed to create convergence across sectors and States in terms of skill training activities. In addition, to meet the training needs in the construction industry, NITI Aayog jointly with the Indian construction industry has set up Construction Industry Development Council (CIDC) to take up activities for the development of the Indian construction industry. One of the main objectives of CIDC is to benefit the construction industry through conducting training at various levels and organizing workshops to develop a formidable workforce.

**40%**

of graduates of Vocational Education and Training (VET) system find employment.<sup>35</sup>

The Government had also launched a National Network of Building Centres with the Housing and Urban Development Corporation (HUDCO), for dissemination and adoption of cost-effective and energy efficient building technologies. The centres are involved in skill upgradation and training to the artisans (masons, carpenters, bar-benders, plumbers, electricians, etc.) on innovative and cost effective technology options.

Apart from the Government, industry players have also actively participated in taking initiatives to bridge the skilled manpower gap in the construction industry. For example, L&T has been imparting trainings and creating skilled labour through its Construction Skills Training Institutes (CSTIs) since 1995.<sup>36</sup> In another pioneering effort towards skilling workforce in the construction sector, Rustomjee and Prestige group partnered to commence operations of the Rustomjee Prestige Vocational Education and Training Centre in 2017 that provides training in mechanical and electrical trades, plumbing, water proofing, real estate sales, concrete technology, quality management system and project management among others.<sup>37</sup> CREDAI collaborated with the Centre to ensure that the industry standards and benchmarks are maintained. The institute also conducts short-term training programmes in collaboration with other construction industry organizations seeking skilling for their personnel.

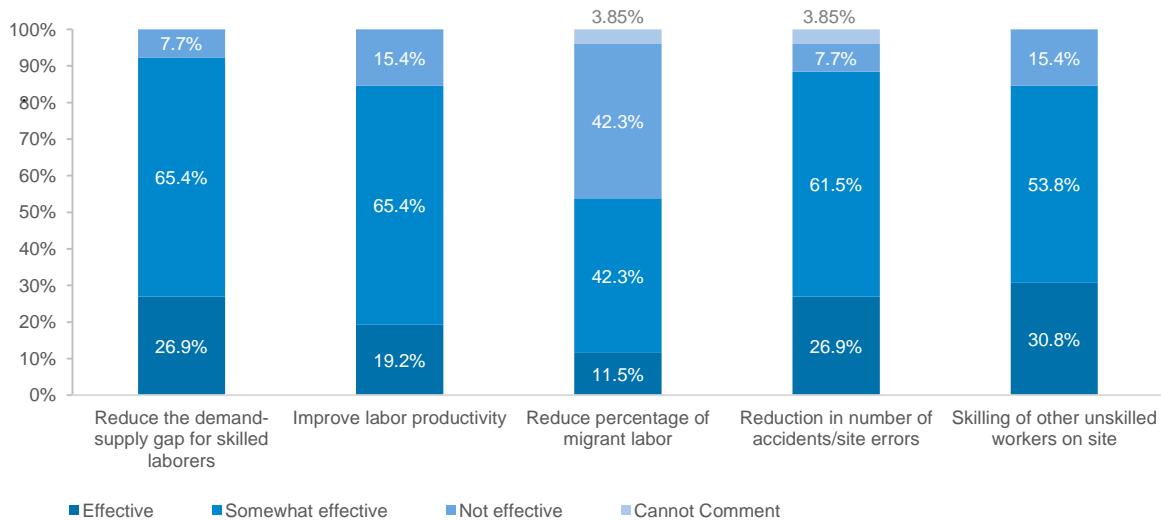
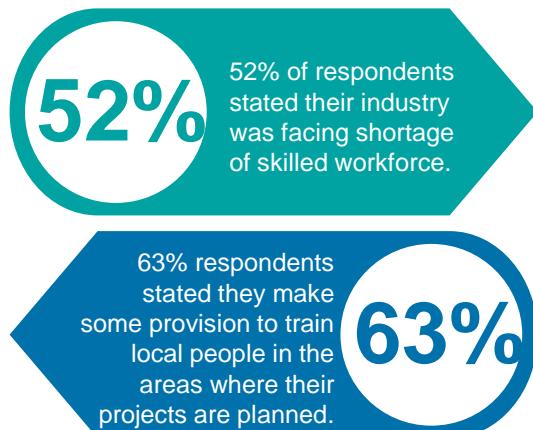
Vocational Education and Training (VET) system, that was to play a major role in transformation of vocational education landscape in India, is not responding to the needs of the labour market.

## Impact assessment

In a fast growing and evolving construction industry, the need for skilled labour is of paramount importance. Over the last decade, CIDC has made substantial achievements in the area of HRD, especially for construction workers, artisans and supervisory cadre personnel. The programme is now spread over 19 states and supported extensively by various state governments. The support from state governments has been extended in terms of provision of physical infrastructure, 29 ITIs, nomination of learners under various central and state schemes such as NREGS, Chattisgarh Raj Mistry Yojana, vocational training for candidates belonging to SC/ST categories and training of jail inmates.<sup>38</sup> However, the programme outreach requires efforts for attracting youth and ensuring placements.

According to the KPMG-PMI survey 2018, 52% respondents stated that their projects are facing shortage of skilled workforce. This percentage is a clear indication of the potential for improvement in skill landscape for the construction industry, though majority of respondents mentioned that the Skill India Mission has been effective to some extent in addressing few core issues.

65.4% of the respondents in the survey stated that the Skill India Mission has managed to give a head start to addressing the demand-supply gap for skilled labors in the industry and improve labour productivity. In addition, organizations are also promoting skilling activities at a micro level, with encouraging contractors to undertake training for locals at project sites, or including training initiatives as part of their CSR activities.



Source: KPMG-PMI survey 2018

38. Skill Development of Construction Workers, S. C. Pattanaik, Dr. Fikit Institute of Structural Protection and Rehabilitation, Mumbai

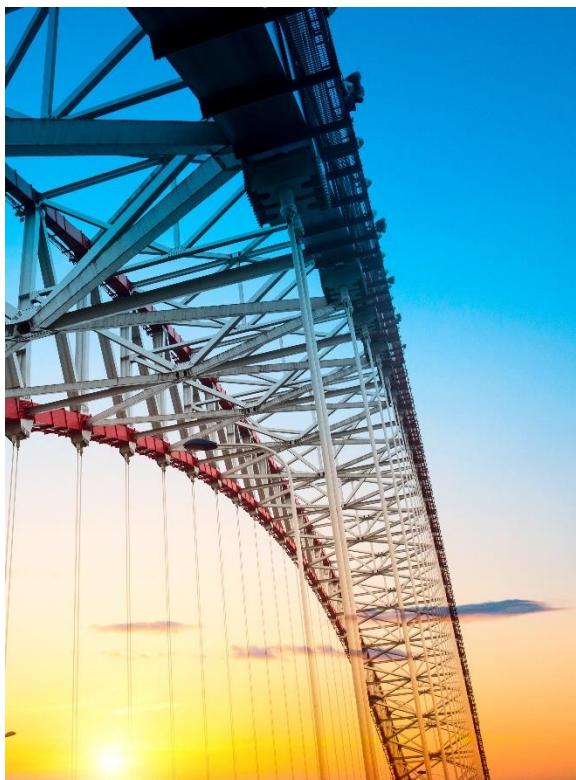
## Recommendation:

### Modify bidding procedures and criteria



#### Implementation status of the recommendation

In the past few years, the landscape of procurement of goods and services in the Government set-up has evolved. With technology playing a major role, introduction of online marketplace such as GeM and e-procurement portal has made the overall procurement process more transparent, time-bound and cost-effective. Complementing this, few Implementation Agencies have diversified from the traditional competitive bidding to new and evolved bidding procedures such as QCBS and Reverse Auctioning for infrastructure projects.



#### Impact assessment

According to the KPMG-PMI survey 2018, 35.5% respondents stated that they have adopted one methodology of bidding procedure in their organization and almost 82% of such respondents stated they use competitive bidding procedure as a single methodology for procurement. In addition, the survey also revealed that 45% respondents stated they still do not use the QCBS bidding procedure and 48% said they do not use the reverse auction method for procurement in their organization. Another alternative to L1 bidding method especially in public sector infrastructure projects is the average bid method. According to 87% of the respondents, this is not being used in their organizations, with most of the respondents being unaware of this methodology. These numbers are fairly high indicating that the industry has a huge scope for adoption of new procurement methodologies and the need to move away from the traditional L1 bidding method. With contractors bidding unrealistically low, compromising on quality and projected timelines to win contracts and buyers losing the negotiation power, modified bidding methods is the way forward.

**45%**

of respondents stated they still do not use the QCBS procedure for bidding process in their organizations.

**48%**

of respondents stated they do not use the reverse auctioning methodology as a bidding procedure.

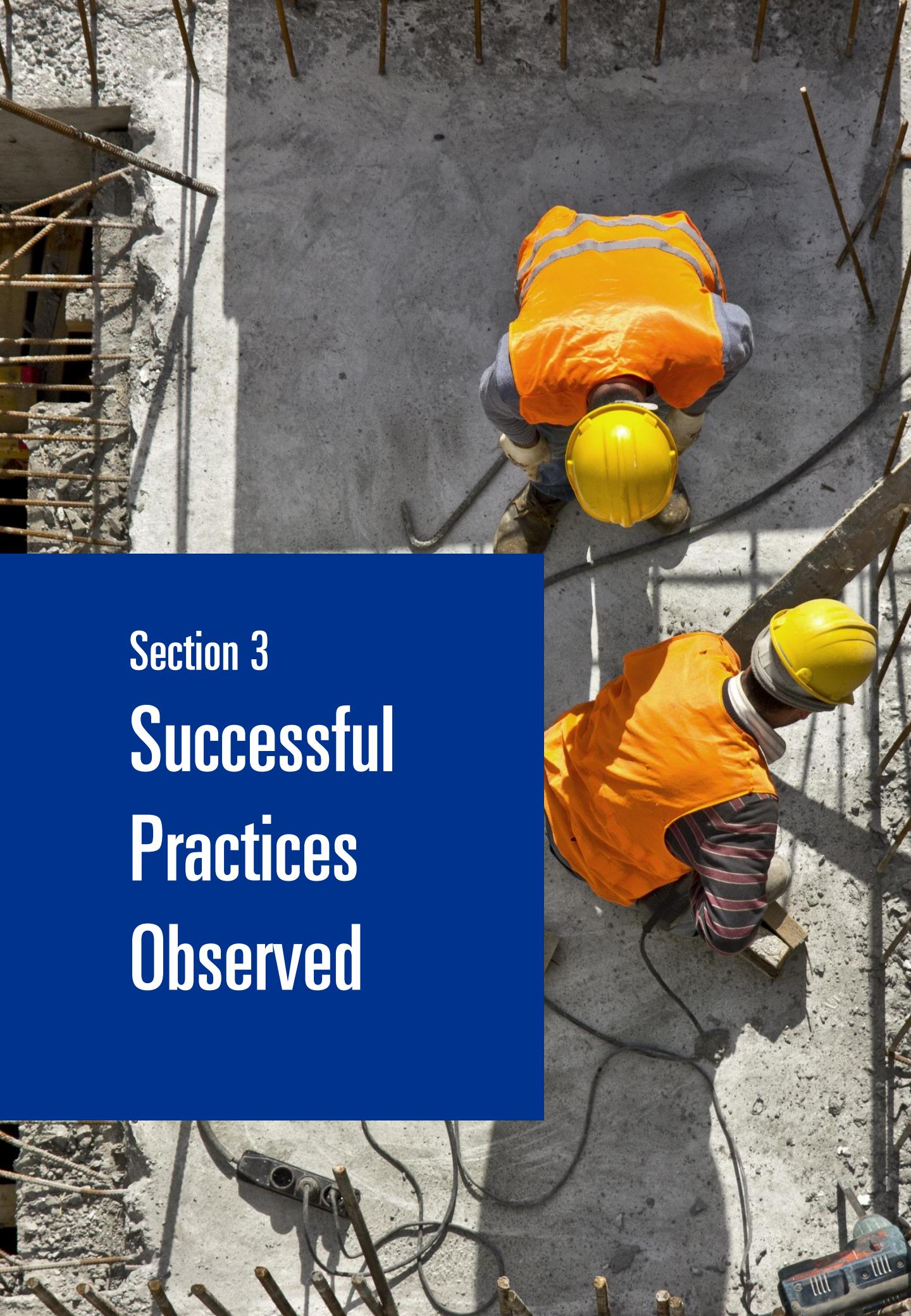


# Section 3

# Successful

# Practices

# Observed



# Achievements in the Infrastructure Project Delivery

The Government in the past few years has emphasized on creating world class infrastructure in the country with the objective of building a strong economic base for a developing nation. Some of the major programmes undertaken by the Government to transform the infrastructure landscape are:

- Sagarmala programme – for accelerating port-led development,
- Bharatmala – to strengthen the road network in the country,
- Mumbai Trans Harbour link project – for building the country's largest sea bridge, and
- Setu Bharatam Project – for making national highways free of railway level crossings.

Sectors such as roads, railways, renewable energy, urban development and civil aviation have been the prime focus for the Government and are undergoing a huge transformation. A few notable achievements of the Government that have paved the way for improved economic development are:

- Increase in the construction of express highways from progress rate of 12 km per day to 27 km per day now,<sup>39</sup>
- Rural roads connectivity increased from 56 percent in 2014 to 82 percent in 2018,<sup>40</sup>
- Impetus to regional air connectivity for reviving unserved and underserved airports and improve air connectivity in Tier 2 and Tier 3 cities,<sup>41</sup>
- 9,528 km of broad gauge railway line commissioned since 2014,<sup>40</sup>
- Urban transformation through development of smart cities, and
- Approximately one crore affordable houses built.<sup>40</sup>

The infrastructure industry also boasts of several iconic projects that have been executed in recent years and recognized globally for their unique features and proposition.

 **Statue of Unity** is the world's tallest statue at 182 meter, crossing the previous world highest statue of Spring Temple Buddha in China at 153 meter. Completed in a record time of 48 months, the statue was inaugurated on 31 October 2018. The statue is an example of exemplary engineering and use of sophisticated state-of-art technology.<sup>41</sup>

 **DFCCIL Ateli-Phulera**, a 190 km stretch of Western Dedicated Freight Corridor was inaugurated in August 2018. The corridor capable of attaining speeds up to 100 kmph with loading capacity of 13,000 tonnes is the first fully mechanized track laying in India that achieved an average per day track laying of two to three kms.<sup>42</sup>

 **Dhola-Sadiya bridge in Assam** is the longest river bridge in India spanning 9.15 km, connecting Assam and Arunachal Pradesh. The bridge reduces travel time from six to one hour and distance by 165 km. Strategically important for the Indian Army, it reduces travel time to reach Arunachal-China border by three to four hours.<sup>43</sup>

 **Chenani Nashri Tunnel (Patnitop tunnel)** is India's longest road tunnel, measuring a length of 9.28 km. An "all-weather" tunnel, it reduces the travel distance between Jammu and Srinagar by 30.11 km. Inaugurated in April 2017, it is the country's first and world's sixth road tunnel with a transverse ventilation system.<sup>44</sup>

 **Katra- Banihal Rail Link** is the world's highest railway bridge, 1315m long, soaring 359 meter above the level of Chenab riverbed and 30 meter higher than the Eiffel Tower. It is the seventh largest arch-shaped bridge in the world, likely to be commissioned in 2019.<sup>45</sup>

39. Press Information Bureau, Ministry of Home Affairs, Government of India, 29 May 2018

40. <https://48months.mygov.in/>

41. <http://www.statueofunity.in/>

42. <https://www.financialexpress.com/india-news/indian-railways-dedicated-freight-corridor-first-section-to-be-operational-by-2018/550010/>,

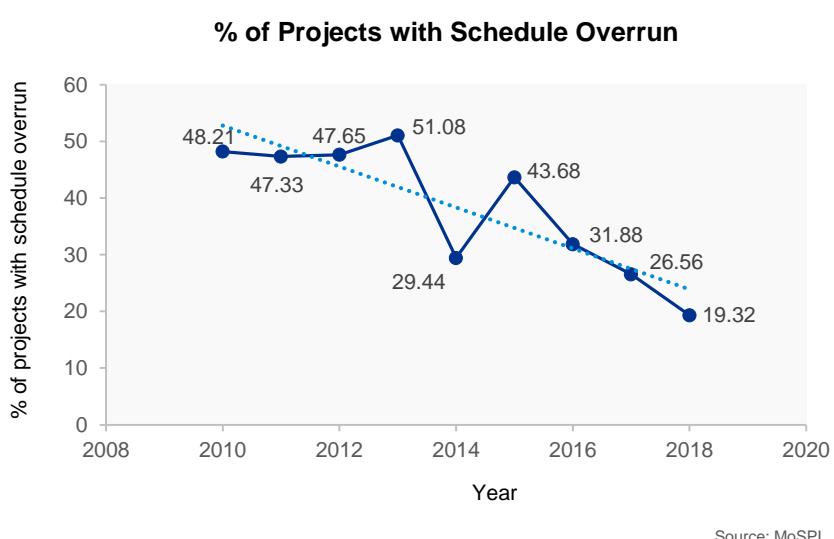
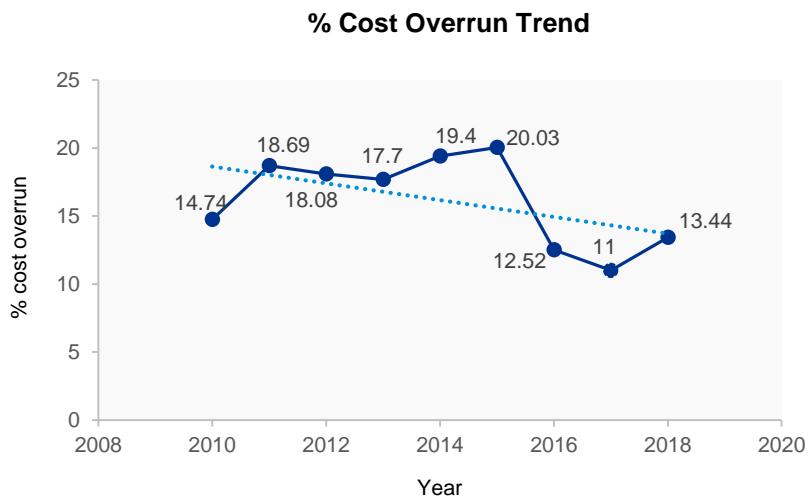
43. <https://economictimes.indiatimes.com/news/economy/infrastructure/dhola-sadiya-seven-things-you-need-to-know-about-indias-longest-bridge/articleshow/58852554.cms>

44. Multiple news articles

45. <https://www.india.com/travel/articles/worlds-highest-rail-bridge-interesting-facts-about-chenab-railway-bridge-in-jammu-and-kashmir/>

# Trend in Overruns of Infrastructure Projects

As per the information provided by the Infrastructure and Project Monitoring Division (IPMD) of MoSPI, project overruns across sectors have been witnessing a declining trend, especially over the past three years. Exhibited below are the overall percentage of cost overrun and percentage of projects with schedule overruns for infrastructure projects monitored by MoSPI from the year 2010 to 2018. This is reflective of overall performance improvements in infrastructure projects, which is partly attributed to some of the government initiatives launched in the past few years.



# Government Initiatives for Successful Project Delivery

## 1 PRAGATI - Pro-Active Governance And Timely Implementation

The Government of India launched **PRAGATI**, a unique ICT based multi-purpose, multi-modal interactive platform on 25 March 2015 to monitor and review important programmes and projects of the Centre as well as projects flagged by State Governments.<sup>46</sup> The system brings transparency and accountability with face time and real-time exchange of information among key stakeholders.

The platform enables the PMO's office to expedite decision making and remove bottlenecks in projects. The platform has a built-in feature that maintains directions given by the Prime Minister in the system for further follow-up and review till the issue is resolved and closed.

As per the information provided by MoSPI, presently, approximately 270 projects are being monitored under PRAGATI. Some of these projects that have also been studied for the KPMG-PMI report 2018 are:

- **New Airport at Pakyong, Sikkim**
- **Tapovan Vishnugad Hydro Power Project, Uttrakhand**
- **Six Laning of Panipat- Jalandhar section**
- **Four Laning of Gwalior- Shivpuri section**
- **Lalitpur- Khajuraho New BG Rail Line Project**

Noted developments in project progress and actions on pending decisions/permissions have been observed in these projects over the past few years. **The recent successful opening of the New Airport at Pakyong, Sikkim** is an example of one such development.

### Salient features of PRAGATI

Monitors and reviews important programmes and projects by GoI	Addresses issues flagged by the State Governments
Enhances transparency and improves accountability	Built-in feature to maintain decisions taken for further follow-up and review
Facilitates real-time presence and exchange among various stakeholders	Enables PMO's office to resolve implementation problems and expedite execution and completion of projects
Addresses bottlenecks in projects due to inter-dependencies between Government Ministries/Departments/ Bodies	Three tier (PMO, GoI Secretaries and Chief Secretaries of States) IT based redressal and monitoring system

One of the recommendations in KPMG-PMI report 2012 was – Set up a three tier project/program management office structure in the country to monitor and debottleneck infrastructure projects



## eSuvidha - Project Management System (ePMS)

(Weblink - <https://esuvidha.gov.in/>)

eSuvidha, a project management system, has been developed for resolving various project issues with a view to fast tracking the approvals for setting up and expeditious commissioning of large public, private and PPP projects. It also helps to remove implementation bottlenecks in these projects. This portal is administered by the Project Monitoring Group (PMG), a special cell set up in 2013 under the Cabinet Secretariat, moving under the Prime Minister's Office (PMO) from September 2015. In February 2019, PMG has been merged with Invest India, the national investment promotion and facilitation agency, under Department of Promotion of Industry and Internal Trade (DPIIT), Ministry of Commerce, Government of India. With the merger, a special cell namely Project Monitoring-Invest India Cell (PMIC) has been set up in Invest India. DPIIT has been mandated to be the nodal ministry for review of investment in public and private projects facing challenges.<sup>47</sup> The projects considered by PMG are currently pertaining to the following sectors:

- National Highways and Railways
- Civil Aviation and Shipping
- Petroleum and Natural Gas
- Chemicals and Fertilizers
- Coal, Power and Mines
- Cement, Construction and Steel

As per a PMG performance update summary report dated 1 October 2018, more than 3,100 issues raised on PMG's portal relating to 718 projects have been resolved with a total anticipated investment of approximately INR 29.77 lakh crore. The report also highlights that as on 31 March 2018, out of the 602 projects addressed by PMG for resolving issues through the portal, 335 projects with investment amounting to INR 11.43 lakh crores have been partly or fully commissioned.

Under the purview of PMG, several issues are considered such as environment, forest and

<sup>47</sup> Notification on PMG from DPIIT sourced from Invest India

wildlife clearances, industrial license permission, road crossing of pipelines/transmission lines, grant of RoW, land acquisition issues such as Government notifications/disbursement of compensation, removal of encroachments, relief and rehabilitation plan, power and water supply, consent to establish and operate from State Pollution Control Board to name a few.

The Project Monitoring Group complements the functions of the Infrastructure and Project Monitoring Division (IMPD) under MoSPI. In addition, there has also been a directive from the PMO for greater coordination with State Governments to speed up the project clearance process, especially by getting all State Governments to adopt a similar online portal as set up by the PMG for the Central Government.

### **India Investment Grid (IIG)** (Weblink - [www.indiainvestmentgrid.com](http://www.indiainvestmentgrid.com))

The India Investment Grid (IIG) is an interactive and dynamic web portal that showcases investment opportunities across states and sectors in India, connecting domestic and foreign investors to project promoters across India. Developed and managed by Invest India, IIG is a critical initiative of the Department of Promotion of Industry and Internal Trade (DPIIT), Government of India to provide impetus to investments in India and enhance the ease of doing business.

IIG enables monitoring of project implementation through the entire lifecycle of the project. Central ministries and state governments can monitor progress of projects across both the government and private sectors. Further, real time connect and collaboration between project promoters and investors at the planning and the pre-tendering stage allow for setting more realistic timeframes and milestone targets through the procurement and implementation cycle. Projects uploaded on IIG can also avail facilitation by Invest India.

*(Refer write-up on 'Invest India' in Annexure for more details)*

### **Proactive steps taken to accelerate Land Acquisition**

National Highways Authority of India (NHAI) has introduced the single Competent Authority Land Acquisition (CALA) account system to aggregate disbursed compensation funds and maximize interest savings. The single account centralized fund management system ensures financial discipline, simplifies the monitoring and management of compensation funds for the land acquired for national highway projects undertaken by NHAI.

In another innovative step towards easing the land acquisition process, MoRTH with the help of National Informatics Centre has developed a web portal, **Bhoomi Rashi**, to digitize the



entire process of land acquisition. This single point platform for online processing of land acquisition notifications has significantly helped expedite the process of land acquisition. All stakeholders such as farmers, landowners, contractors and investors, State PWDs who prepare the DPRs on the basis of which the land is acquired, state revenue officials who carry out the actual land acquisition etc. would benefit from the transparency introduced by the portal in the land acquisition process.

In addition, MoRTH has issued comprehensive guidelines for land acquisition for national highways in December 2017 to simplify the complex issues of land acquisition such as applicability of certain provisions of the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement (RFCLARR) Act 2013 to NH Act 1956, determination of market value of land to be acquired, issue of multiplication factor, bulk acquisition through consent of land owners etc.



### **Policy initiatives and interventions by Ministry of Road Transport and Highways<sup>48</sup>**

In the road sector, the Government has made sustained and focused efforts to identify issues affecting the sector and addressing them through appropriate policy interventions. The major policy initiatives in the last four years are as follows:

- *Increased threshold for project appraisal and approval* - MoRTH has been authorized to appraise and approve projects up to INR 1000 crore (earlier INR 500 crore).
- *Innovative implementation models* – With the introduction of project implementation models such as Hybrid Annuity Model (HAM) and Toll Operate Transfer (TOT), the Government has optimally taken over the project risk and thereby revived the interest of private players and FIs in road projects.

In addition to the above, 73 troubled projects of length 8310 km have been revived through policy interventions such as:

- Private developers allowed 100% equity divestment two years after start of operations from all operational BOT projects.
- Allowing rescheduling of premium committed in stressed assets by concessionaires during bid stage.
- Rationalized compensation to concessionaires for languishing National Highway projects in BOT mode for delays not attributable to concessionaires.
- Financial assistance provided by NHAI through One Time Fund Infusion Scheme (OTFIS) to troubled BOT projects that have achieved at least 50% physical progress.



### **Use of spatial technology for monitoring and managing National Highways**

NHAI is the nodal agency in the country mandated to strengthen the national highway network in the country along with other road projects. Realizing the significance of technology to expedite project preparation, enhance progress monitoring, operation and maintenance, NHAI signed an MoU with National Remote Sensing Centre (NRSC) under Indian Space Research Organization (ISRO) and North East Centre for Technology Application and Research (NECTAR) for use of spatial technology for managing and monitoring national highways in the country.<sup>49</sup>

Satellite data, geospatial technology and Unmanned Aerial Vehicles (UAV) are useful technologies that help in preparation of DPR, conducting site investigation and pre-feasibility studies, monitoring of road sections under-construction and asset management.

48. Press Information Bureau, Government of India, MoRTH, 23 July 2018

49. Press Information Bureau, Government of India, MoRTH, 13 January 2016

## Integrated Permitting Process

The numerous Government initiatives and positive steps taken in the infrastructure space, combined with the growing need for infrastructure development in the country owing to a fast paced developing economy, has positioned India as a favorable destination for large capital investments. This is reflected in India's ranking in the **World Bank's Ease of Doing Business (EODB) Index 2018**, that has seen a giant leap of 33 positions that is from 100<sup>th</sup> position in 2017 to 77<sup>th</sup> in 2018.

This jump is attributed to significant improvement in areas such as ease and fast tracking of approval/clearance process, getting electricity faster and cheaper, and strengthening access to credit, among other parameters.

**India is the only country to rank among the top 10 improvers for the second time in a row, and becomes the top ranked country in South Asia for the first time.** Among BRICS economies, India ranks third, overtaking South Africa and Brazil.

Enormous amount of work has been put in place in the past three years towards easing out the process of receiving construction permits. The earlier system of applying to several agencies for NOCs has now been replaced with one integrated common application form. Besides, **an online system** is set up requiring applicants to apply only through online portal rather than offline. **The deemed NOC functionality is in place**, that means the application would be construed as a deemed NOC if there is no objection for 15 days. Similarly, the **deemed approval functionality** ensures building plan approval is mandatorily granted within 30 days, else deemed approval is to be given automatically. All this has made the process of getting construction permits much simpler and faster than before.

Of the ten parameters used for EODB ranking, India showed improvement in six parameters that includes notable improvement in construction permits as shown in the table below.

Doing business topics	2019	2018
<b>Starting a business</b>	137	156
<b>Dealing with construction permits</b>	52	181
<b>Getting electricity</b>	24	29
<b>Registering property</b>	166	154
<b>Getting credit</b>	22	29
<b>Protecting minority investors</b>	7	4
<b>Paying taxes</b>	121	119
<b>Trading across borders</b>	80	146
<b>Enforcing contracts</b>	163	164
<b>Resolving insolvency</b>	108	103

Source: KPMG analysis

**e-Nivesh Monitor**, another initiative towards improving the processes of obtaining approvals, is an online portal managed by PMG to fast track and monitor the procedure for obtaining approvals on proposals pending for clearances beyond timeline at various Ministries/Departments or Government organizations. 75 key approval granting processes in the Central Government for setting-up new projects have been taken up for digitization and integration in e-Nivesh. Enabling a more efficient, transparent and convenient interface between the Government and new businesses, e-Nivesh is an integrated platform that brings together the relevant information from various online central and state level services/clearances portals and facilitates private entrepreneurs to browse industry information on a single platform. Such digitization initiatives is also helping States improve their ranking on the EODB Index and attract more investment in projects.

# Measures adopted by Implementation Agencies to address overruns

During the course of this study, several positive measures adopted by Implementation Agencies to improve project performance were identified in the case study example projects. Few key measures are listed below. The list is not exhaustive.



## New Airport at Pakyong, Sikkim

### **Memorandum of Understanding (MoU) signed between the Government of Sikkim (GoS) and the Implementation Agency**

- An MoU was signed between the Government of Sikkim and the Implementation Agency on 28-March-2002 and a revised MoU was signed on 30-June-2015.
- Responsibility for pre-development approvals such as clearance from the Ministry of Defence and Ministry of Environment, which are generally time consuming activities, were taken by the Government of Sikkim. In addition, all the necessary Administrative Approvals (A/A) and Expenditure Sanctions (E/S) were also issued by the state government.
- As per the MoU, security at Pakyong airport has been provided by GoS to ensure minimal pilferage.
- The revised MoU addressed the issue of protests from local residents demanding balance compensation for damaged properties around Pakyong airport, wherein compensation disbursement was taken up by the office of SDM Pakyong, reducing the burden of work on the Implementation Agency.

### **Claims management**

- The Implementation Agency, under the amended Arbitration and Conciliation Act, 1996, released a percentage of arbitral award under challenge to the contractor. This step of releasing a percentage of the arbitral award under challenge, has enabled the work to progress and the project to get completed.

*Source: As observed and discussed with project stakeholders during case study conducted on 13 – 14 March 2018*



## Tapovan-Vishnugarh Hydro Power Project

### **Measures taken for time saving**

- The Implementation Agency received approval from Uttarakhand Government for extracting construction material from quarry. Environment Impact Assessment for the same is in progress.
- Secured advances were provided to contractors with poor financial conditions. This helped in continuity of works.
- Realigning of silt flushing tunnel (SFT) decreased its length substantially from 2350 meters to 1400 meters.
- Use of hard gel grout and Rockstab 1.2 A/B helped contractors in controlling poor geological conditions.
- Considering slow progress due to poor geology in Silt Flushing Tunnel, the Implementation Agency explored SediCon Seluicer System for silt flushing, which will remove dependency on SFT for commissioning of project.

### **Measures taken for cost saving**

- Realigning of SFT and value engineering of intake system, barrage and de-silting has accounted for a cumulative cost savings of 53 crore.

*Source: As observed and discussed with project stakeholders during case study conducted on 12 – 15 March 2018*

# Successful Practices Observed in Implementation Agencies

During our discussions with various Implementation Agencies such as ONGC, NTPC, and NHAI, few successful practices emerged. These practices, if leveraged by the industry at large, can lead to improved project delivery. The corresponding assigned ranking is indicative and is based on their potential to address project overruns.

## Use of Technology



The use of technologies such as web camera, mobile applications, drones, PMIS etc. helped the interview respondents in Roads and Power sector for real-time monitoring and control of

infrastructure projects, throughout the project lifecycle. While many respondents stated that they have already started on the digital journey of construction, they still believe that the use and impact of technology are yet to be completely explored in the Indian infrastructure sector.

### Rank #1 – Most effective in addressing majority of reasons for overruns

## Vendor Scorecard



Vendor scorecard assists in measuring vendor performance in different areas such as delivery, quality, service and cost. An Implementation Agency in the oil and gas sector stated that vendor

scorecards helped them in providing regular feedbacks to vendors, thus ensuring continuous performance improvement. It also led to better communication with vendors and promoted a performance based culture.

### Rank #3

## Structured Vendor Meetings

It is critical to ensure that vendors meet contract requirements and client expectations. One of the implementing agencies in oil and gas sector had implemented a practice of periodic vendor meetings to improve vendor performance by regularly collecting feedback for addressing vendor concerns regarding evaluation criteria, contract terms, payments etc.

### Rank #5



## Liaison with Authorities

Typically in large infrastructure projects, one of the major reasons of delay for project start or handover is obtaining approvals/clearances from multiple statutory/regulatory authorities. This process not only takes a long time but is also complex due to the lack of clarity of information required. One of the interviewed implementing agencies stated the practice of forming specific teams/committee's by liaising with Central, State and Local Authorities for faster redressal of such issues.

### Rank #2



## Value Engineering

For large construction projects, opportunities for cost reduction/optimization should be identified, while ensuring that they do not adversely affect the quality of outcome. Value engineering is a typical method to optimize the design while maintaining or improving performance and quality requirements. Respondents in the road sector quoted various value engineering methods adopted for project and cost efficiency.

### Rank #4



## Contractor Reward Policy

Incentives can help motivate vendors/contractors and maximize their performance to achieve timely or early completion of the project. One of the respondents in oil and gas sector quoted the usage of performance incentive based contracts. This ensured the organization to get high quality services at reasonable price quotations, while vendors get rewarded for meeting/exceeding their expectations.

### Rank #6

## National Highway Projects

The National Highways Authority of India (NHAI) has been setting new benchmarks in the progress rate for adding road infrastructure. Additionally, numerous national highway projects are being monitored at highest level by PRAGATI - Pro-Active Governance And Timely Implementation, a GOI initiative to debottleneck their progress. Few of these projects include:

- Four laning of Krishnanagar - Behrampore section of NH-34 (78 km), Bareilly-Sitapur section of NH-24 (158 km), Panvel-Indapur section of NH-17 (84 km) and Gwalior-Shivpuri section of NH-3 (125.3 km) along with development of 6 lane highway between Panipat to Jalandhar section of NH-1 (291 km)

KPMG India has been monitoring the progress of first three projects mentioned above for the lending consortium. The successful practices implemented in these projects include:

- ✓ **Construction cost monitoring**, which has led to timely escalation of any probable cost overrun and clear monitoring of end-use of construction related payments,
- ✓ **Risk tracking and mitigation plans monitoring**, which facilitated keeping focus on key action areas, escalating issues hitherto suppressed/ignored, and taking critical management decisions, and
- ✓ **Project governance improvement measures**, which helped in instituting structured processes for progress monitoring, billing systems and reconciliations. These measures would potentially avoid contractor disputes at a later date.





# Section 4

# Current State

# Assessment of

# Infrastructure

# Projects

# Scope of Study

The objective of this study is to bring out the core issues in implementing large infrastructure initiatives of the government and suggesting recommendations for strengthening project and program management capabilities.

This study largely focuses on the performance of infrastructure projects (valued more than INR 150 crore), which are centrally monitored by the **Ministry of Statistics and Programme Implementation (MoSPI)**. Based on the database of centrally monitored projects provided by MoSPI, subject organizations for interviews and projects for case studies were selected for conducting the current state assessment. MoSPI database of projects consolidated for the **Flash Report** for the month of **January 2018** has been considered for the purpose of this study.

## About MoSPI Flash Report

**The Infrastructure and Project Monitoring Division (IPMD), MoSPI**, is the project management arm and apex monitoring institution of the Government of India. IPMD brings out reports that are presented to the Prime Minister's Office, Cabinet Secretariat, Ministry of Finance, Planning Commission and the concerned administrative Ministries.

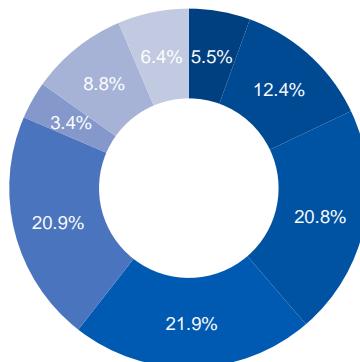
One such report is the MoSPI Flash Report, which is released on periodic basis by MoSPI on central sector projects (INR 150 crore and above only) reporting their status.

The Flash Report is a ready reference document that consolidates all project related information such as project start date, project end date, project cost and expenditure, name of the Implementation Agency and implementation status etc. for central sector projects on a single platform.

According to the data from MoSPI Flash Report-January 2018, of the total 1,304 projects, 16 projects were ahead of schedule, 372 were on schedule while 354 projects were delayed. In addition, 345 projects have incurred cost overrun while 78 projects have shown cost savings. A total of 94 projects have incurred both time and cost overrun. The total investment outlay of the 1,304 projects was INR 16.21 lakh crore, which are expected to complete at a cost of INR 18.41 lakh crore.

**Total Number of projects- 1,304**

**Total planned cost- INR 16.22 Lakh Cr.**

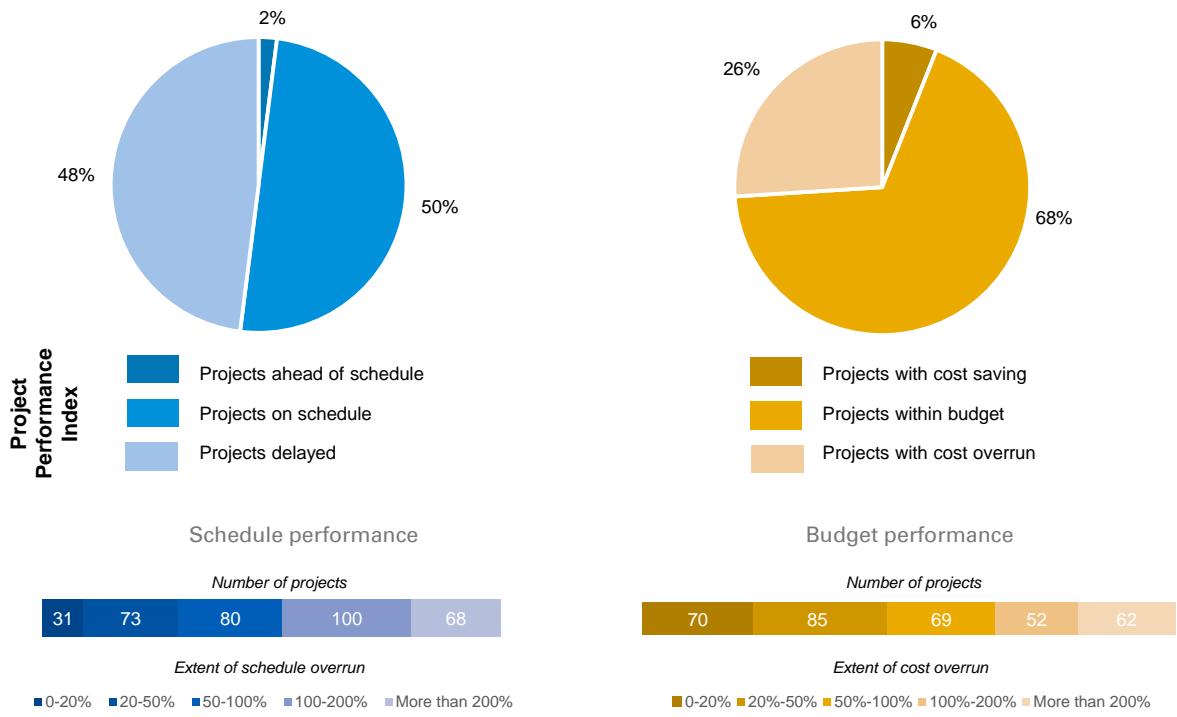


Percentage on graph represents part of total planned cost in each sector

## Sector (Planned Cost in INR lakh crore)

Coal (0.90)
Oil and Gas(2.01)
Power(3.37)
Railways(3.55)
Roads(3.39)
Steel(0.55)
Urban Development(1.42)
Others(1.03)

Source: MoSPI Flash Report- January, 2018



Source: MoSPI Flash Report- January, 2018, KPMG analysis



# Sector-wise Performance Overview

While the MoSPI database is only a subset of infrastructure projects in India, it is a fair representation of the Indian infrastructure industry. Exhibit 1, below captures the performance analysis of each sector from the MoSPI database on parameters of percentage cost and time overrun. Due to limited data availability, defense production and heavy industry sector projects have been excluded from this analysis.

## Exhibit 1 - Sector performance basis percentage cost overrun and average time overrun

Sector (number of projects)	Cost overrun				Time overrun			
	Original cost* (in INR lakh crore)	Anticipated cost* (in INR lakh crore)	Cost overrun* (%)	No. of projects with cost overrun	Average project duration (in months)	Average time overrun (in months)	Time overrun* (%)	No. of projects with time overrun
Railways (355)	3.55	4.83	36%	218	92	50	54%	43
Roads and highways (509)	3.39	3.45	2%	43	35	19	51%	109
Power (122)	3.37	3.98	18%	43	41	23	56%	67
Oil and Gas (112)	2.01	2.03	1%	17	46	10	22%	35
Urban development (37)	1.42	1.47	4%	7	38	22	58%	23
Coal (92)	0.897	0.892	-1%	9	63	24	38%	38
Steel (30)	0.549	0.552	0.4%	5	58	16	28%	16
Shipping and ports (9)	0.047	0.051	10%	4	32	51	159%	3
Civil aviation (2)	0.0062	0.0099	59%	2	42	51	121%	2
Others **	0.9558	1.0939	14%	5	32	22	69%	16

\*all figures have been rounded to the closest whole number

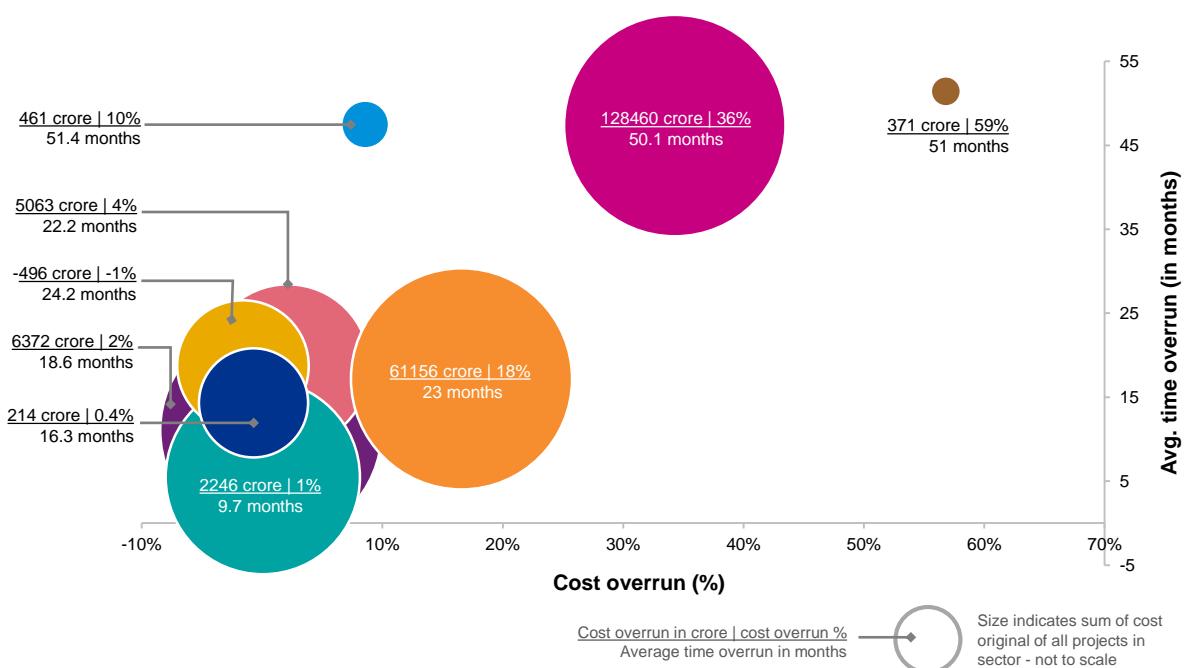
\*\*(atomic energy, telecom, mines, health and family welfare, fertilizers)

For time overrun calculations, all projects with original date of completion on or before 31 Dec 2017 have been considered

All calculations for cost/time overrun have been done considering anticipated project cost/completion date

All projects with no data for original and/or anticipated date of completion have not been considered for time overrun calculations

Source: MoSPI Flash Report January 2018; KPMG India analysis



# Overrun Trend in Select Sectors

While the overruns in projects have been prevailing, the extent of their relationship with project size needs to be established so the corrective efforts by Implementation Agencies and other stakeholders can be channelized accordingly.

Project database consolidated by MoSPI for last four years has been evaluated to analyze this relationship. The projects in the database were categorized under four slabs according to the project cost – *Slab 1: INR 150 to 500 crore, Slab 2: INR 500 to 1000 crore, Slab 3: INR 1000 to 5000 crore and Slab 4: above INR 5000 crore*. Power, Oil and Gas, Railways and Roads and Highways being the major recipient sectors of infrastructure investment, have been considered for this analysis.

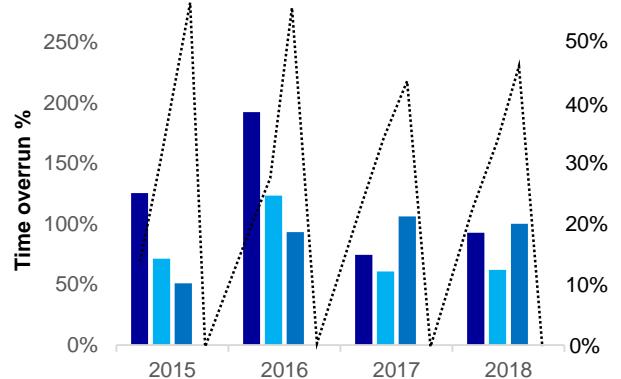
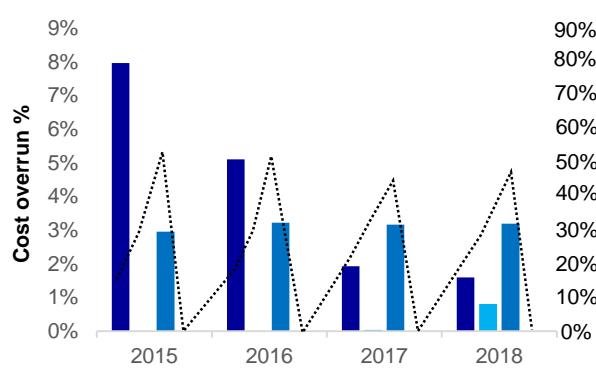
The graphs below demonstrate this analysis for the average cost and time overrun in each slab vis-à-vis the relative capital investment percentage in the respective year. This allowed to plot the average of capital contribution of projects in each slab against their average overruns.

Further, priority slabs have been highlighted in each sector based on their overruns and capital investment being above average. Project slabs with 3 metrics (1. *cost overrun*, 2. *time overrun*, and 3. *capital investment*) above average are termed as the primary focus slabs and slabs with 2 metrics above average are termed as secondary focus slabs. In sectors where no project slab has 3 metrics above average, slabs with 2 metrics above average are termed as the primary focus slabs.

While these metrics' level would change on yearly basis, such analysis can aid the Implementation Agencies in establishing measures suitable for particular size of projects.

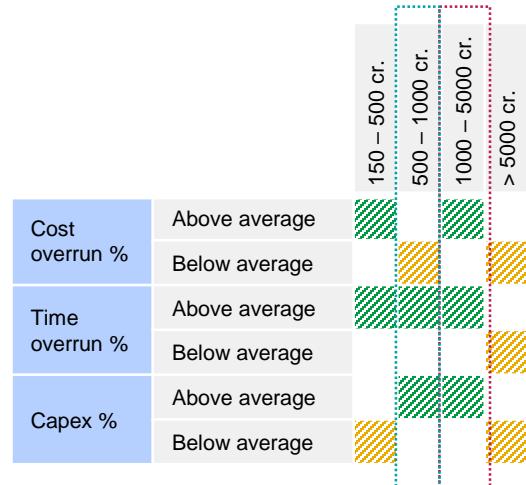


## Roads and Highways

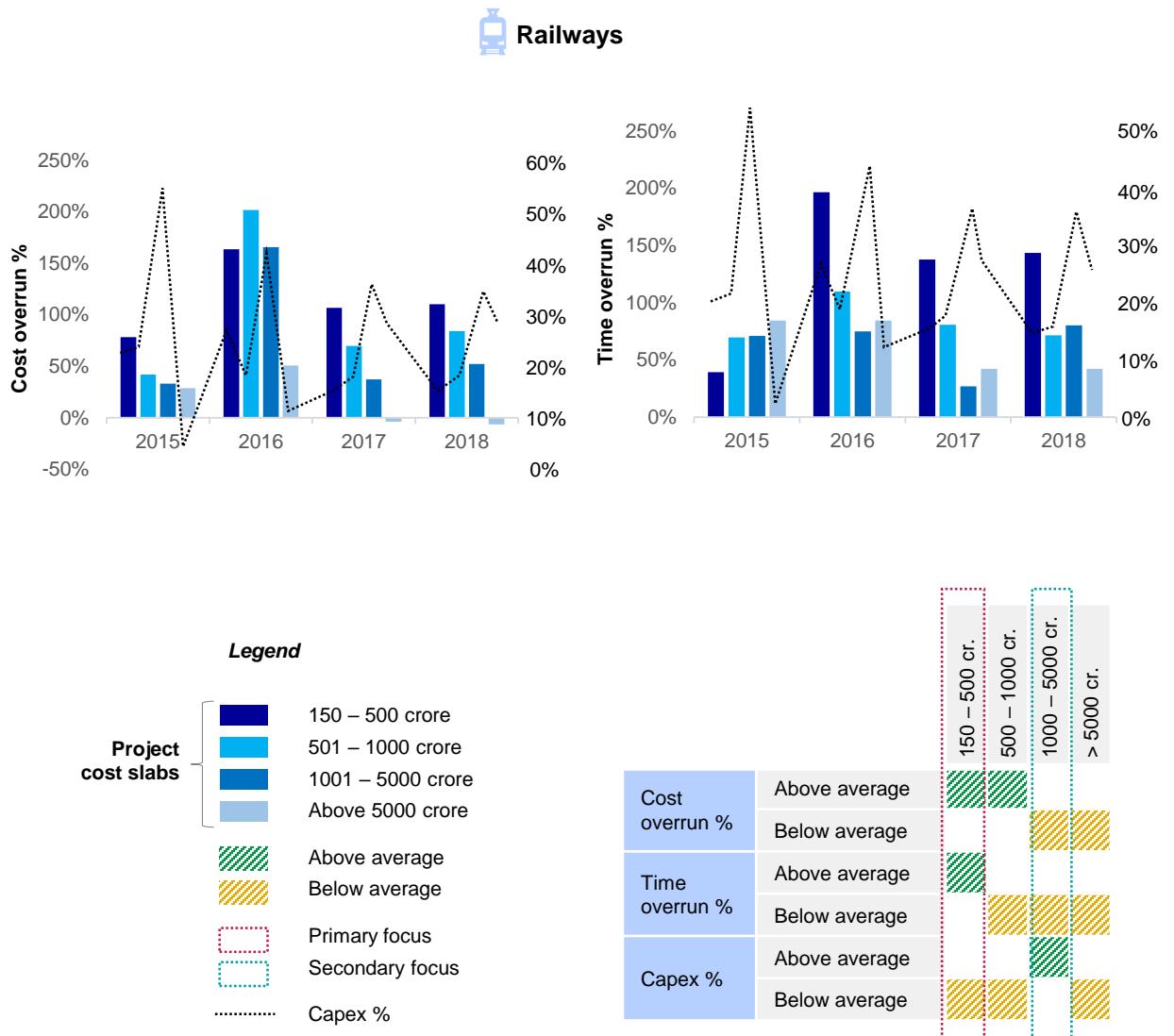


### Legend

<b>Project cost slabs</b>	150 – 500 crore
	501 – 1000 crore
	1001 – 5000 crore
	Above 5000 crore
.....	Above average
	Below average
.....	Primary focus
	Secondary focus
.....	Capex %

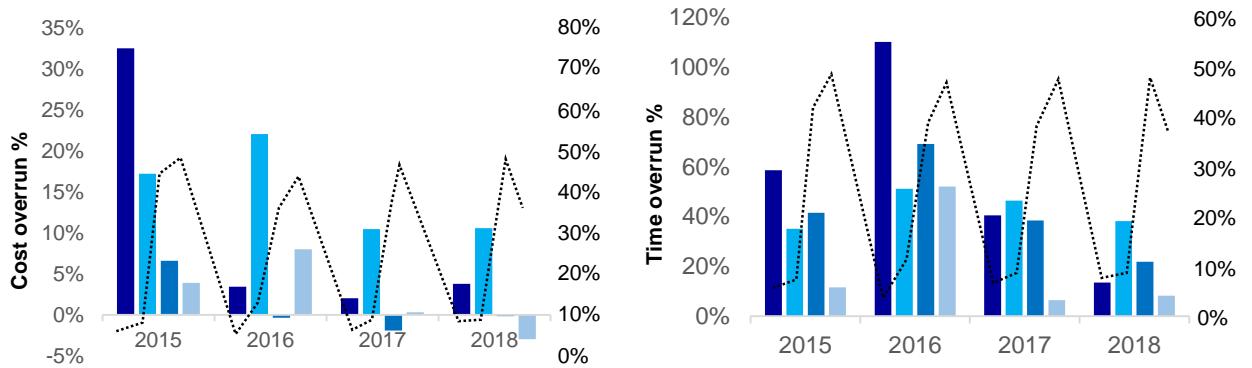


In the roads and highways sector, since two project slabs have 2 out of 3 metrics above average, priority should be given to slab with capital contribution above average. Therefore, Slab 3: INR 1000 to 5000 crore should be the primary focus slab and Slab 2: INR 500 to 1000 crore should be the secondary focus..

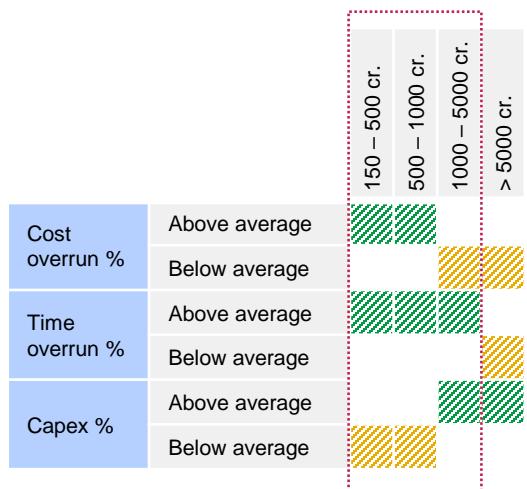
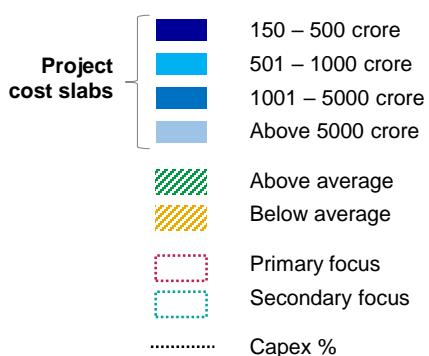


In the railways sector, since two slabs have 1 out of 3 metrics above average, priority should be given to slab with capital contribution above average. Therefore, Slab 1: INR 150 to 500 crore should be the primary focus slab and Slab 3: INR 1000 to 5000 crore should be the secondary focus.

 Oil and Gas



### *Legend*



In the oil and gas sector, since three slabs have 2 out of 3 metrics above average, hence all three highlighted slabs should be the primary focus.

# Infrastructure Industry Performance - A comparison between 2012 vs. 2018

As per the information provided by the Infrastructure and Project Monitoring Division (IPMD) of MoSPI, the cost and time overrun percentages in infrastructure projects across various sectors were compared between year 2012 when the first KPMG-PMI study on infrastructure projects in India was conducted and the year of current study that is 2018. The comparison in Exhibit 2 indicates that most of the sectors have shown an improvement.

**Exhibit 2**

Sector	Overall Sector Cost Overrun %		Trend	Overall Sector Time Overrun %*		Trend
	2012	2018		2012	2018	
Railways	84%	36%		28%	12%	
Roads and Highways	3%	2%		58%	21%	
Power	3%	18%		53%	55%	
Oil and Gas	6%	1%		47%	31%	
Urban Development	102%	4%		25%	62%	
Coal	13%	-1%		100%	41%	
Steel	8%	0.4%		59%	53%	
Shipping and Ports	6%	10%		30%	33%	
Civil Aviation	0%	59%		33%	100%	

\* Percentage of number of projects facing time overrun w.r.t. total number of projects  
Source: MoSPI December 2012 Flash Report and MoSPI January 2018 Flash Report

# Our Point of View

## Sector-wise Performance

The comparative sector performance chart highlights the underperforming sectors in terms of projects having overruns and shows the extent of overruns across sectors. While most of the sectors show substantial time overrun, major extent of cost overrun is witnessed mainly in four sectors i.e. Railways, Power, Ports and Civil aviation.

Railways sector shows a concerning trend with the highest project investment but having 36% cost overrun and 54% time overrun on an average for it's project portfolio. Considering the volume of projects in the Railways sector, this warrants sector specific corrective interventions.

The Road sector though shows an encouraging trend of 2% cost overrun but time overruns is reported at around 51% of the original average duration. This indicates that while the cost baselining in road sector is relatively better, more proactive schedule control needs to be applied.

Power sector projects show a trend with 18% cost overruns and 56% schedule overruns. 35% of the projects face cost overrun and almost 55% of the projects are facing time overruns. This warrants a thorough review and corrective measures need to be implemented.

Projects in Oil and Gas sector are performing relatively better with 15% projects cumulatively showing 1% cost overrun and 31% projects contributing to a 22% cumulative time overrun. Similarly, projects in the Coal sector are also performing better as it has seen 14% projects having cost overrun and has witnessed 38% time overrun.

The overall trend indicates that schedule overrun is a much common phenomenon across sectors and the extent of overruns is significant, which invariably leads to cost overruns. As per the study findings, such overruns are primarily attributed to controllable factors such as inadequate baselining or minimum control or forecasting on items affecting schedule.

The sector wise reasons for both time and cost overruns are captured in this study which can be referred for sectorial interventions.

# Summarizing Key Challenges Across Project Lifecycle

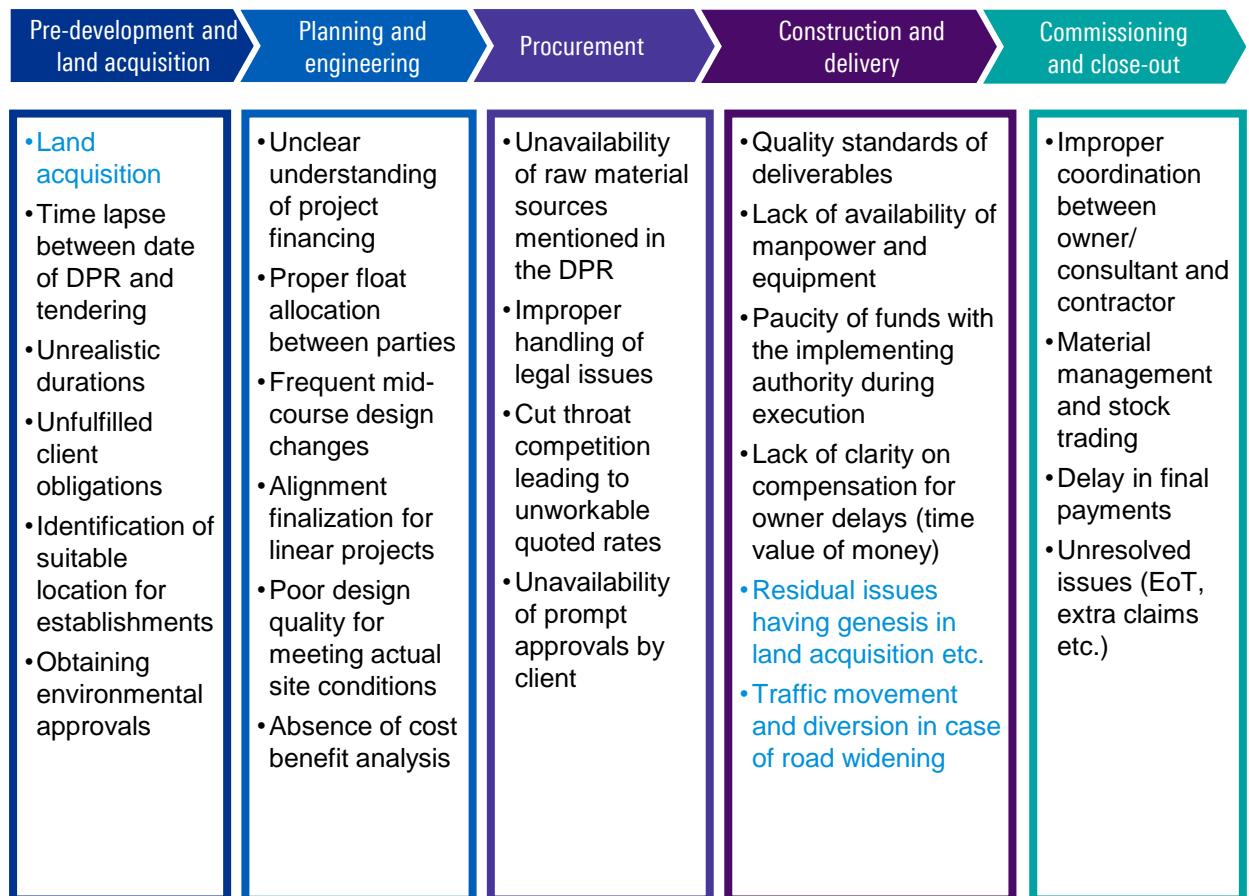
Infrastructure projects are usually complex and face numerous challenges across the project lifecycle. Some key perspectives on challenges faced in each stage of the project lifecycle emerged out of the discussions with various project stakeholders from Implementation Agencies and contractor organizations during the KPMG-PMI survey 2018.

Challenges faced by Implementation Agencies				
Pre-development and land acquisition	Planning and engineering	Procurement	Construction and delivery	Commissioning and close-out
<ul style="list-style-type: none"> <li>• Inadequate soil investigations and Detailed Project Report</li> <li>• <b>Obtaining approval for pre-investment activities</b></li> <li>• Allotment of project and signing of MoA with the concerned State Government</li> <li>• Site handover, utility shifting</li> <li>• Civil unrest/protest</li> <li>• Compensation issues/ Government determined rates vs. aspirational rates</li> </ul>	<ul style="list-style-type: none"> <li>• Inadequate time given to project planning before execution</li> <li>• Timely availability of survey inputs</li> <li>• Costing based on real time market scenario</li> <li>• Quality of LSTK Contractor/PM C/CA/TPI</li> <li>• Inadequate planning and improper base lining.</li> <li>• Delay in engineering approvals</li> <li>• Absence of critical path monitoring</li> <li>• <b>Delay in obtaining statutory clearances</b></li> </ul>	<ul style="list-style-type: none"> <li>• Improper contractor due diligence and selection</li> <li>• Delay in award/re-award of works</li> <li>• Timely availability of engineering inputs for placing orders</li> <li>• Adherence to delivery timelines by the vendors</li> <li>• Sudden fluctuations in material cost/quantity</li> </ul>	<ul style="list-style-type: none"> <li>• Shorter working windows due to weather conditions</li> <li>• <b>Civil unrest/protests</b></li> <li>• Contractor non-performance and termination</li> <li>• Change in policy/law</li> <li>• Design/scope change</li> <li>• Re-work due to poor quality of work</li> <li>• Unavailability of trained manpower</li> <li>• Lack of project communication</li> <li>• Equipment breakdown and their idle time</li> <li>• Inadequate contractor/sub-contractor capacity</li> <li>• Increase in interest rate during construction</li> <li>• Claims and disputes</li> </ul>	<ul style="list-style-type: none"> <li>• Untimely mobilization of contractors' commissioning experts and tools</li> <li>• Compilation of documents requiring technical and commercial closure</li> <li>• <b>Delay in obtaining regulatory approvals (operations)</b></li> <li>• Contractual disputes</li> </ul>

In addition to above, '**compliances to internal processes**' is a major challenge in infrastructure projects based on our discussions with stakeholders, which may also indirectly contribute to time and cost overrun.

Note: The highlighted points in blue are issues that require input and support from the State Governments where the projects are being implemented.

### Challenges faced by Contractors



### Challenges throughout project lifecycle (for both Implementation Agencies and Contractors)

- 
- Lack of project integration
  - Contractual disputes due to poor framing of contract agreement
  - Slow decision making process
  - Inadequate and inefficient risk management
  - Legal issues and long-drawn court cases

Major reasons of delay in different project stages which have been quoted in majority by the survey respondents have been elaborated in the following sub-section.

**Note:** The highlighted points in blue are issues that require input and support from the State Governments where the projects are being implemented.

# Pre-development and Land Acquisition



**Delay in obtaining regulatory approvals and permits is a primary reason for delays in the Pre-Development stage of the project.**

Obtaining regulatory approvals is a tedious process, where challenges are manifold as the approvals are spread across the project lifecycle. As such, the project teams often tend to under-estimate or overlook some of the approvals during planning stage. Additionally, most of these approvals are required from different ministries/government departments which makes it an arduous task to coordinate and obtain these approvals in a timely manner.

As per this study, 75% of the respondents stated that obtaining regulatory approvals is a major bottleneck in the pre-development stage of the project. While this number was 62% in KPMG-PMI 2012 study, it shows that some progress has been made in this scenario.

More than **75%** of interview respondents quoted delay in obtaining regulatory approvals as a primary reason for overruns in project pre-development stage



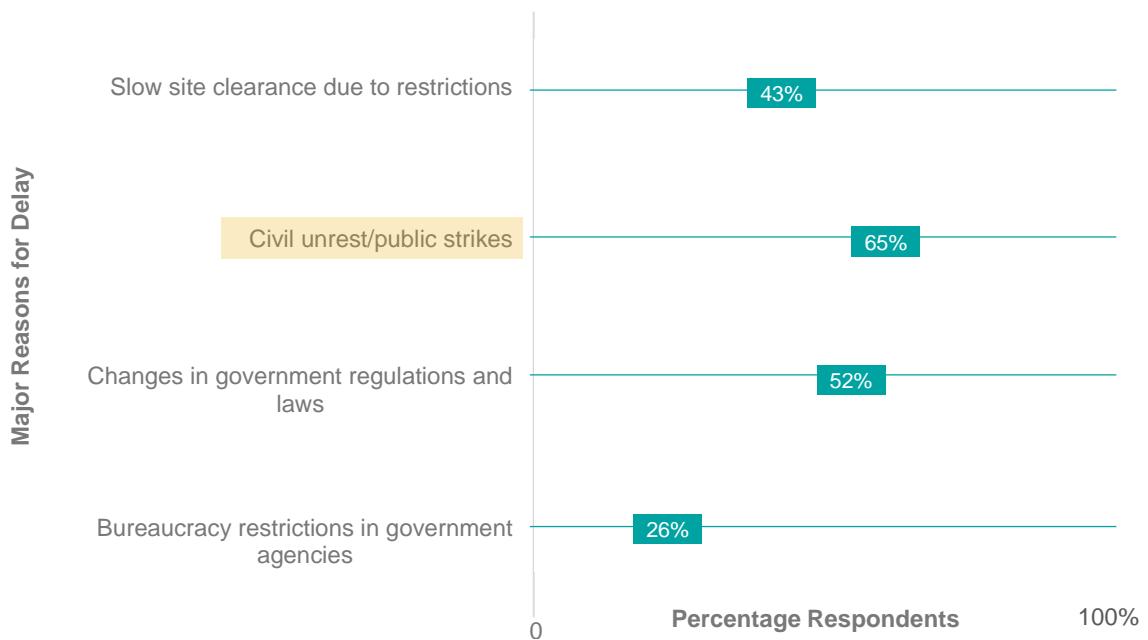
### What can be done:

- ✓ Regulatory approvals from various department/ministries need to move to a single window online system with time bound approval process. Single-window approval systems at MoEF and in many State Governments for industries have yielded positive results, which need to be expanded across other infrastructure sectors.
- ✓ Build in realistic estimates/buffers for regulatory approvals in the overall plan through integrated schedules and regular monitoring.



In the four laning of Gwalior-Shivpuri section of NH 3, land acquisition issues had been a major factor. This coupled with other factors led to a delay of 29 months of delay and ~29% cost overrun.

For details, refer to "Case Studies" sub-section of Section 4 in this report.



### Civil Unrest/Public Strikes/Law and Order situation

Land acquisition distress is prevalent in infrastructure projects across the globe. This leads to animosity amongst the locals for giving away their land and often results in public unrest/showdowns, especially in remote regions populated by farmers. Moreover, with deep media outreach, protests and public strikes are the common tools used to contest the land ownership rights that affects the pace of projects. These protests are rarely handled efficiently and in many cases spiral out to a law and order situation, which is detrimental to the project.

**What can be done:**

- ✓ Educating the impacted land owners about the **socio-economic impacts** of the project by providing a perspective of the positive change that the project can bring.
- ✓ Employing and up skilling the locals for construction works, which may also lead to employment for operations.
- ✓ Providing improved living conditions in the Rehabilitation and Resettlement colonies.

**65%** of interview respondents quoted civil unrest as a primary reason for delay in land acquisition



In the Pakyong Airport project case study, civil unrest has been a major factor, which along with others led to 86 months of delay and ~78% cost overrun.



For details, refer to "Case Studies" sub-section of Section 4 in this report.



# Planning and Engineering



## Suboptimal Feasibility/ Investigation Reports

Incomplete and improper feasibility reports and Detailed Project Reports (DPR) often lead to incorrect cost and time estimates, which is a result of limited or incomplete understanding of the project scope. Additionally, DPR prepared several years before project initiation, forecast incorrect ground conditions during execution phase. This leads to improper baselining, contributing to fragile targets.

As per the study statistics, 56% of the respondents stated that suboptimal feasibility reports are a major bottleneck for the project. This number was 67% in KPMG-PMI 2012 study, which is indicative of incremental progress but there is still significant scope for improvement.

More than **55%** of interview respondents quoted suboptimal feasibility reports as a primary reason for delay in planning stage of a project



**What can be done:**

- ✓ Assign realistic budget and timeline for consultants to formulate/develop DPR.
- ✓ Use technology (eg: Drones, LIDAR etc.) to enhance speed and quality of DPR completion.
- ✓ Prepare a brief project plan to narrow down to a reasonable level of detail on the project.
- ✓ Include provisions to revise DPR's in case of a huge time lapse between DPR preparation and on ground project initiation.

For detailed recommendation, refer to the Section - Enablers for Successful Project Delivery, recommendation #1 - Invest Heavily in Pre-planning and Site Investigation

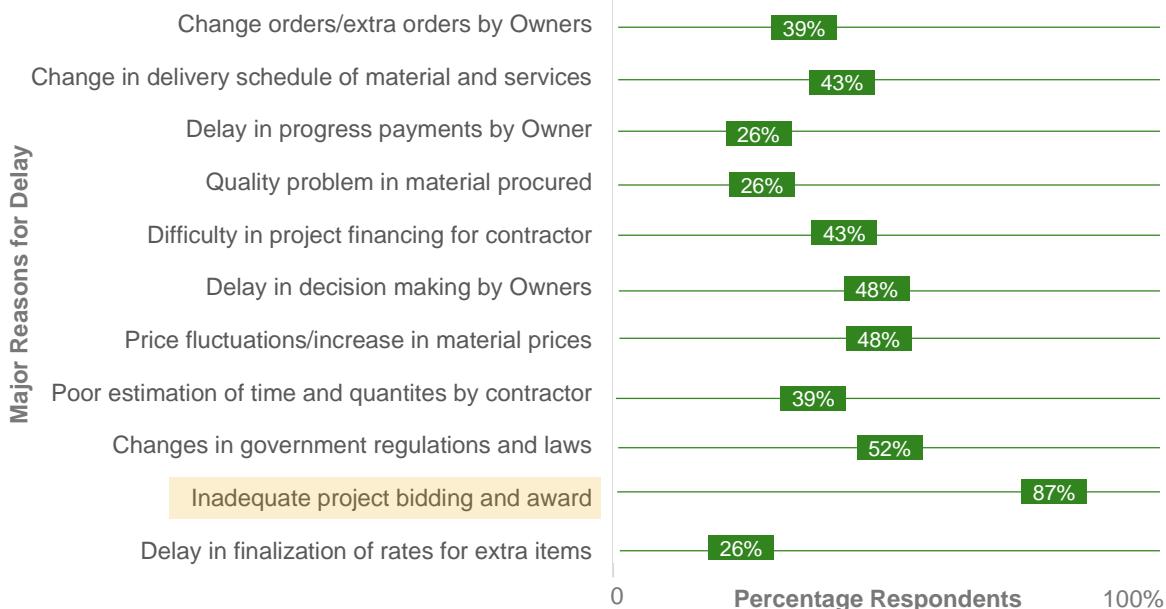
In the six laning of Panipat-Jalandhar section of NH-1, inadequate soil investigations and DPR were identified as major bottlenecks, which along with other reasons led to a delay of 47 months and ~23% of cost overrun.



For details, refer to "Case Studies" sub-section of Section 4 in this report.



# Procurement



## Inadequate project bidding and award

Contracts should include virtually every aspect of a business relation, including payment terms, pricing, and service levels expectations. Delay and cost overrun sometimes become inherent in terms of poor contractor selection, unethical practices, difference between the winning bid and second bid, difference between the winning bid and the engineer's estimate, etc. Thus, it is important to note that procurement process and contract management is critical for successful project completion. Poor selection of contractors due to unrealistic bid values and limited technical capability to handle the project will lead to cost overruns, schedule delays, poor quality, and an unacceptable outcome.

More than **85%** of interview respondents agreed that limitations on type of bidding and award to contractors acts as a major bottleneck in procurement stage of the project.



In Barh Stage- I, finalization of EPC Contractor and Non Performance of SG and TG Contractors, were identified as major factors for delay. These two, along with others led to 123 months of delay and ~ 73% cost overrun.



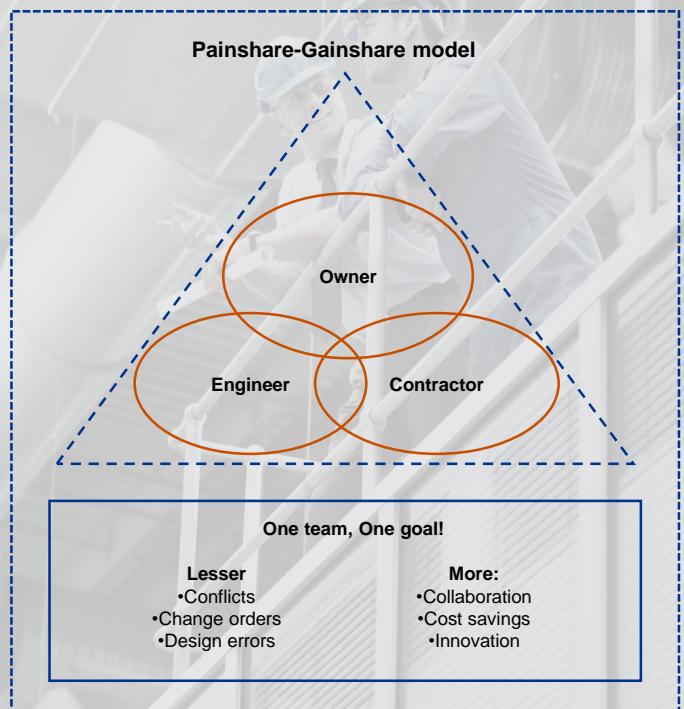
For details, refer to "Case Studies" sub-section of Section 4 in this report.

# Our Point of View

## Integrated Project Delivery (Painshare-Gainshare model)

With projects becoming large, complex, and uncertain, the traditional delivery methods are proving to be outdated and leading to claims and disputes. Implementation Agencies should gradually move to Integrated Project Delivery (IPD) methods or adopt their key attributes in the contracting structure for ensuring early involvement of downstream players (contractors, subcontractors, and consultants) to minimize the value loss.

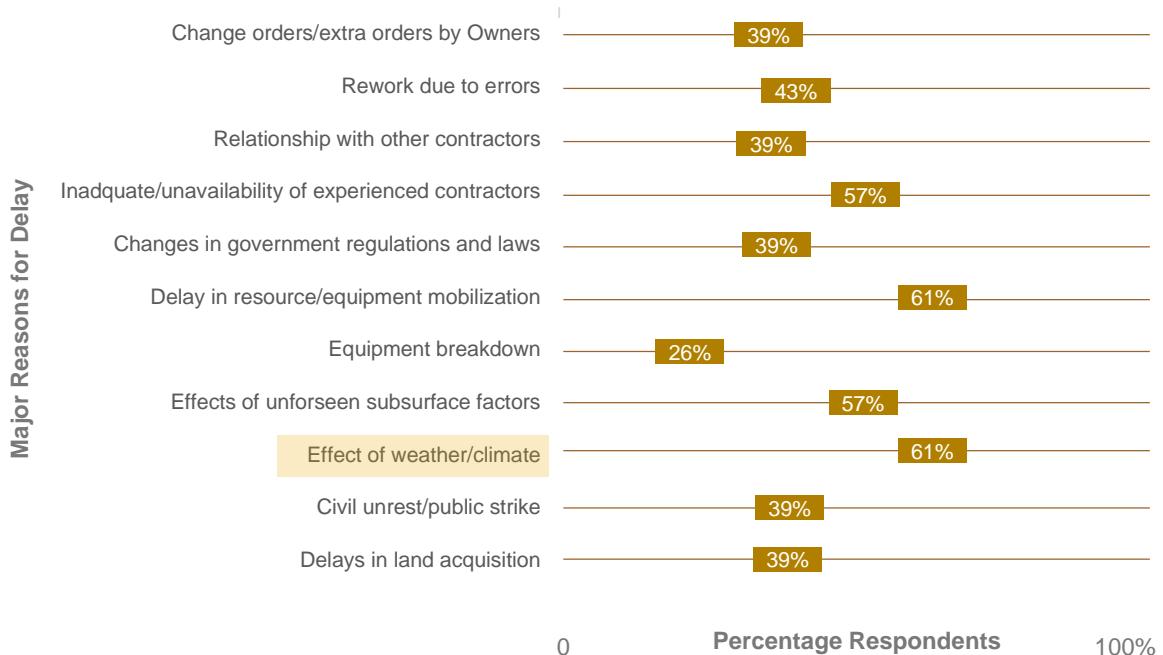
Multiple organizations in various countries such as US, UK, Canada, Chile, and UAE amongst others are following the IPD model in building projects across sectors. Globally, projects with such delivery methods have been reported to have accrued substantial savings in total budget and completed ahead of schedule.



Alliance based contracts such as 'relational contracts' have been designed to foster collaboration and achieve integrated project delivery. Such contracts apportion benefits and responsibilities based on trust and partnership between parties.

The Government and Implementation Agencies have an integral role to play in implementing such delivery methods and drive early collaboration of inter-dependent parties (owner, contractor, engineering consultants) for a common goal of project success through a single contract. It is also referred to as '**Painshare-Gainshare**' model.

# Construction and Delivery

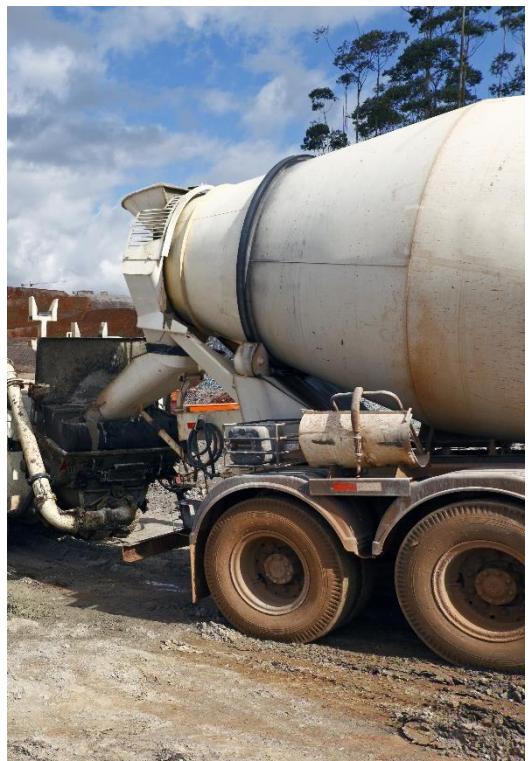


## Effect of Weather

Weather disruptions not only cause direct time loss during bad weather but some events can also cause damage to partly completed structures which could take days or weeks to repair.

Extreme temperatures could cause work to stop, or negatively impact productivity; these can be dangerous as hypothermia and heat stroke can lead to fatality. Severe storms such as hurricanes and cyclones not only cause damage to the project site, they also stop work during the event and usually impacts the project several days before/after the storm.

Rains on the other hand contribute to both time and cost delays by intermittently stopping work, causing contamination/damage to material at site and making roads impassable for long durations.



### What can be done:

- ✓ Proper planning during schedule preparation stage, keeping weather forecasts in consideration. Identify activities that may be impacted by rain, such as earthworks, and plan such activities in non-rainy season, or schedule activities such as roofing/lifting large equipment in non-windy months.
- ✓ Understand the expected weather conditions and make necessary precautions or infrastructure to deal with such conditions without impacting the productivity.

More than **60%** of interview respondents agreed that inclement weather adversely impacts construction projects.



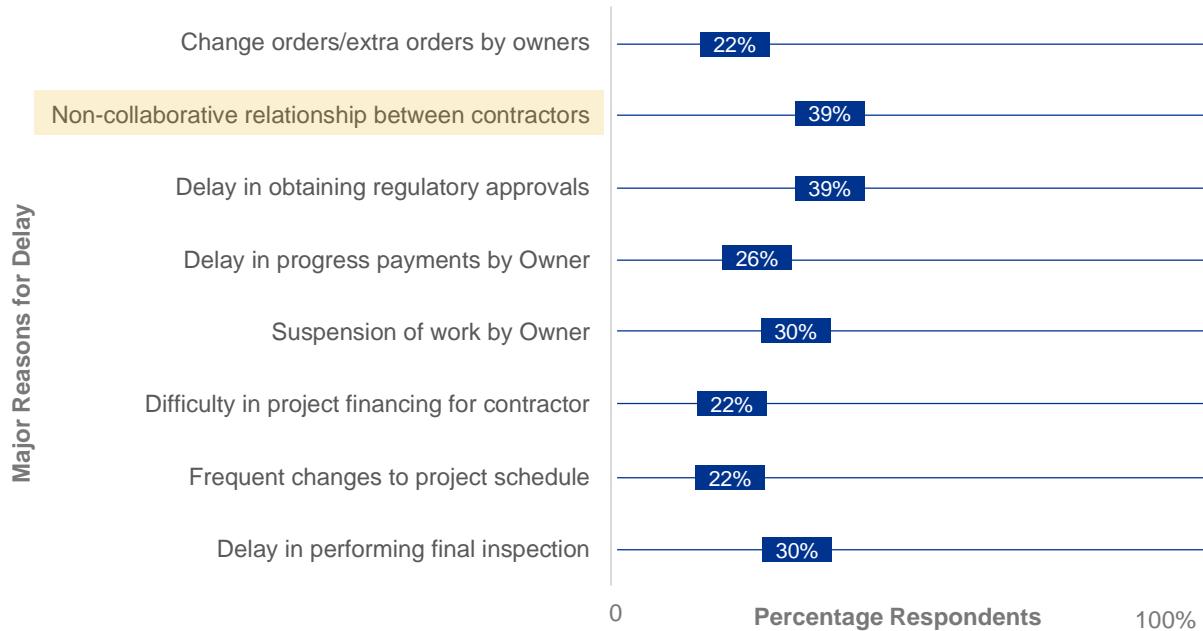
In Tapovan Vishnugad Hydroelectric project, shorter working window due to weather was a major factor for delay of 105 months with ~73% cost overrun, which could have been reduced with better planning upfront.



For details, refer to "Case Studies" sub-section of Section 4 in this report.



# Commissioning and Close-out



## Non-collaborative relationship between contractors

Being the last stage of a project life-cycle, commissioning and close out phase is often overlooked by organizations, especially in the overall chaos of commissioning the projects and making it operational. However, closure phase of a project is usually fraught with dangers of disputes leading to overruns. One key challenge during this phase is the relationship between different contractors working on the project. Contractors tend to pursue their own interests and practice a transactional approach in closing the project, which can adversely affect collaboration. Additionally, during closure, project's open points and defective works are to be attributed and that is when blame shifting arises, which needs to be avoided. Hence, it is important to properly document project records right from the start of the project and also manage the different parties effectively during the closure stage.

**39%** of interview respondents quoted relationship between contractors to be a major challenge during project commissioning and closeout phase.



### What can be done:

- ✓ Ensure that at project initiation, the scope of work is clearly defined and documented for all contractors, clearly stating out the dependencies of work and responsibilities for each contractor in order to avoid future clashes.
- ✓ Conduct periodic meetings with all contractors to enable healthy discussions on issues, work out interdependencies and challenges. This would ensure improved coordination between all contractors.
- ✓ Employ the principles of **Last Planner® System (LPS)**, that brings those who will execute work (the team) together to jointly develop an implementation plan through series of conversational processes. This would promote sense of ownership, collaboration and cordial relationship between contractors.



# Case Studies

## Insights on selected projects across five sectors

To deepen our understanding of the performance of infrastructure projects and ground level issues, we conducted select case studies of projects across five key driving sectors; roads, power, railways, civil aviation and petroleum. These projects were selected based on the magnitude of time and cost overruns. Project stakeholders across various levels, both from contractor and Implementing Agencies were interviewed and the available documentation was reviewed.

While high level recommendations have been provided for each case study, detailed recommendations and implementation measures for common issues have been documented in Section 6 which may also be referred to.



# Case Study # 1 New Airport at Pakyong, Sikkim



Case study conducted on – 13 and 14 March 2018

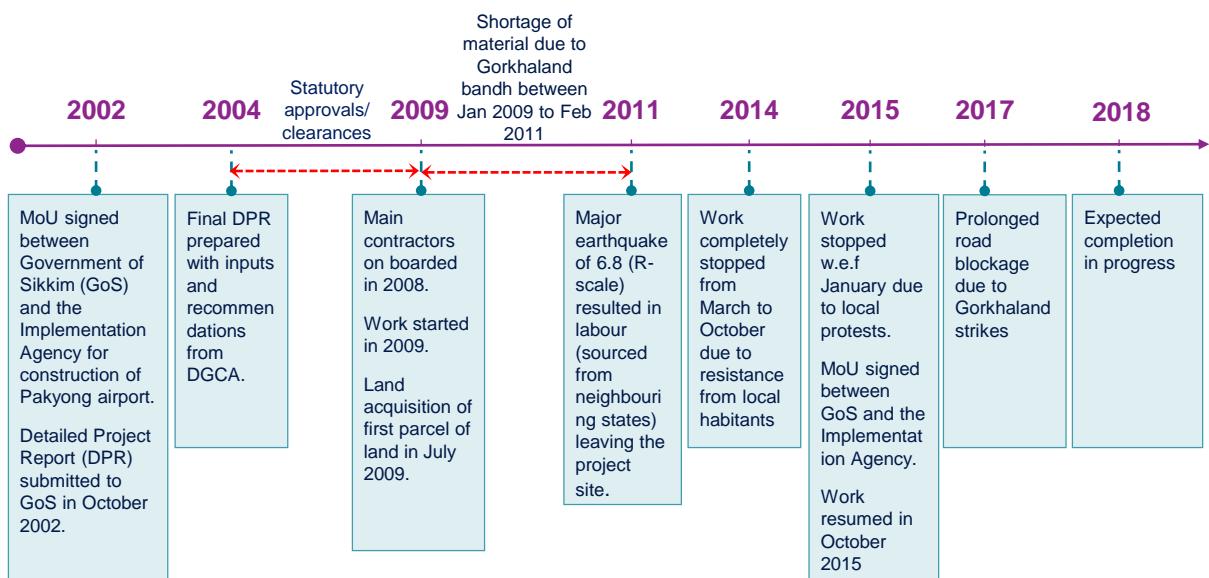
## Background

Pakyong Airport is the first airport to be constructed in the state of Sikkim in the Northeastern region of India and is amongst the very few greenfield airports in the region. The airport is spread over 400 acres and is located at Pakyong, a village 35 km south of Gangtok, which is the state capital of Sikkim. Presently the nearest airport to Sikkim is in Bagdogra (Defence Airport with Civil Enclave) and the nearest rail head is Siliguri, both in the neighboring state of West Bengal. Due to hilly terrain and weather related problems, the inroad connectivity to Sikkim from these connecting points is frequently interrupted. The road traffic is also impacted due to frequent agitation in the Gorkhaland area of West Bengal.

The project was planned to be completed within two years of project initiation. However, the main contractors, when on-boarded, revised the project timeline to five years. Further, the project ran into additional delays owing to several (uncontrollable and controllable) reasons due to internal and external factors. The revised date of completion for the project was March 2018 which was further delayed due to unavailability of clearance to operate.

Key Project Details		Project Status as on 14 Mar 2018	
<b>Location</b>	Pakyong, Sikkim	<b>Planned Completion Date</b>	14 Jan 2011
<b>Contract Delivery Model</b>	Item rate contract	<b>Anticipated/Revised Completion Date</b>	31 Mar 2018
<b>Planned Start Date</b>	14 Jan 2009	<b>Time Overrun</b>	86 months
<b>Revised Start Date</b>	29 Jan 2009	<b>Cost Original</b>	INR 309.46 crore
<b>Project Duration</b>	24 months	<b>Cost Revised/Anticipated</b>	INR 553.53 crore
<b>Project Type</b>	Greenfield Project	<b>Cost Overrun</b>	INR 244.07 crore (78.86%)
		<b>Cumulative Expenditure till date</b>	INR 531.69 crore
		<b>Physical Completion</b>	99.95%

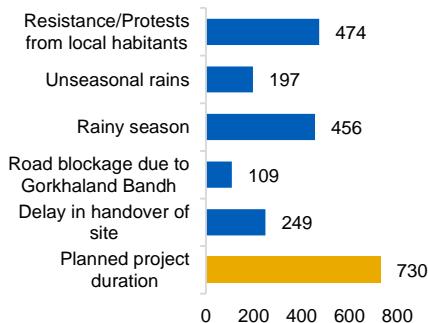
## Chronology of Events



### Major Project Components:

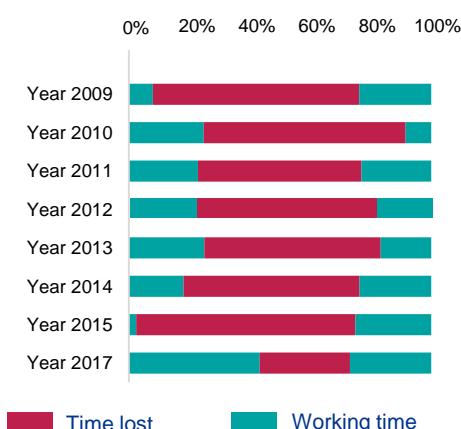
- Designed for ATR/72/500, AVW 21 tonnes
1. Cutbacks to form the airfield platform
  2. 1.7 km long North-South runway will only operate in one direction due to adjacent high hills in the flight path
  3. Apron with space for two planes
  4. Near vertical face reinforcement wall. (Maximum height - 74 meters)
  5. Terminal building (floating population - 100, staff - 50)
  6. Air Traffic Controller (ATC) tower
  7. Isolation bay for emergency
  8. DVOR - ground based radio navigational aid

**Number of project days affected (in days)**



Time overrun as on 01 March 2018 - 86 months  
(The airport was inaugurated in September 2018)

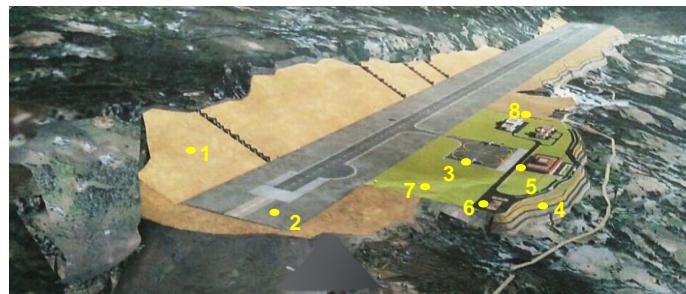
**Year-wise percentage delay in project**



\*There was not time lost (delay) in the year 2016

On an average **only 40%** of time duration per year was available for construction work

### 3D rendering of the Pakyong airport, Sikkim



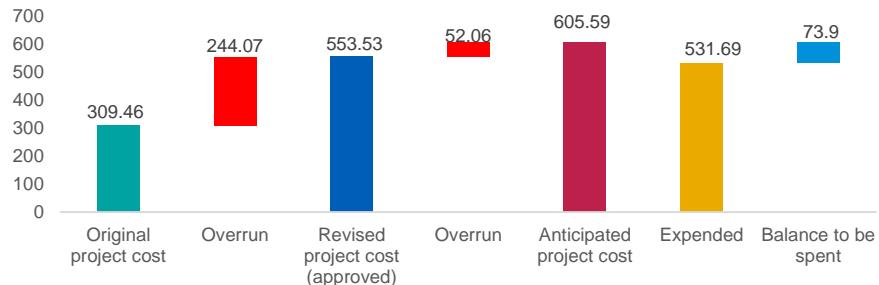
Source - Airports Authority of India

### Root Causes of Time and Cost Overrun

Controllable	Uncontrollable
<b>Local protests during execution</b>	<b>Land acquisition and local agitation at project initiation</b>
<ul style="list-style-type: none"> <li>• Implementation Agencies/contractors faced protests from local residents demanding requisite compensation for damage to their properties as a result of the shifting of the soil filling on which the airport was constructed.</li> </ul>	<ul style="list-style-type: none"> <li>• Land acquisition was a key challenge as over 147 households were to be displaced and relocated/compensated.</li> </ul>
<b>Weak labour/material management</b>	<ul style="list-style-type: none"> <li>• Major part of land was only handed over to the contractor by 05 Oct 2009 which resulted in an initial delay of eight months.</li> </ul>
<ul style="list-style-type: none"> <li>• Sourcing labour and material for the project site was a challenge due to its remote location and lack of locally available resources.</li> <li>• The project faced intermittent delays due to poor material management of diesel, geogrid and geotextile by the contractor.</li> </ul>	<ul style="list-style-type: none"> <li>• A total of 201.97 acres of land was acquired by state government in a piecemeal manner with the last parcel taken over in May 2012.</li> </ul>
<b>Project pre-planning and execution inadequacies</b>	<b>Shorter working window</b>
<ul style="list-style-type: none"> <li>• The soil testing was not done adequately. As a result, progress of pavement work was affected due to distress observed in the pavement already executed.</li> <li>• The DPR clearly specified the required clearance for runway is 75 meters on either side of the centerline. However, the clearance is as less as 48 meters at one point on the length of runway.</li> </ul>	<ul style="list-style-type: none"> <li>• The region has extended rainy season from April to October, that is approximately seven months. This leaves a very short working window.</li> <li>• Unseasonal rains, which is a common phenomenon in the region, compounded the problem.</li> </ul>
<b>Gorkhaland Bandh</b>	
	<ul style="list-style-type: none"> <li>• Shortage of diesel and other essential construction material for over 21 months due to intermittent closure of NH31A, the main route for supply of materials, due to Gorkhaland bandh.</li> </ul>

## Cost overruns in the project

**Project cost summary (in crore) as on 01 March 2018**

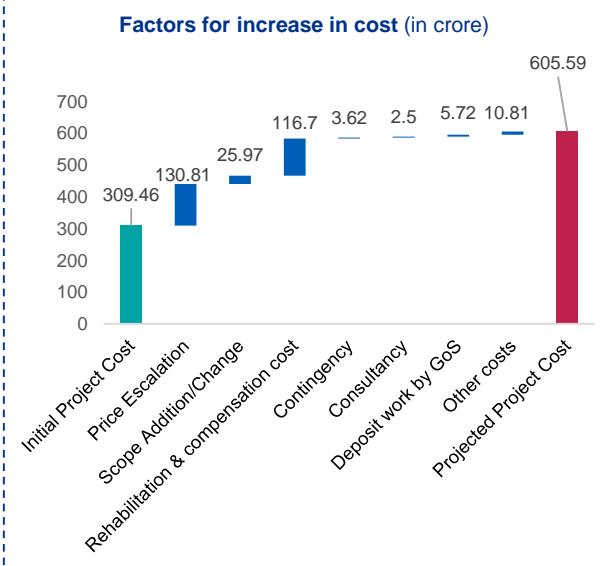


The original project cost estimated by the Implementation Agency at project initiation was INR 309.46 crore which was revised to INR 553.53 crore. Additionally, the Implementation Agency incurred rehabilitation and compensation costs that were not accounted for in the initial project cost. Subsequently, the total projected cost is INR 605.59 crore, which is an increase of approximately 95% of the original project cost. This cost overrun can be attributed mainly to the following reasons:

- **Price escalation** – the preliminary project estimates included a price escalation factor with 24 months of project duration as consideration. The project got delayed by over 86 months.
- **Engineering inadequacies (escalation in civil and electrical works) and scope change/addition** – The project work involved heavy earthwork in cutting and filling and construction of retaining wall up to a height of 74 meters using a unique construction technology called MSE or RE wall technology . The filling was carried out in layers with time allowed for each layer to settle and consolidate.

However, adequate time was not provided for soil settlement, that resulted in visible cracks in the executed pavement works. This required a remedial action for reinforcing the pavement works, that led to cost implications on the project.

- In addition, soil nailing work at uphill side has been suggested as a corrective measure to hold the unstable earth on slope. This work was not included in the initial scope due to lack of proper soil tests conducted to assess soil stability.
- **Rehabilitation and compensation cost** – While rehabilitation cost for habitants relocated during land acquisition was accounted for, rehabilitation and compensation cost increased as a result of extensive damage to existing properties in the area surrounding the project site.



North-west view of the runway

Project site pictures



South view of the runway

## Recommendations

### Project Pre-planning

- Adequate time and efforts should be invested in project pre-planning and pre-development activities such as site investigation, surveys and tests especially for a project involving complex site conditions and high probability of geological surprises. In addition, consultants appointed for preparation of DPR and conducting site evaluation/surveys should be evaluated in detail for their prior experience, use of technology, and other capability parameters during their selection, in order to avoid suboptimal quality of such studies.

### Procurement and Contracts

- Globally, FIDIC contracts are widely acceptable standard forms of contract known for their balanced approach to the roles and responsibilities of the main parties, as well as the allocation and management of risk. The Implementation Agency may consider modifying their approach to prepare model contracts in alignment with suitable international standards such as FIDIC or other similar contracts.

### Project Organization and Governance

- Project monitoring and implementation teams should be adequately staffed with highly skilled and specialized professionals, especially for projects involving complex site conditions and exposure to project delays.
- The scope of work of PMC should be comprehensive and well defined. The scope of PMC on this project was only limited to engineering consultancy and not project monitoring. The PMC eventually stopped providing its services in 2016.

### Planning and Monitoring

- While the target duration of the project was originally set, the contractor's assessment for same may be taken into consideration to avoid overruns at later stage of the project. This can be done both at pre-bid stage and contract finalization stage.
- The Implementation Agency may introduce a project management information system (PMIS) for complex projects of such scale to timely monitor work, assess risks and develop mitigation plans.

Detailed Recommendations to be referred in Section-6



- ✓ Invest Heavily in Pre-planning and Site Investigation
- ✓ Collaborative and Agile Planning
- ✓ Reforming Procurement and Strengthening Contracts Management
- ✓ Establishing a Robust Project Governance

**Despite the challenges stated above, the airport has been successfully inaugurated on 24 September 2018 by the Hon'ble Prime Minister of India.**



## Case Study # 2 New Terminal Building at Civil Enclave, Goa

Case study conducted on – 11 April 2018

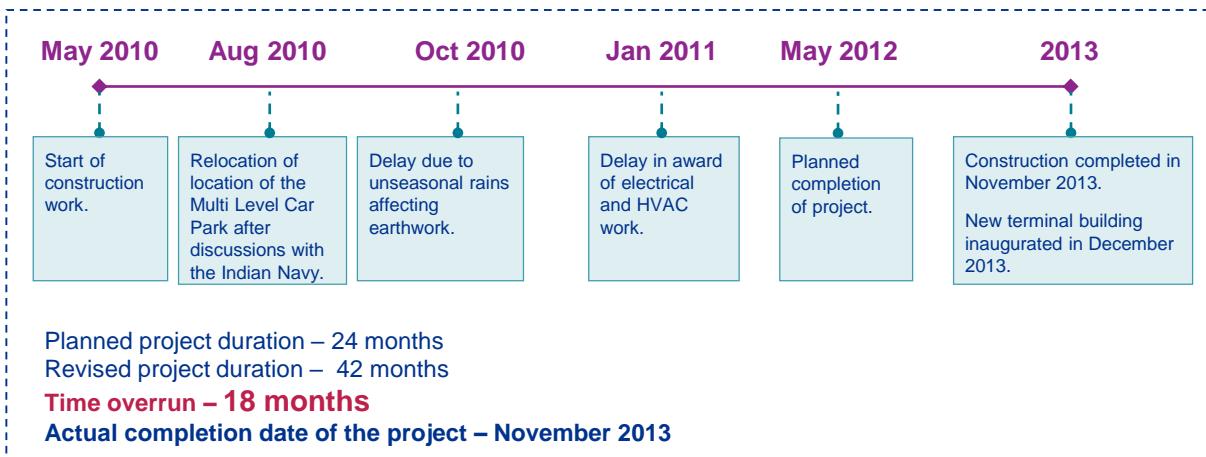
### Background

The Dabolim Airport, located in Dabolim, 30 km from the state capital of Panjim, is the sole airport in the state of Goa, that handles both domestic and international passengers. It operates as a civil enclave in a military airbase, INS Hansa. Before the revamp, the airport was built over an area of 249 acres. Due to high traffic witnessed at the airport, the Ministry of Civil Aviation planned to upgrade the existing airport with a new integrated terminal building and multi-level car park enabled with improved flight information display systems, information technology infrastructure and upgraded services spread over an area of 9.9 acres.

The project was planned to be completed in two years at commencement. However, due to delays attributable to inadequate planning and execution, and heavy monsoon in the first year, the project timeline was pushed out by three months with a revised completion date of 31 Aug 2012. Subsequently, the project suffered a time overrun of 15 months and the airport was finally opened up in December 2013.

Key Project Details		Project Status as on 11 Apr 2018	
<b>Location</b>	Dabolim, Goa	<b>Planned Completion Date</b>	15 May 2012
<b>Contract Delivery Model</b>	Item rate Contract	<b>Final Completion Date</b>	Nov 2013
<b>Project Start Date</b>	16 May 2010	<b>Time Overrun</b>	18 months
<b>Project Duration</b>	24 months	<b>Cost Original</b>	INR 335 crore
<b>Type of Project</b>	Brownfield Project	<b>Cost Revised/Anticipated</b>	INR 388.53 crore
<b>Major Project Components</b>	Terminal Building, Multi Level Car Park (MLCP)	<b>Cost Overrun</b>	INR 53.83 crore/15.97%
		<b>Cumulative Expenditure till date</b>	Information not available
		<b>No. of Milestones Achieved/Target</b>	All milestones achieved
		<b>Physical Completion</b>	100%

### Chronology of events



### Major Project Components:

1. New integrated terminal building
2. Multi level car park
3. Connecting corridor of aerobridges
4. Relocation of cargo and underground sumps
5. Flight Information Display Systems (FIDS)
6. CCTV Installation
7. Designed to handle over 2,750 passengers at peak hour.

### 3D rendering of the NITB, Goa



Source - Airports Authority of India

### Root Causes of Time and Cost Overrun

#### Controllable

##### **Weak labour management**

- There was shortage of labour at site for civil and MEP works on account of ineffective resource planning by the general contractor.

##### **Procurement coordination issues**

- The project procurement process was carried out from the Implementation Agency's head office, and there were coordination issues between teams at site and head office. Gaps in procurement planning and weak coordination between the two teams led to project delays.

##### **Inadequate planning and execution**

- Soil testing was not done adequately as the soil actually found on site was quite different from the soil characteristics predicted in the study.
- Inadequate planning of the project also led to shortage of steel at the site which delayed civil works.

##### **Change of Scope**

- Addition of west side finger that was not a part of the original scope led to time overrun and cost escalation.

#### Uncontrollable

##### **Heavy unseasonal rainfall**

- Heavy rainfall continued from June 2010 till the first week of December 2010. This was more than the regular duration of monsoon period.
- Heavy rainfall affected the earthworks as the work could not resume till January 2011.

##### **Delay in approvals**

- There was a delay in approval from the competent authority for roads and highways for joining the airport approach road to NH-17

#### Project site picture demonstrating excessive water-logging on site due to heavy unseasonal rainfall



## Cost overruns in the Project

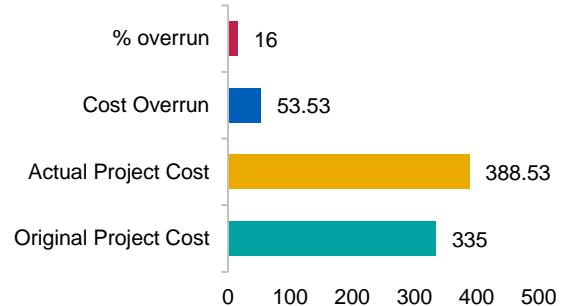
The original project cost estimated by the Implementation Agency at project initiation was INR 335 crore which was revised to INR 388 crore. The project incurred a cost overrun of approximately INR 53 crore, which can be attributed mainly to the following reasons:

- Price escalation** – Due to the delay of 18-month delay, there was an escalation of prices for material and manpower to the tune of INR 15.24 crore.
- Change of Scope** – The addition of the west side finger that was not in the original scope of the project led to an addition of INR 43.27 crore to the original project cost.

## Recommendations

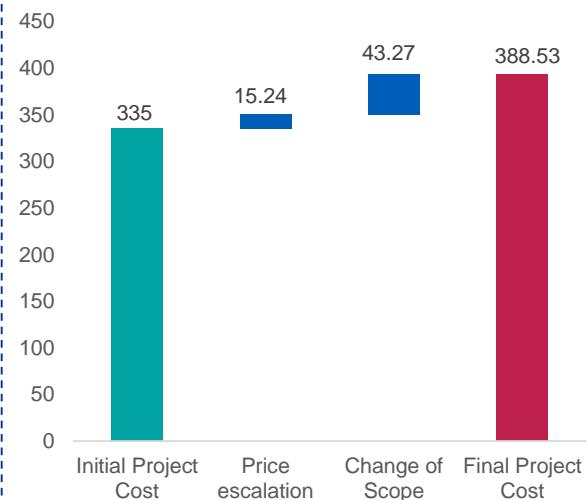
- Change in scope, if any should be planned out in detail and with approval of all the project stakeholders, with appropriate time and cost considerations incorporated into the project baselines.
- Improved coordination between the various bodies such as the Navy, State Government, the Implementation Agency and the competent authority for roads and highways would have expedited the project completion by reducing delays in hand over of land, land acquisition and gaining approval for connection of the approach road with the national highway.

**Project Cost Summary (in INR crore)**  
as on November 2013 (project completion)



**Cost overrun - 16% of original project cost**

**Factors for increase in cost (in crore)**



Detailed Recommendations to be referred in Section-6



- ✓ Collaborative and Agile Planning
- ✓ Deepen Stakeholder Management for Land Acquisition and Regulatory Approvals

# Case Study # 3 Barh Stage I, Patna, Bihar



Case study conducted on – 13 and 14 March 2018

## Background

The Implementation Agency is in the process of setting up the second supercritical thermal power station - Barh Stage I. Spread over 3,196 acres in Patna district of Bihar. The project's foundation stone was laid in March 1999. The planned capacity for Stage I is 1980 MW, with three units of 660 MW each. The coal is sourced from Amrapali block in North Karanpura Coalfields and water for plant operations is sourced from the Ganges. The project has been financed with a Debt-Equity ratio of 70:30 and it is currently under execution.

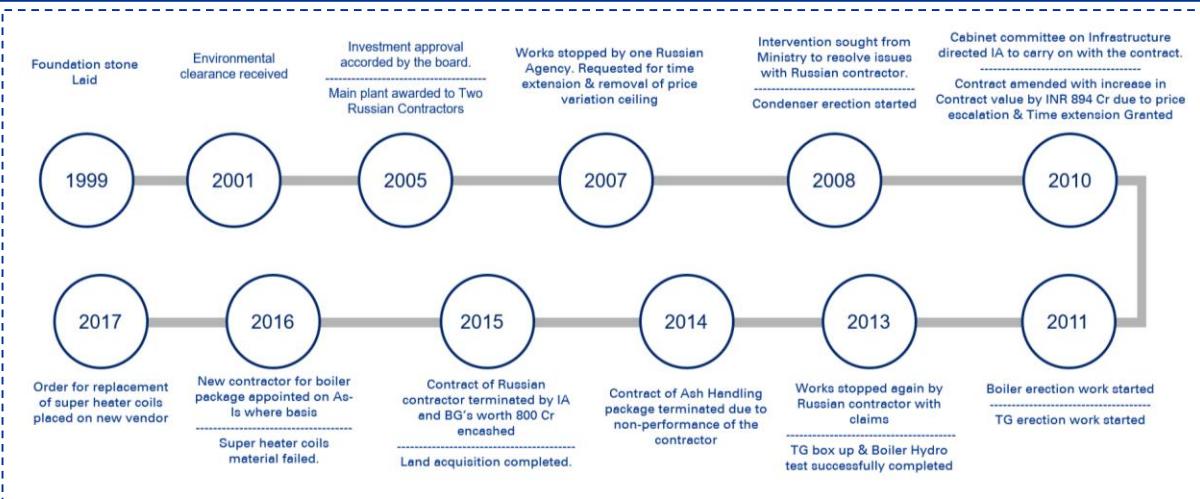
Few key attributes of the project are:

- The project was approved under the Mega Power project policy
- The plant has been divided in 43 packages as Split Package philosophy was finalized for project execution
- Main plant equipment was sourced from Russian companies.

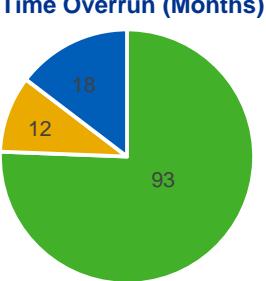
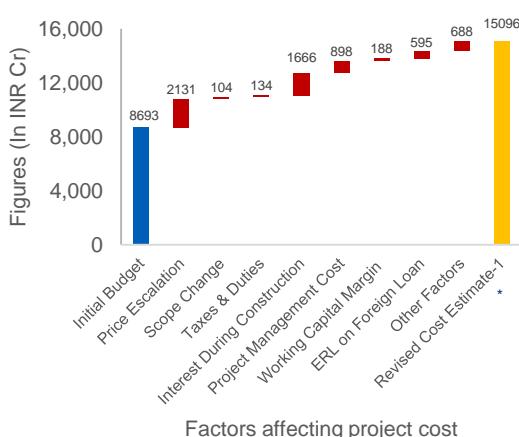
Key Project Details		Project Status as on 14 Mar 2018	
<b>Location</b>	Barh, Patna, Bihar	<b>Planned Completion Date</b>	January 2011
<b>Contract Delivery Model</b>	EPC (Split Package Mode)	<b>Anticipated/Revised Completion Date</b>	April 2021
<b>Project Start Date</b>	14 Mar 2005	<b>Time Overrun</b>	123 months
<b>Revised Start Date</b>	Not applicable	<b>Cost Original</b>	INR 8,693 crore
<b>Project Duration</b>	70 months	<b>Cost Revised/Anticipated</b>	INR 15,096 crore <sup>1</sup>
<b>Type of Project</b>	Greenfield	<b>Cost Overrun (in crore and %)</b>	INR 6,403 crore and 73.6%
<b>Major Project Components</b>	Boiler, turbine, generator and balance of plants	<b>Cumulative Expenditure till date</b>	INR 14,154 crore (Till Jan 2018)
		<b>No. of Milestones (Achieved/Target)</b>	5/11
		<b>Physical Completion</b>	-

1. As per the last approved budget in Dec 2015. Likely to go up further.

## Chronology of events



## Root Causes of Time and Cost Overrun

Controllable	Uncontrollable																														
<b>Non performance by Steam Generator (SG) and Turbine Generator (TG) Contractor</b> From project initiation, there were contractor delays due to request for changes to the contract terms. Despite provision of price variation in the contract, contractors demanded removal of upper limit (capped at 20%), contract price revision and time extension. Due to delays in engineering and supplies of SG package, several balance of plant packages were also affected as proper inputs were not being provided to the vendors. Post several discussions and contract amendments, the contract was terminated in Jan '15 on account of non performance. The project timeline was affected by 93 months and incurred a cost overrun of INR 2,131 crore.	<b>Implementation of Goods and Services Tax (GST)</b> The project was accorded the Mega project status by the Ministry of Power. Benefits of the Mega project status were "Nil" excise duty and customs duty. Subsequent to the implementation of GST, all the benefits of mega projects were subsumed under the new law. Any supplies made after 01 Jul 2017 were taxed under the new law. Due to this there was a slowdown in supplies from July 2017 to September 2017, as no vendor agreed to bear the taxes. However, the Implementation Agency provided a window period to all vendors to supply the balance material by March 2018. During this period, all taxes and duties were borne by the Implementation Agency.																														
<b>Re- award of boiler package</b> After termination of boiler contract, the Implementation Agency decided to award the package to boiler OEM on As-Is-Where-Is basis and discussions were initiated with various contractors. However, due to unique design and related issues, the complete process of re-award of the boiler package took more than one year to complete.																															
<b>Material failure</b> The hydro test for boiler Unit #1 was successfully completed by the boiler contractor in February 2013. However, post re-award, several leakages were observed in the superheater during the Hydro Test in April 2017. Investigations revealed that defective material was used in the superheater. Subsequently, a new contract for supply and installation of superheater was placed with another supplier with a delivery period of 18 months for the 1 <sup>st</sup> unit. Hence, the overall impact of failure of material resulted in a delay of 18 months, though the procurement from other manufacturer might have led to savings for the Implementation Agency.																															
<b>Land acquisition</b> The Implementation Agency faced challenges in acquiring land for the project during pre-development and development phase. At the time of main plant's EPC contract award, only 50% of land was acquired. 95% of land was acquired by Aug-07 (29 months from the zero date). The entire process of land acquisition was completed in 2015.	<p><b>Time Overrun (Months)</b></p>  <table border="1"> <thead> <tr> <th>Category</th> <th>Value (Months)</th> </tr> </thead> <tbody> <tr> <td>Delay due to non performance of contractors</td> <td>93</td> </tr> <tr> <td>Delay due to re-award of boiler package</td> <td>12</td> </tr> <tr> <td>Delay due to material failure</td> <td>18</td> </tr> </tbody> </table> <p><b>Cost Overrun (INR crore)</b></p>  <table border="1"> <thead> <tr> <th>Factor</th> <th>Value (INR crore)</th> </tr> </thead> <tbody> <tr> <td>Initial Budget</td> <td>8693</td> </tr> <tr> <td>Price Escalation</td> <td>2131</td> </tr> <tr> <td>Scope Change</td> <td>104</td> </tr> <tr> <td>Taxes &amp; Duties</td> <td>134</td> </tr> <tr> <td>Interest During Construction</td> <td>1666</td> </tr> <tr> <td>Project Management Cost</td> <td>898</td> </tr> <tr> <td>Working Capital Margin</td> <td>188</td> </tr> <tr> <td>ERL on Foreign Loan</td> <td>595</td> </tr> <tr> <td>Other Factors</td> <td>688</td> </tr> <tr> <td>Revised Cost Estimate-1*</td> <td>15096</td> </tr> </tbody> </table> <p>Total revenue loss due to delay- INR 29,733 crore Total profit loss due to delay- INR 3,661 crore</p> <p>* Revised Cost Estimate-1: calculated in Dec'15 considering costs (including IDC) upto FY'17</p>	Category	Value (Months)	Delay due to non performance of contractors	93	Delay due to re-award of boiler package	12	Delay due to material failure	18	Factor	Value (INR crore)	Initial Budget	8693	Price Escalation	2131	Scope Change	104	Taxes & Duties	134	Interest During Construction	1666	Project Management Cost	898	Working Capital Margin	188	ERL on Foreign Loan	595	Other Factors	688	Revised Cost Estimate-1*	15096
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## Challenges going forward

Revised cost estimate was prepared in December 2015. However, the project is likely to be commissioned by April 2021. Hence, the development cost of the project will further increase due to the following factors:

### **Implementation of Goods and Services Tax**

Post the window period (Mar-2018) for supply of material provided to all the vendors, all taxes and duties will be borne by the vendors. Thus, an increase in cost of material and services will be incurred by the Implementation Agency.

### **Extra Claims**

Due to delays in providing inputs for engineering fronts at site and taking over of packages, several Balance of Plant package vendors have put up extra claims. The aggregate value of claims is INR 229 crore. Apart from extra claims, some vendors have also requested the Implementation Agency to foreclose the contract.

Reasons given by vendors are as follows:

- i. Reimbursement of servicing or repair of equipment already supplied but not erected
- ii. Reimbursement of servicing or repair of equipment erected but not made operational.
- iii. Reimbursement of BG and insurance charges
- iv. Overstay or idling charges

### **Installation of Flue Gas Desulphurizer**

As per the Ministry of Environment, Forest and Clearance notification dated December 2015, it is mandatory for all coal based power plants under construction to install Flue Gas Desulphurizer before declaration of commercial operation. This is likely to impact the overall project budget and timeline.

### **Zero Discharge**

As per the environmental policy all power plants are required to comply with zero discharge norms. To meet this criteria, the Implementation Agency will need to install ETP and STP, which will add to overall project cost and time.

**Sanctions on Russian Vendors:** In January 2018, the U.S. Department of Treasury announced sanctions on the TG package supplier. This unforeseen event impacted the project.

Supplies of Unit#1 are nearly complete except for few electrical and Cndl equipment but for Unit #2 and 3, some supplies are still pending. The supplier has submitted the proposal for resolution, and it is under review by the Implementation Agency.

**Warranty Issues:** Generally the warranty period of equipment/system is 12 months from the date of commercial operational declaration or 18 months from successful completion of facilities. Due to delays in project, few contractors have raised concerns for not extending the warranty.



## Proactive Actions taken by the Implementation Agency

- **Target to reduce the phase gap** - Although the phase gap between units is six months, the Implementation Agency is internally trying to reduce the commissioning phase gap to two months. This will help reduce the project timeline by eight months
- The Implementation Agency has formed a senior level committee to examine the claims and make recommendations to settle the claims.

## Recommendations

1. **A contractual framework** for managing defaults by international contractors and triggering contract termination should be prepared in consultation with the Central government, in order to prevent the issues which were faced in Barh project.
2. **Project Schedule Management:** An integrated L2 schedule was prepared at the start of the project which is not updated regularly. The process of regularly updating the schedule should be incorporated for critical path monitoring.
3. **Risk Management:** A formal Risk Management Process should be adopted where a Risk Manager is assigned to each project. This will enable proactive identification of risks and provide opportunity for early action.
4. **Lessons learned:** A lessons learnt repository should be created and updated. The repository shall capture all the learnings from the project. This will help in mitigating similar issues, if faced in future.
5. **FGD Timeline compression:** A reduction in the installation timeline for FGD should be planned. Currently, as per tender, it is 33 months from the date of award for the first unit and, with a phase gap of six months for subsequent units. As per these timelines, the schedule for Stage I is expected to be pushed further.

Detailed Recommendations to be referred in Section-6



- ✓ Collaborative and Agile Planning
- ✓ Embedding a Culture of Risk Management
- ✓ Reforming Procurement and Strengthening Contracts Management
- ✓ Establishing a Robust Project Governance Structure



# Case Study # 4 Tapovan Vishnugad Hydro Power Project, Uttarakhand

Case study conducted on – 12 to 15 March 2018

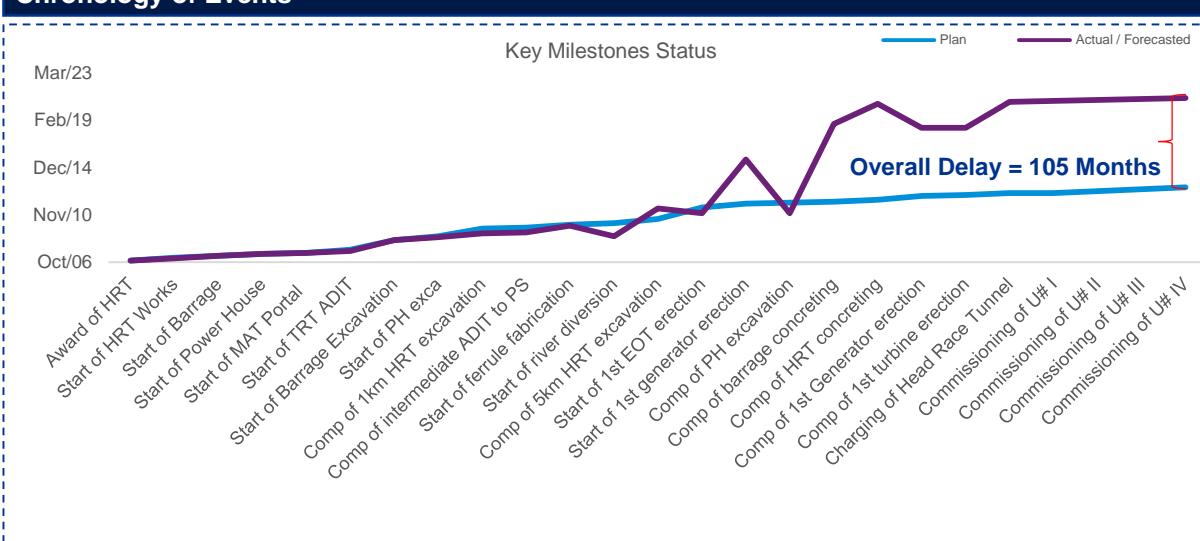
## Background

The proposed Tapovan Vishnugad Hydroelectric Project is a run-of-river scheme. Barrage of the project is located on Dhauliganga while the tail race tunnel is on Alaknanda. The project involves construction of Barrage, Intake, Desilting System, HRT, ADITs, Power House, GIS, Surge Shaft and Pressure Shaft. A maximum gross head of 494 m is proposed to be utilized to generate 2558 GWH of energy, in a 90% dependable year with an installed capacity of 4x130 MW.

Implementation agreement for this project was signed with Uttarakhand Government on 23 June 2004 and investment approval was received on 16 Nov 2006. Major project packages were awarded till June 2007 and project works were expected to start from February 2007 while commissioning of first unit was planned to be achieved in Sep 2012. The project faced severe delays in most of the packages, however delay in HRT, Barrage and Desilting System has pushed commissioning of first unit to September 2020, leading to an overall delay of eight years.

Key Project Details		Project Status as on 15 Mar 2018	
<b>Location</b>	Joshimath, Uttarakhand	<b>Planned Completion Date</b>	March 2013
<b>Contract Delivery Model</b>	Unit Price Contract	<b>Anticipated/Revised Completion Date</b>	December 2020
<b>Project Start</b>	November 2006	<b>Time Overrun</b>	105 months
<b>Revised Start Date</b>	-	<b>Cost Original</b>	INR 2978.48 crore
<b>Project Duration</b>	77 months	<b>Cost Revised/Anticipated</b>	INR 5,154.94 crore
<b>Types of Project</b>	Greenfield	<b>Cost Overrun</b>	INR 2,176.47 crore / 73%
<b>Major Project Components</b>	Barrage, HRT, Adit, Power House, Desilting, GIS, SS and PS	<b>Cumulative Expenditure till date</b>	INR 3,387 crore
		<b>No. of Milestones Achieved/Target</b>	19/31
		<b>Physical completion</b>	70%

## Chronology of Events



## Root Causes of Time and Cost Overrun

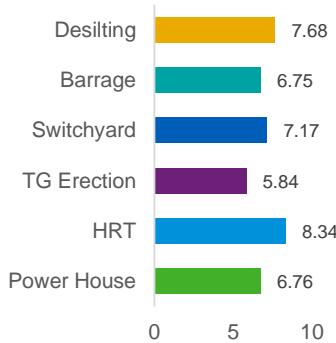
### Controllable

#### Geology Investigation

Geology investigation is carried out to select the layout of Hydro project, which limits geological surprises in open and underground works during execution. As per the guidelines of CWC - *"Drill holes one at each of the portal and adit sites and additional at-least one every 1-5 km interval depending upon the length of the tunnel, was required"*. This means minimum six holes (3 for adits and 3 for HRT) were required, however in Tapovan Vishnugad, only 4 holes were drilled during the investigation stage. Geophysical Profiler or Magnetotelluric method or any other suitable method could have been used for seismic survey, which would have provided better geological information. The difference between geological details provided in the contract and actual conditions encountered is one of the many reasons mentioned by the main contractor in the arbitration.

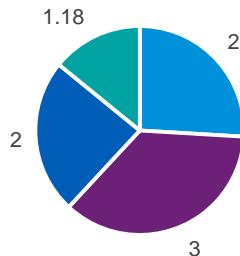
#### Project Delay Analysis

##### Package Wise Delay (in years)



#### Delay analysis of critical path

##### Delay Analysis for HRT (in months)



- Delay in re-award of works
- Delays for poor geology
- Non Performance of Contractors
- Other factors

#### Selection and termination of vendors due to non performance

The first contract was awarded for HRT package in November 2006, however, only 63% (7652/12088m) of tunneling works was excavated till January 2014, and three major halts (36 months) were encountered due to poor geology. From 2012 to 2014, no substantial works were carried out, which led to the termination of contract in January 2014. The package was re-awarded to another contractor in Mar 2016. As HRT was on project critical path, this impacted the project schedule by 26 months.

#### Non performance of contractors

After the re-award of HRT works for balance 37% works, the contractor finalized its contract with sub-contractor (TBM operating contractor) in November 2016, but the TBM spare parts were not ordered till December 2017. As per schedule, the contractor should have been ready with TBM within 12 months of contract award but there was a delay of more than 18 months. Vendor is currently executing the DBM portion but the work has not started on all fronts.

Due to poor financial condition of two major contractors, the bulk procurement could not get completed for construction material such as cement, steel and other items. This restricted them to take up available parallel fronts.

### Uncontrollable

#### Impact of 2012 and 2013 floods

Unprecedented floods in August 2012 and June 2013 resulted in cofferdam washout and hence the project lost two working seasons in barrage and desilting chambers.

## Recommendations

### **Project organization**

- For underground works, completion of tunnel in right alignment plays an important role, and requires a professional survey team. However, in case of Tapovan Vishnugad project, there is no independent survey agency and the Implementation Agency relied on the survey by contractors. It is recommended to have an in-house team for the same. Calibrated instruments and specialized survey team not only ensure proper alignment of structures but also bring accuracy in quantity surveying for item rate contracts.

### **Approval cycle for additional items**

- Cycle time for approval of additional items is generally 3 to 4 months which adversely impacts the performance of financially weak contractors. A system for faster approval and payment of such items should be established.

### **Procurement and contract management**

- Selection of contractors entirely on L1 basis needs to be replaced by a rating method. Each bidder should be rated based on the aggregated sum of different aspects such as financial condition, past performance, technical know how, risk bearing capacity and effective management of local issues.
- Provisions for capping of idling claims and arbitration values in contracts may also be explored to limit the risk of increased project cost.
- Profit sharing (during early commissioned period of project) with contractors should be explored in the main contract. Such incentives motivate contractors for timely completion.

### **Effective planning and control**

- For schedule management and critical path monitoring, L2 integrated schedule should be updated regularly and packages on critical path should be regularly monitored.
- Risk management—Although the Implementation Agency performs risk management, a structured framework is required for the same.
- Earned value analysis—Time and cost work streams should be evaluated in conjunction with earned value analysis. Updated S-Curves should be incorporated in management reports also.

### Detailed Recommendations to be referred in Section-6



- ✓ Invest Heavily in Pre-planning and Site Investigation
- ✓ Collaborative and Agile Planning
- ✓ Augmenting Organizational Skillsets
- ✓ Reforming Procurement and Strengthening Contracts Management



# Case Study # 5 Six Laning of Panipat-Jalandhar section

Case study conducted on – 13 and 14 March 2018

## Background

The six laning of the existing four lane, 291.1 km long Panipat-Jalandhar section of NH 1 (old numbering) from km 096+000 to 387+100 in Haryana and Punjab was taken up as a Public Private Partnership project in 2008 and awarded to an Indo-Spanish joint venture. At present, the project is on the verge of achieving final completion after receiving provisional completion in Sep 2015. The Concessionaire began widening works after taking over the existing toll plazas on the entire project stretch on appointed date and began collecting and sharing toll revenues (20.14% - 1% YoY increase) with the Implementation Agency as per the terms of the Concession. The project ran into delays due to various reasons, especially due to shifting of toll plazas and lack of available work-front. In mid 2013, a Punjab and Haryana High court order regarding the project delay resulted in an impasse between the Concessionaire and the Implementation Agency till the Supreme Court overruled the High Court order and paved the way for resumption of works in 2014. The project then witnessed works being taken up in the available Right of Way (RoW). However, there still remain certain stretches where the Implementation Agency is yet to handover 5.9 Ha of RoW to the Concessionaire. There also remain certain major works under the Change of Scope (CoS).

Key Project Details		Project Status as on 14 Mar 2018	
<b>Location</b>	Haryana and Punjab	<b>Planned Completion Date</b>	09 Nov 2011
<b>Type of Project</b>	Brownfield	<b>Time Overrun</b>	47 months
<b>Major Project Components</b>	Flyovers, Underpasses, Bridges	<b>Anticipated Final Completion</b>	30 Apr 2018
<b>Contract Delivery Model</b>	PPP – DBFOT (Toll)	<b>Cost Original</b>	INR 4,517.93 crore
<b>Project Start and End Date</b>	11 May 2009 and 10 May 2024	<b>Cost Revised/Anticipated</b>	INR 5,572.55 crore
<b>Project Duration</b>	30 months	<b>Cost Overrun – Concessionaire</b>	INR 1,054.62 crore (23.34%)
<b>Concession Period</b>	15 years	<b>Cost Overrun – Authority</b>	INR 971.164 (CoS)
<b>Commissioning Date</b>	30 Sep 2015	<b>Cumulative Expenditure</b>	INR 5,572.55 crore
		<b>Milestones Achieved/Targets</b>	4/4
		<b>Physical completion</b>	95.75%



		Root Causes of Time and Cost Overrun																
		Controllable	Uncontrollable															
<b>Days elapsed since project start</b>		<p><b>Land Acquisition and Utility Shifting</b></p> <ul style="list-style-type: none"> <li>Delays in the acquisition of land including the shifting of structures in the proposed RoW, especially the 40 army assets between the Rama Mandi and PAP Chowk stretch, led to delay in commencement of works till April 2016.</li> <li>Similar delays were observed due to shifting of electric poles, BSNL cables and sewers which were all found lying within the RoW. Till February 2018, 1859.1 Ha out of the required 1865 Ha has been acquired.</li> </ul>	<p><b>Bank interest rate inflation</b></p> <ul style="list-style-type: none"> <li>This led to interest during construction (IDC) overrun.</li> </ul>															
<p>Today 31-Mar-2018</p>		<p><b>Escalation in Market Prices of all Major Construction Materials</b></p> <ul style="list-style-type: none"> <li>Price escalation for materials such as Steel, Cement, Bitumen and Diesel for most of the construction phase, especially in the 2011-2013 period.</li> </ul>	<p><b>Judicial processes</b></p> <ul style="list-style-type: none"> <li>Case related to the 2013 Punjab and Haryana High Court order directing the Implementation Agency to take over the project because of the project missing the extended completion deadline led to a stoppage of works for a period of over 9 months.</li> <li>The Concessionaire appealed against the HC order in the Supreme Court, which in April 2014 overruled the HC order and also directed the Implementation Agency to permit the Concessionaire to shift the existing toll plazas and collect toll therefrom. This not only resulted in delay in construction of the new toll plazas but also led to an opportunity loss of toll revenues for the Concessionaire from the new locations.</li> </ul>															
<b>Change of scope works (in INR crore)</b>		<p><b>Scope Creep</b></p> <ul style="list-style-type: none"> <li>There were certain structures that were required at specific project locations but were not proposed in the Detailed Project Report (DPR) prepared by the Consultant, and therefore were absent from the original scope mentioned in the tender documents.</li> <li>These structures have to be taken up later by the Implementation Agency through the Concessionaire under Change of Scope (CoS) clause in the Concession. As on February 2018, INR 511.94 crore worth of CoS works are pending the Implementation Agency's approval.</li> </ul>	<p><b>Demands for additional structures</b></p> <ul style="list-style-type: none"> <li>This has resulted in approximately five to six km of the project stretch being blocked by people in the vicinity of the project stretch.</li> </ul>															
<table border="1"> <thead> <tr> <th>Status</th> <th>Value (INR crore)</th> <th>Percentage</th> </tr> </thead> <tbody> <tr> <td>Completed</td> <td>59,476</td> <td>5.4%</td> </tr> <tr> <td>To be executed</td> <td>430,226</td> <td>39.2%</td> </tr> <tr> <td>Not Started</td> <td>32,974</td> <td>3.0%</td> </tr> <tr> <td>Executed</td> <td>511,496</td> <td>46.6%</td> </tr> </tbody> </table> <p>Total INR 971.164 crore</p> <p>Legend: Completed (dark teal), To be executed (light blue), Not Started (purple), Executed (tan).</p>		Status	Value (INR crore)	Percentage	Completed	59,476	5.4%	To be executed	430,226	39.2%	Not Started	32,974	3.0%	Executed	511,496	46.6%	<p><b>Public unrests</b></p> <ul style="list-style-type: none"> <li>Public unrest led to stoppages and disruptions of Concessionaire's work on certain stretches across the project.</li> </ul>	
Status	Value (INR crore)	Percentage																
Completed	59,476	5.4%																
To be executed	430,226	39.2%																
Not Started	32,974	3.0%																
Executed	511,496	46.6%																

## Cost overruns in the Project

Owing to various reasons attributable to different stakeholders and also due to extraneous circumstance arising from the judicial order (Punjab and Haryana High Court), the total project cost which was initially estimated at INR 4,518 crore was revised to INR 5,573 crore representing an overrun of INR 1,054 crore till February 2018.

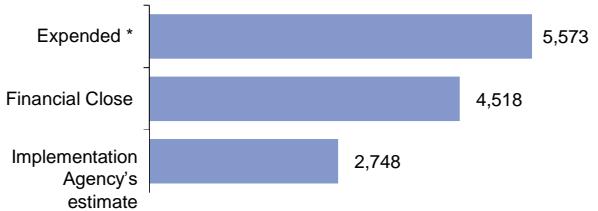
The cost overruns can be captured through these heads:

- Interest During Construction arising from increase in interest rate of debt.
- Price Escalation – estimated at INR 290 crore – due to increase in the market prices of major bulk materials.
- Idling of Plant and Machinery mobilized by the Concessionaire.
- Existing Road Maintenance/Diversions – these were carried out during the standstill period by the Concessionaire at its own cost.

Delays were largely attributable to:

- Land Acquisition - 97% RoW has been handed over till date. Certain parcels of land for 6 laning are still unavailable due to urbanization.

**Total Project Cost Details**  
(in INR crore)



\* till Feb-2018

- Shifting of Utilities - Approvals from various parties (Railways, Irrigation department, Telecom provider, Electricity board and Public Works Department) delayed initiation or resumption of works due to infringement of their utilities.
- Requests by people along certain project stretch led to the Concessionaire being unable to commence works on those stretches, and subsequently resulted in additional works.

# Case Study # 6

## Four Laning of Gwalior-Shivpuri section



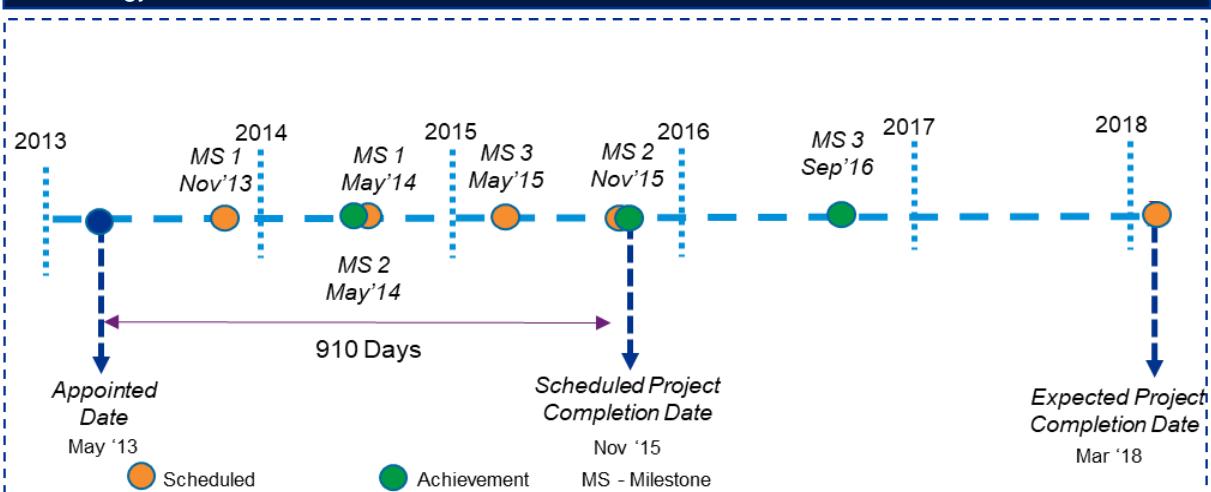
Case study conducted on – 13 and 14 March 2018

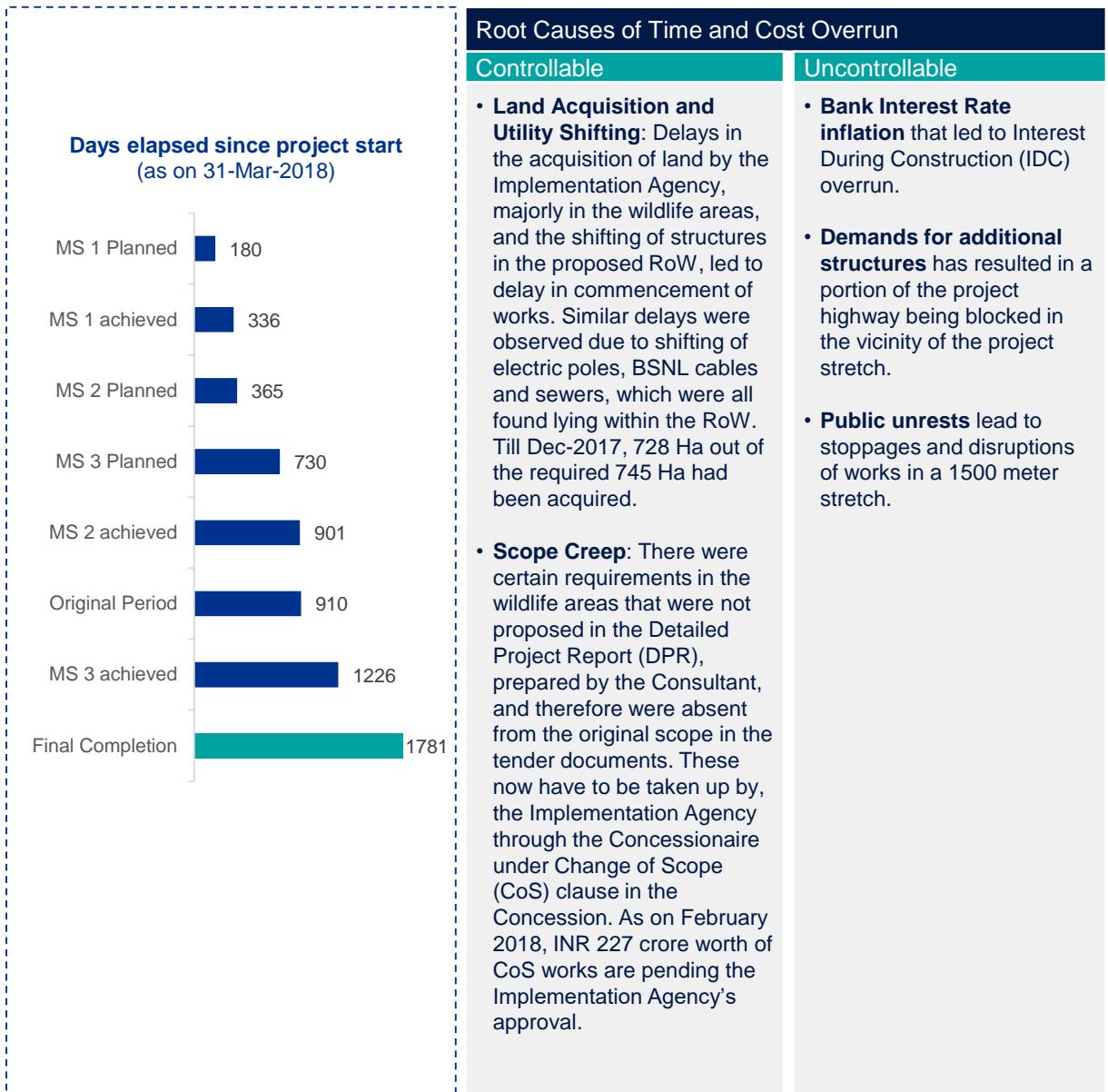
### Background

The four laning of the existing two lane, 125.3 km long Gwalior- Shivpuri section of NH 3 (old numbering) from km 015+600 (NH 75) to 236+000 (NH 3) in Madhya Pradesh, which is a part of the Agra-Gwalior-Shivpuri-Indore- Mumbai road was taken up as a Public Private Partnership project in 2013 and awarded to an Indian firm on BOT-Toll basis. The project is on the verge of achieving completion in March 2018. The project faced delays due to various reasons, especially on account of land acquisition issues and change of scope in the wildlife protected areas of Madhav National Park from 101.85 to 107.35 km (5.5 km) and in the Ghatighan town portion due to Son Bird Sanctuary. The project also faced halts in work due to cashflow issues of the contractor, delay in submission of designs and drawings by the concessionaire for bridges, unrest by locals and delay in mobilization of equipment and manpower at site. The Implementation Agency is yet to hand over 16.10 Ha of RoW to the Concessionaire. There are additional works under change of Scope (CoS), worth approximately INR 227 Cr that have been submitted to the Implementation Agency.

Key Project Details		Project Status as on 14 Mar 2018	
<b>Location</b>	Madhya Pradesh	<b>Planned Completion Date</b>	12 Nov 2015
<b>Project Type</b>	Brownfield	<b>Anticipated Final Completion</b>	31 Mar 2018
<b>Major Project Scope</b>	2 Toll Plazas, 4 Major Bridges, 3 ROBs, 1 VUP, 9 PUP	<b>Time Overrun</b>	29 months
<b>Contract Delivery Model</b>	PPP – DBFO Pattern (BOT Toll)	<b>Cost Original</b>	INR 1,055 crore
<b>Project Start</b>	16 May 2013	<b>Cost Revised/Anticipated</b>	INR 1,601.77 crore
<b>Project Duration</b>	30 months	<b>Cost Overrun – Concessionaire</b>	INR 307.77 crore (29.17%)
<b>Concession Period</b>	29 years	<b>Cost Overrun – Authority</b>	INR 239 crore (CoS)
		<b>Cumulative Expenditure</b>	INR 1601.77 crore
		<b>Milestones Achieved/Targets</b>	3/3
		<b>Physical Completion</b>	94.37%

### Chronology of Events





## Cost overruns in the Project

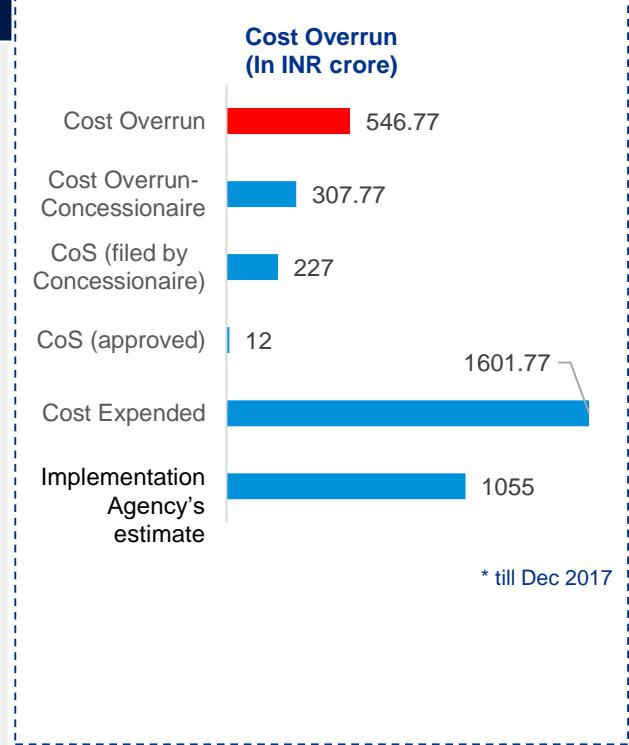
Owing to various reasons that are attributable to multiple stakeholders, the total Project Cost which was initially estimated at INR 1,055 crore was revised to INR 1,601.77 crore representing a 52% overrun of INR 546.77 crore till December 2017.

The cost overrun can be captured through these heads:

- Increase in Interest During Construction arising from increase in interest rate of debt.
- Change of scope in the wildlife protection zones.
- Idling of plant and machinery mobilized by the concessionaire

Delays were largely attributable to:

- **Land Acquisition** - 99% RoW has been handed over till now. Certain parcels of land for 4 laning are still unavailable as those lands are under wildlife protected areas. These areas have now been de-notified and will be taken up under Change of Scope.
- **Change of Scope** – The 5.5 km stretch in the wildlife protected areas requires a number of structures which were not in the DPR and the concessionaire has filed a claim of INR 227 crore for completing these structures.



- **Shifting of Utilities** – Delay in certain approvals/shifting in utilities by agencies such as railways, irrigation, telecom, electricity board etc. has further delayed initiation or resumption of works.

## Recommendations

**Due to the similarity of the execution models of both the road projects' case studies and the issues identified, the recommendations have been combined, as detailed out below.**

### ➤ Panipat – Jalandhar

- Final decision should be taken for the pending CoS works – estimated at INR 512 Cr so as to compensate the Concessionaire.
- The arbitration initiated by the Concessionaire should be participated in and closed, to compensate the claimed amount. The Implementation Agency may seek recourse to the 2015 amendment in the Arbitration and Conciliation Act and look for early closure to avoid further delays and increase in the cost of claims by the Concessionaire. This would alleviate the financial loss claimed by the Concessionaire and also minimize the inflation in the cost of claims.

### ➤ Gwalior – Shivpuri

- Final decision should be taken for the additional CoS works – estimated at INR 227 Cr so as to compensate the Concessionaire.
- An independent engineer should be appointed in order to check the quality of works done by the Concessionaire (as the last NCR was raised in December 2016).

### ➤ Common recommendations for Implementation Agency

- Stakeholder management should be improved by involving central agencies, state boards and local authorities in order to expedite pending hindrances and make encumbrance free land available to the Concessionaire at the earliest.
- Regular follow ups should be done with multiple parties, with limited assistance by the Concessionaire as per the Concession, for early approvals of estimates and running bills of the deputed contractors engaged for shifting the respective utilities.

Detailed Recommendations to be referred in Section-6



- ✓ Invest Heavily in Pre-planning and Site Investigation
- ✓ Reforming Procurement and Strengthening Contracts Management
- ✓ Deepen Stakeholder Management for Land Acquisition and Regulatory Approvals

## Way forward

### Project organization and structuring

- Hiring retired/veteran state revenue department officers to aid the Implementation Agency in land acquisition and liaise with the local administration may be considered.
- The Implementation Agency's Project Implementation Units (PIUs) may need staffing augmentation to ensure adequate pre-construction workload especially for over 130-140 km long NH projects.
- The Lender's Independent Engineer may deploy a permanent representative at site to monitor the Concessionaire's progress, status of pre-construction and certify the EPC contractor's running account bills and other costs incurred by the Concessionaire.
- The Implementation Agency may allocate projects greater than 130-140 km lengths among two PIUs to ensure optimal responsibilities on each with respect to pre-construction related activities and clearances.

### Project governance

- Time bound approval should be provided for CoS requests by the Concessionaire or other parties to avoid an impasse.
- Empowering the Implementation Agency's project heads to grant provisional approval (75%) on immediate receipt of any utility shifting estimate from the respective state board/department may be considered. Final approval may be sourced from the higher authority after further examination. This would help in early appointment of the utility contractor to be engaged in the shifting activities.
- Granting of provisional COD only on achieving contiguous length totaling 75% of the project length may be reconsidered for future concession agreements, as it may hinder early collection of revenue.

### Stakeholder management

- Inviting the State government as a stakeholder in National Highway projects may be considered, especially those undertaken as PPP. An innovative revenue sharing model or any other mode of compensation as feasible may be devised to attract interest from the states. This would incentivize the states to get involved in the land acquisition, forest clearance and utility shifting processes with more interest.



# Case Study # 7 Development of B-127 Fields – Sagar Laxmi Modification Project

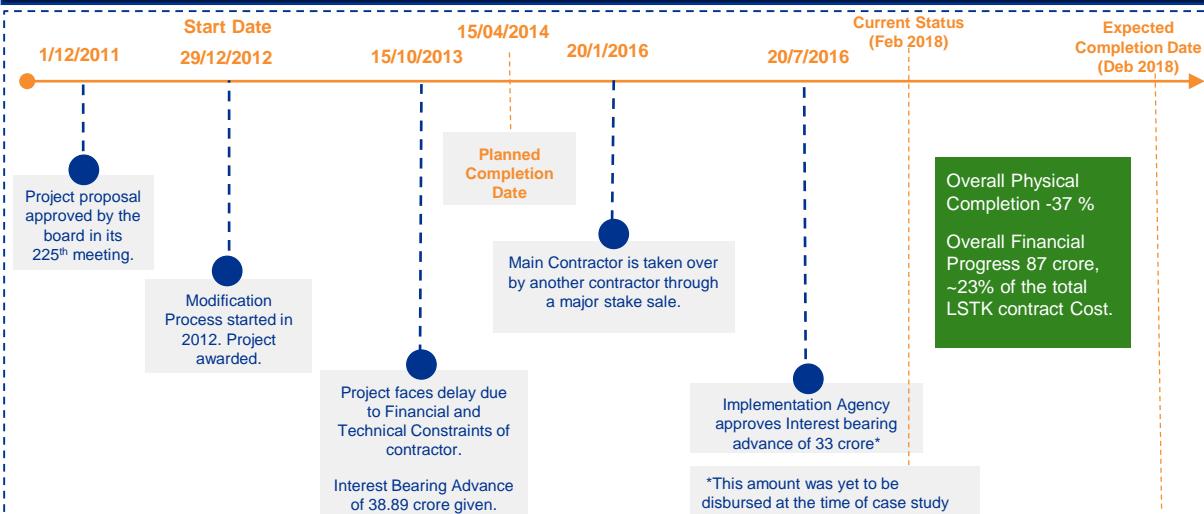
Case study conducted on – 24 January 2018

## Background

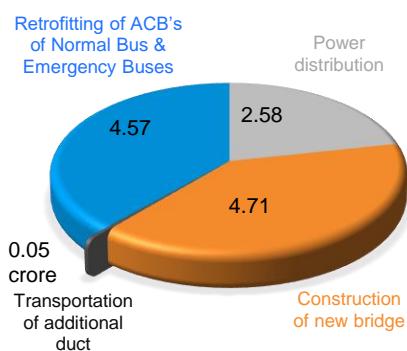
The Sagar Laxmi Dry docking and modification project is a part of the 'Integrated Development of B-127 Cluster (B-127, B-157 and B-59) with additional development of B-55 Field' project. Sagar Laxmi Jack-up production platform is a converted production platform from jack-up drilling rig, Sagar Vikas to a mobile offshore production unit. The rig was initially deployed in Panna field (Bridge connected to Panna-A Platform), later at Neelam Field (Bridge connected to B-173A Platform) and is presently installed at a bridge connected to D1 Well cum water injection Platform in D1 field. Before deploying for the bridge connected at B-127 platform, Sagar Laxmi requires dry-docking, process modifications and up-gradation of power generation capacity from current site rating of 0.965 MW x 3 Units to 4.06 MW x 2 Units to cater to the power requirement and utilities of B-127 facilities in addition to its own power consumption. Topside modifications involve upgradation of existing power generation facilities at Sager Laxmi to meet the requirement of PGC to be installed at B-127 well head platform. As per the latest schedule, the project is delayed and is expected to be completed by Dec 2018.

Key Project Details		Project Status as on 24 Jan 2018	
<b>Location</b>	Mumbai Offshore/Reliance Shipyard - Offshore Jetty	<b>Planned Completion Date</b>	15 Feb 2014
<b>Contract Delivery Model</b>	Lump Sum Turnkey Contract	<b>Anticipated/Revised Completion Date</b>	31 Dec 2018
<b>Project Start</b>	29 Dec 2012	<b>Time Overrun</b>	58 months
<b>Revised Start Date</b>	-	<b>Cost Original</b>	INR 388.94 crore
<b>Duration</b>	16 months (Planned)	<b>Cost Revised/Anticipated</b>	INR 400 crore (further overruns are expected)
<b>Type of Project</b>	Brownfield	<b>Cost Overrun</b>	INR 12 crore/3%
<b>Major Components</b>	Relocation of Sagar Laxmi at B-127	<b>Cumulative Expenditure till date</b>	INR 87 crore
		<b>No. of Milestones (Achieved/Target)</b>	1/8
		<b>Physical Completion</b>	37.84%

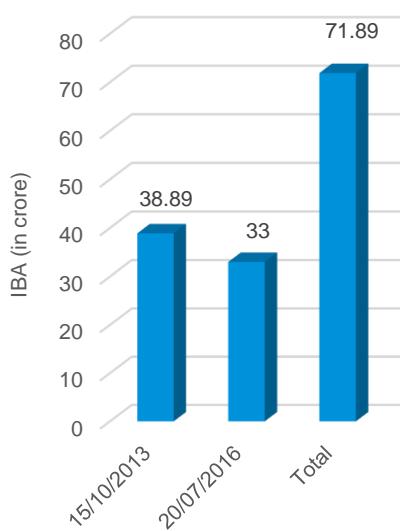
## Chronology of Events



**Percentage Value of Change Order to the Total Contract Value (all values in crore)**



**Interest bearing advance given to the contractor during the timeline of the project**



Although INR 71.89 crore was given as IBA, the process has not been expedited and continues to be delayed

**Root Causes of Time and Cost Overrun**

**Controllable**

**1. Scope Changes**

**Construction of new bridge between Sagar Laxmi and B127 platform.** With an additional cost of INR 4.71 crore, this scope change amounted to 39% of the total changes.

**Change in Power system distribution scheme**

This has resulted in an increase in the total cost due to scope changes by INR 2.57 crore. This change amounted to 21.64% of total scope change.

**Retrofitting of ACB's of Normal Bus and Emergency Buses (16 Nos.).** This resulted in a cost increase of INR 4.56 crore. The retrofitting works constitute 38.35% of the total scope changes.

**Change order due to transportation duct** is 0.42% of the total scope changes.

**2. Contractor Due Diligence**

Improper financial due diligence and awarding of contract to the lowest bidder led to about 300% increase in time. Further delays are also expected. This highlights the contractor's inability to execute such a project in the specified timeline.

**Uncontrollable**

**1. Financial Constraints**

Due to the financial constraints of previous contractor, progress of the project was affected.

On contractor's request, 1st Interest bearing advance (IBA) was given to the contractor in March 2013 to expedite the project. However, the required progress could not be achieved. Additionally, the contractor could not return the amount, hence, the IBA was recovered by invoking BGs.

**2. Handing over process between previous contractor and new contractor**

The former contractor had been taken over by another major contractor by selling off a majority stake in January 2016.

The takeover process took almost one year and impacted the project, especially the procurement process due to lack of funds.

## Recommendations

### 1. Financial capability assessment

- Financial capability of the bidders should be checked thoroughly during pre-bid/qualification stage along with the technical capability, which may include parameters other than bid capacity and turnover.
- Agencies may consider appointing a third party PMO for setting up the bidding process and vendor selection and vendor evaluation process.

### 2. Procurement and contract management

- Instead of selecting L1 bidder for all the projects, negotiations with L2 or L3 bidder may be considered, especially in cases where the difference in the bid price of L1 and the ‘put to tender’ cost is more than 10% -15% or any other threshold defined by the agency.
- Contract provisions for non-performance of contractor may be evaluated along with the exit clause due to non-performance. This may help the Implementation Agency to take appropriate and timely action.
- Other methods of bid evaluation may be explored in the current bid methods to ensure selection of right vendor/contractor.

### 3. Risk management

- Risk Identification and mitigation planning should be done periodically during the project lifecycle.
- Setting up a PMO should be considered for risk identification, quantification of risks and managing the mitigation process; right from the project start.
- Project risk management strategy should allow defensive mechanisms in case of non performance of the contractor. The same should be included in the internal manual of the Implementation Agency.
- Flexibility in decision making based on the performance of the contractor should be permitted and contractual remedial clauses may be implemented to minimize the impact on the project.

### 4. Governance

- Regular Client- Contractor meetings along with other stakeholders should be arranged to agree on completion timelines.
- Project schedule should be finalized along with the contractor to be on the same page regarding project completion timelines.
- A formal process for change of contractor and negotiations or fresh bids for the same work may be worked out.
- A formal change management system should be set up to address changes with regard to contractor's scope.

Detailed Recommendations to be referred in Section-6



- ✓ Embedding a Culture of Risk Management
- ✓ Reforming Procurement and Strengthening Contracts Management
- ✓ Establishing a Robust Project Governance Structure

# Case Study # 8 Assam Renewal Project



Case study conducted on – 08 to 10 January 2018

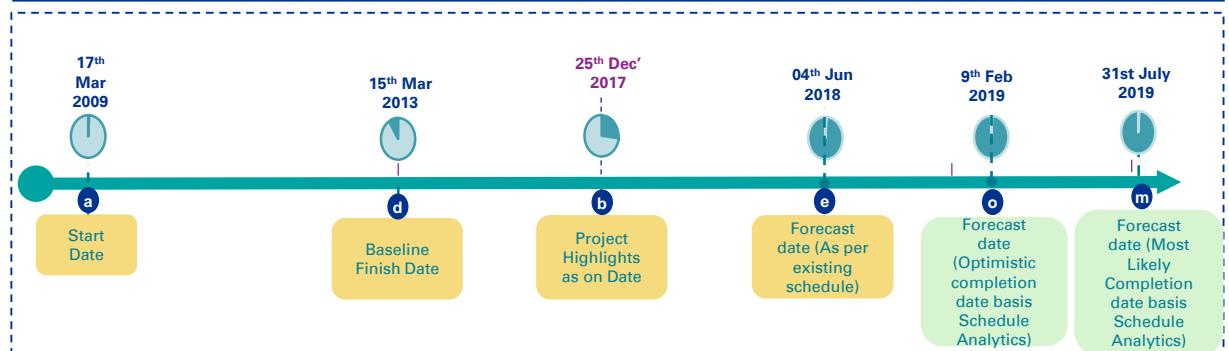
## Background

This is the Implementation Agency's biggest ever EPC project to revamp Onshore surface facilities. The purview of the project encompasses revamp/up-gradation of Lakwa – Lakhmani fields with optimization of 21 installations to 9 integrated installations. The immediate challenge of this project is to maintain production during execution. Identifying existing pipelines that can be used to maintain flow and strategically lay temporary/permanent pipelines for diversion of flow was the kernel of the project. Primary reasons that impacted the timeline of the project are lack of detailed planning, delay in detailed engineering, ineffective schedule management and monitoring, limited mechanisms for risk management and contract administration and management.

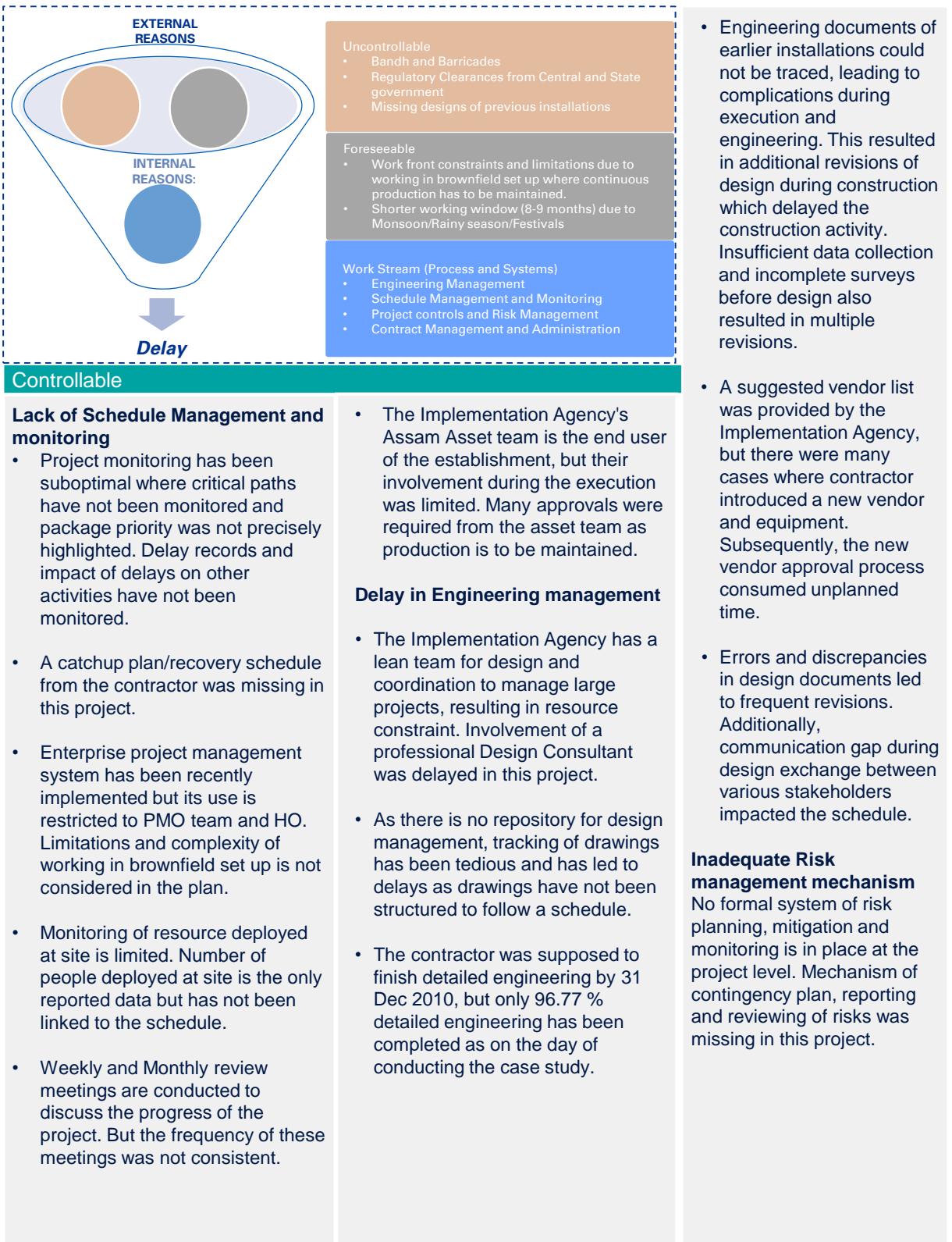
Key Project Details		Project Status as on 10 Jan 2018	
<b>Location</b>	Assam	<b>Planned Completion Date</b>	16 Mar 2013
<b>Contract Delivery Model</b>	Lump Sum Turnkey Model	<b>Anticipated/Revised Completion Date</b>	4 Jun 2018
<b>Project Start and End Date</b>	17 Mar 2009 and 16 Mar 2013	<b>Time Overrun</b>	57 months
<b>Revised Start Date</b>	17 Mar 2009	<b>Cost Original</b>	INR 2,378.85 crore
<b>Project Duration</b>	48 months	<b>Cumulative Expenditure till date</b>	INR 2,007.62 crore
<b>Type of Project</b>	Brownfield and greenfield project	<b>Physical Completion</b>	94.82%

Installations	% Completion
GGS VIII	99.69 %
GGS III	97.33 %
GGS I CTF	80.21 %
GCP-CPP	97.86 %
GGS IV	99.43 %
GGS V	81.87 %
LKW ETP/WIP	98.74 %
LKM ETP/WIP	87.81 %
CTF-MRN	82.14 %
Pipeline	94.04 %

## Chronology of Events



## Root Causes of Time and Cost Overrun



### Inadequate resource deployment

Limited resource deployment by the contractor is one of the key factors for schedule overrun. In many installations, where the work front was available, the results would have been different if extra work force was deployed at right time.

### Delay in providing work front

Immediate challenge was to maintain production during execution of this brownfield project. There were many instances where the Implementation Agency was not able to provide work front to the contractor which contributed to schedule overrun.

### Uncontrollable and Foreseeable

The working window in Assam is typically only 8-9 months in a year due to rains, which was further constrained in this project due to various Bandhs.

Due to barricades, access to site was restricted and equipment and other materials could not be supplied to site till these issues were resolved. It was observed that a significant amount of time was lost due to these factors and there is no documented data for productive time lost.

## Recommendations

### Schedule management

1. A comprehensive schedule management process should be implemented with guidelines to prepare schedule, supporting assumptions, defined timelines, responsibilities, deliverables, risks, issues and KPIs.
2. As per the schedule, package prioritization should be done for effective project focus and control.
3. A guideline for basic schedule preparation may be developed including standard WBS, level of detailing, and list of assumptions.

### Project monitoring

1. A meeting calendar should be developed and implemented for effective project reviews with internal and external stakeholders
2. Detailed templates should be prepared to obtain information and inputs from contractors and consultant
3. Escalation matrix with thresholds should be defined

### Engineering Management

1. Dedicated design team should be identified for the project of this scale. An internal value threshold may be set for the same.
2. A repository or centralized document management system can be established to keep track of drawings and accessibility matrix should be defined.

3. Professional engineering consultant should be on-boarded earlier in the project to expedite the engineering approval and review process from Implementation Agency's end.
4. In addition to the contractor, third party should be appointed for the initial detailed site investigation. This would have avoided unexpected scenarios during execution which were faced in the project.
5. Design engineer may be deployed at site during execution so that revision and approval process can be tuned if there are any changes required to be incorporated in design during construction phase.

### Risk Management

A Risk management framework should be established which may include processes for:

- Establishing a risk register
- Conducting initial risk mitigation
- Qualifying and analyzing risks using a quantitative and qualitative risk model and scoring
- Planning for risk mitigation through risk interviews/management workshops
- Incorporating a project risk report to review and monitor progress on agreed mitigation plan.

### Detailed Recommendations to be referred in Section-5

- ✓ Collaborative and Agile Planning
- ✓ Lean Construction Implementation for Productivity Improvement
- ✓ Embedding a Culture of Risk Management





# Case Study # 9 Lalitpur- Khajuraho New BG Rail Line Project

Case study conducted on – 10 May 2018

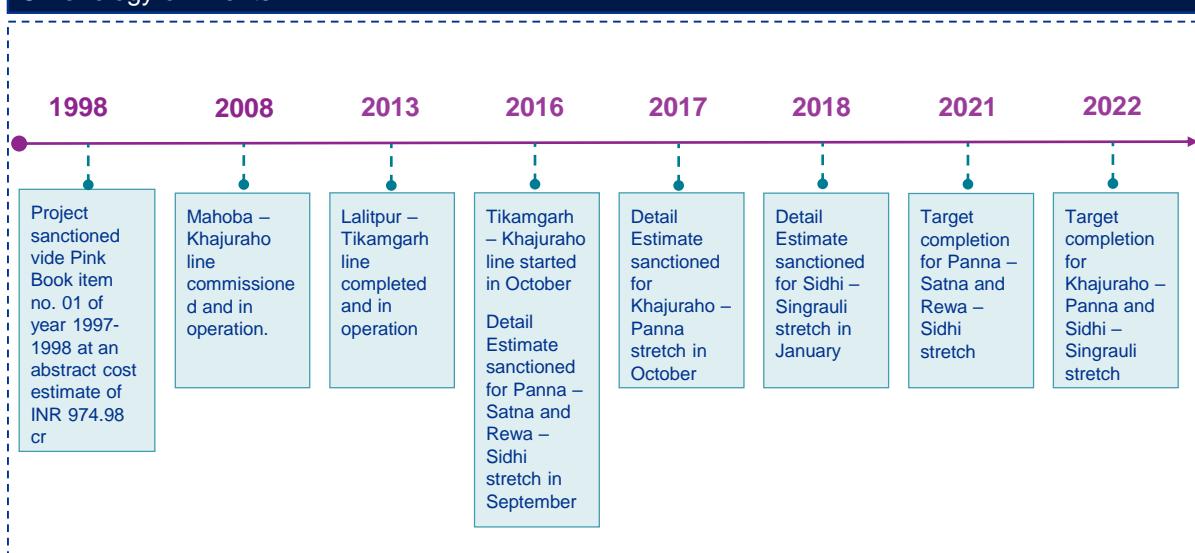
## Background

Lalitpur-Satna, Rewa- Singrauli and Mahoba- Khajuraho New BG Rail Line Project (541km) was sanctioned vide Pink Book item No.01 of year 1997-98 at an abstract cost of approx. INR 975 crore. Following benefits were envisaged from the development of the project:

- Lalitpur – Satna: Shortest route for movement of goods traffic towards Indore and Ahmedabad and also congestion reduction on Bina-Katni as well as Manikpur-Jhansi rail line.
- Boost traffic for Khajuraho from Satna and Lalitpur or Chanderi.
- Increase in local traffic on this line as many multiple purpose projects are proposed on the stretch.

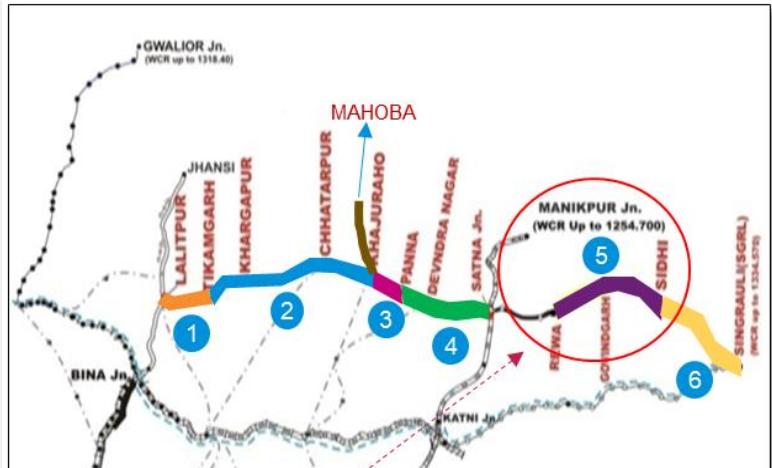
Key Project Details		Project Status as on 10 May 2018	
<b>Location</b>	Lalitpur to Singrauli	<b>Planned Completion Date</b>	March 22
<b>Contract Delivery Model</b>	Item Rate	<b>Anticipated/Revised Completion Date</b>	March 22
<b>Project Planned Start and End Date</b>	Sep 98 and May 08	<b>Time Overrun</b>	166 months
<b>Project Duration</b>	116 months	<b>Cost Original</b>	INR 974.98 crore
<b>Type of Project</b>	Greenfield Project	<b>Cost Revised/Anticipated</b>	INR 6,093.3 crore
<b>Major Components</b>	Permanent Way, Bridges, Stations, SandT	<b>Cost Overrun</b>	INR 5,118.32 crore/ 524.96%
		<b>Physical Completion</b>	42.42%

## Chronology of Events



The project was split in seven stretches:

1. Lalitpur – Tikamgarh (51 km- **completed**)
2. Tikamgarh – Khajuraho (114 km- **completed**)
3. Khajuraho – Panna (70.55 km- in progress)
4. Panna – Satna (73.5 km- in progress)
5. Rewa – Sidhi (88.75 km- in progress)
6. Sidhi – Singrauli (75.75 km- **completed**)
7. Mahoba – Khajuraho (61.5 km – **completed**)



Reviewed for assessment

Source: Project team, project site office

### Root Causes of Time and Cost Overrun

#### Controllable

- **Inadequate Allocation of Funds:** Once the project gets approved by the Ministry, funds are allocated on an year on year basis as per the annual works program for the organization rather than requirement of the project. Due to the insufficient fund allocated to the project, it got delayed and also impacted the cost.
- **Price Escalation:** Project cost was estimated at the prevailing rates of 1996-97. As the project has been delayed by over 166 months, the cost has gone up due to following factors:
  - Significant increase in land cost, and
  - Increase in cost of works
- **Change in Scope:** Typically, for project approval, initially a basic survey is done. After the project is approved, final location survey is carried out to finalize the alignment of the route and facilities. This project is going through forest area due to which alignment was required to be changed resulting in addition of length and increase in number of stations. The alignment change led to a major scope change which adversely affected the cost and time estimates used for approval.

#### Uncontrollable

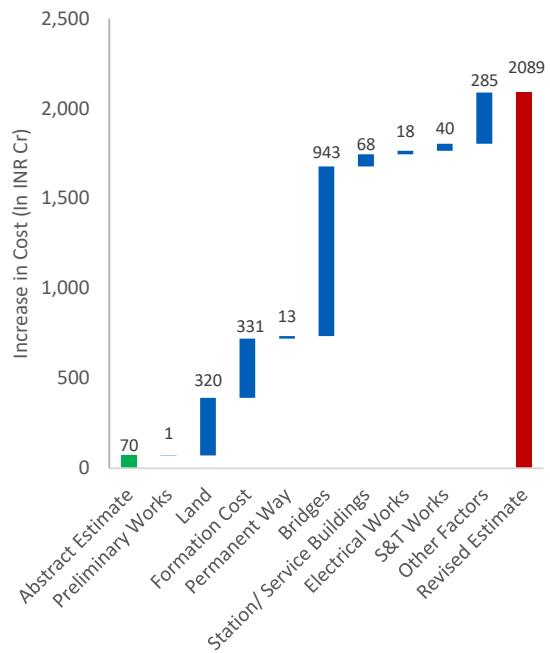
- **Land Acquisition:** Land acquisition is a major roadblock in implementation of railway projects. The Implementation Agency pays to the State governments for land and in turn they acquire/give land to railways. This land acquisition process seems to have impacted the timely completion of this project.

## Cost overruns in the Project

The abstract estimated cost of the project in 1997-98 was INR 974.98 cr and the latest estimated cost as of January 2018 is INR 6093.3 crore. The cost implication can be attributed to the following factors:

- Inadequate allocation of funds for project –** As per current process, funds for executing the project are allocated in the annual works program at the organization level pan India, irrespective of the project priority/stage. Basis the annual allocation, quantum of work to be taken up on the project in the FY is finalized.
- Land Cost –** The cost of land has increased in past two decades and post enactment of Land acquisition bill 2013, the compensation for land acquisition has increased multifold.
- Price Escalation:** The abstract estimate is prepared basis the prevailing rates at that time. As this project is going on for more than two decades, the prices of commodities and services have increased significantly.
- Additional Requirements:** Alignment of several routes were changed to accommodate the forest land and gradient. Due to this, many additional stations, staff colonies and SandT works are required to be done, which were not initially envisaged.

## Break-up for Cost Increase for Khajuraho – Panna section



\*Details only available for Khajuraho – Panna section

## Recommendations

- Allocation of funds for Projects:** Projects are allocated funds through a top down approach, which may be complemented with a bottoms up approach from the ground level to enhance the possibility of allocation of funds based on the status, requirement and aging of the projects
- Land acquisition task force:** It is recommended to make a special task force for land acquisition for large projects with representation from related state governments, forest departments and the Implementation Agency. Representatives from state and forest department would help expedite the process.

- Project management:** The Implementation Agency may adopt structured project management approach for large projects of such scale to timely monitor works, assess risks and develop mitigation plans.
- Project integration:** An integrated approach should be adopted for large projects falling in multiple zones to have visibility of complete project execution.

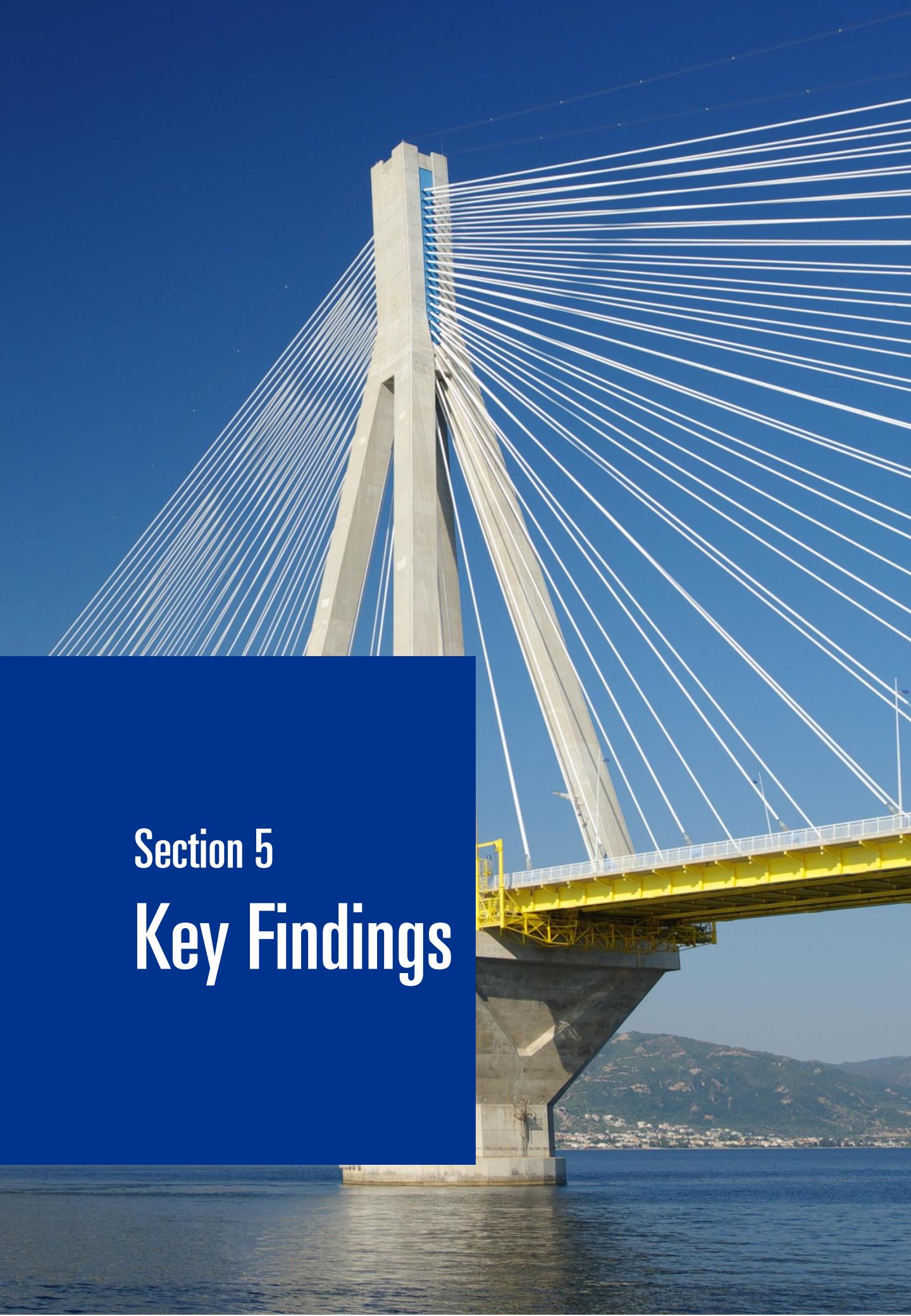
## Detailed Recommendations to be referred in Section-6

- ✓ Deepening stakeholder management for land acquisition and regulatory approvals
- ✓ Augmenting organizational skillsets



# Section 5

# Key Findings





This section encapsulates the reasons for time and cost overruns based on multiple interviews and case studies conducted.

Additional insights have been provided on the current level of usage of technology for infrastructure project delivery and employment potential in infrastructure development in the coming years.

# Sector-wise High Impact Reasons for Time Overruns

	Average Delay (in months)
Railways 	50
Power 	23
Roads and Highways 	19
Urban Development 	22
Oil and Gas 	10
Shipping and Ports 	51
Civil Aviation 	51
Steel 	16

More than **82%** respondents mentioned **delay in obtaining regulatory approvals and unavailability of skilled resources** and ~74% respondents mentioned **delay in land/site handover** have impact on the project schedule.



# Sector-wise High Impact Reasons for Cost Overruns

Cumulative Cost Overrun (in crore)

Railways		1. High cost of land acquisition 2. Escalation in labour costs / ineffective utilization of labour 3. Material price escalation beyond projections 4. Lack of risk management	~INR 1.28 L
Power		1. High cost of land acquisition 2. Lack of risk management 3. Weak contract administration and claim management	~INR 61,100
Roads and Highways		1. High cost of land acquisition 2. Weak contract administration and claim management 3. Suboptimal DPR	~INR 6,400
Urban Development		1. Unavailability of skilled resources 2. Design changes/iterations 3. Scope creep	~INR 5,000
Oil and Gas		1. Design changes/iterations 2. Scope creep 3. Unavailability of skilled resources	~INR 2,245
Shipping and Ports		1. Scope creep 2. Suboptimal DPR 3. Material price escalation beyond projections 4. Contractual disputes due to poor framing of contract documents	~INR 461
Civil Aviation		1. Suboptimal DPR 2. Material price escalation beyond projects 3. Escalation in labour costs/ineffective utilization of labour	~INR 371
Steel		1. High cost of land acquisition 2. Unavailability of skilled resources 3. Weak contract administration and claim management 4. Inadequate/poor selection of technology/equipment	~INR 300

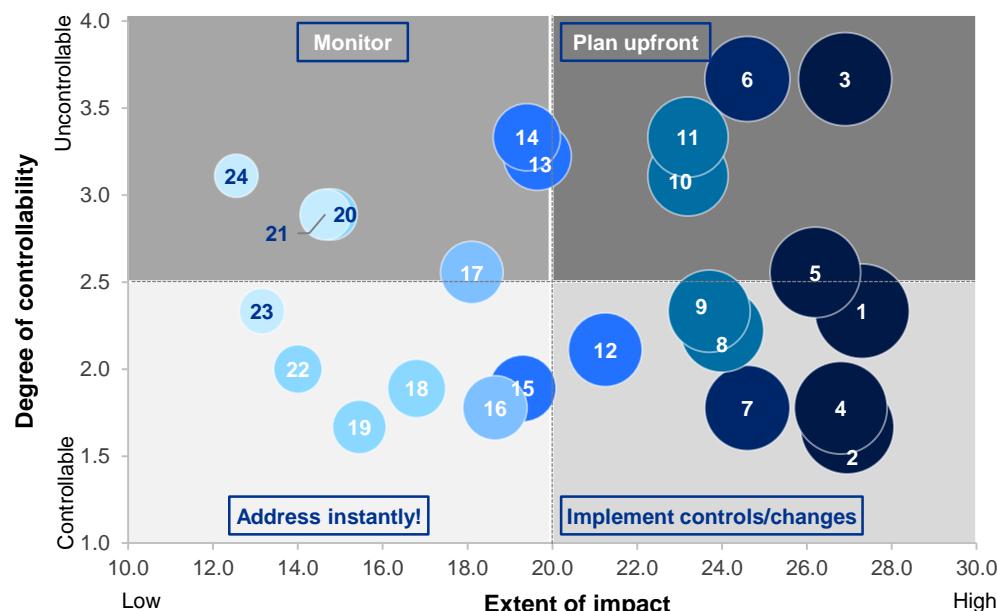
More than **50%** respondents felt **high cost of land acquisition** and **suboptimal DPR** have high impact on the project cost.



# Impact Analysis of Reasons for Time Overrun

Evident from our survey findings and as per MoSPI database, large capital projects in India across sectors have been facing huge overruns. As recorded by MoSPI as on January 2018, the central sector infrastructure industry is facing an average time overrun of 45 months. A number of reasons responsible for this number surfaced in the discussions with project stakeholders. In addition, discussions highlighted that these reasons vary in their degree of impact on project duration and extent of controllability by project stakeholder. Exhibit 3 below maps these reasons on the parameters of controllability and impact that need to be addressed through effective mitigation strategies.

**Exhibit 3 - Degree of severity of reasons for time overruns in infrastructure projects**



Size of the circle indicates % impact on average time overrun

Source: KPMG-PMI survey 2018, KPMG analysis

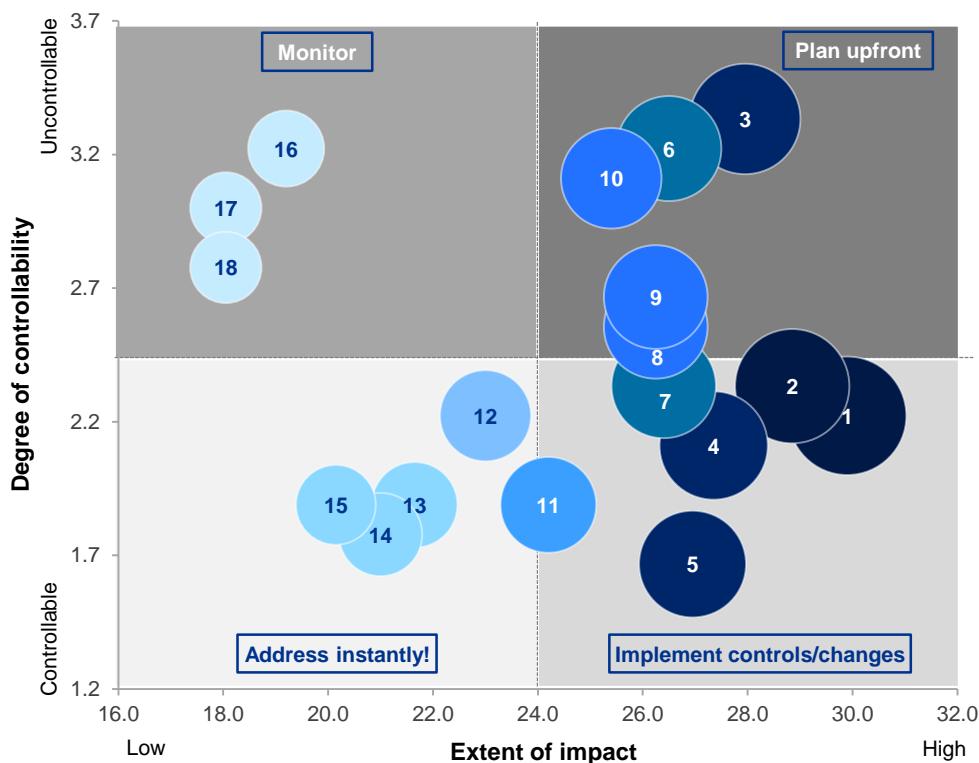
No.	Reason for time overrun	% impact on total time overrun	Average time overrun 45 months
1	Design/scope change	5.2%	
2	Inadequate baselining/lack of planning	5.2%	
3	Land acquisition, utility shifting and local agitation	5.2%	
4	Delay in decision making	5.1%	
5	Claims and dispute	5.0%	
6	Delay in obtaining statutory approvals	4.7%	
7	Ineffective procurement planning	4.7%	
8	Absence of Risk Management	4.6%	
9	Adversarial contract conditions	4.6%	
10	Poor productivity of resources	4.5%	
11	Inadequate availability of skilled resources	4.5%	
12	Lack of adequate contractor assessment	4.1%	
13	Geological Surprises	3.8%	
14	Industrial relations and law and order problems	3.7%	
15	Lack of awareness/use of modern technology/equipment	3.7%	
16	Coordination issues with project stakeholders	3.6%	
17	Pre-commissioning teething troubles	3.5%	
18	Program management	3.2%	
19	Weak/ineffective project monitoring	3.0%	
20	Unavailability/delayed availability of funds	2.8%	
21	Geographical challenges and cultural differences	2.8%	
22	Inadequate/unavailability of experienced contractors	2.7%	
23	Relationship with other projects	2.5%	
24	Shortage of funds/negative cash flows	2.4%	

For details on impact analysis working, refer to the study methodology in Annexures

# Impact Analysis of Reasons for Cost Overrun

As recorded by MoSPI, the central sector infrastructure industry is hit by an overall cost overrun of INR 2.19 INR lakh crore as on January 2018. A number of reasons responsible for this cost overrun surfaced in the discussions with project stakeholders. In addition, discussions highlighted that these reasons vary in their degree of impact on project cost and extent of controllability by project stakeholder. Exhibit 4 below maps these reasons on the parameters of controllability and impact that need to be addressed through effective mitigation strategies.

**Exhibit 4 - Degree of severity of reasons for cost overruns in infrastructure projects**



Size of the circle indicates % impact on average time overrun

Source: KPMG-PMI survey 2018, KPMG analysis

No.	Reason for cost overrun	% impact on total cost overrun	Total cost overrun INR 2.19 lakh crore
1	Suboptimal DPR	6.6%	
2	Scope creep	6.4%	
3	Material price escalations beyond projections	6.2%	
4	Poor selection of consultant	6.0%	
5	Inadequate baseline/lack of planning	5.9%	
6	High cost of land acquisition	5.8%	
7	Design changes/iterations	5.8%	
8	Escalation in labour costs	5.8%	
9	Ineffective utilization of labour	5.8%	
10	Inadequate availability of skilled resources	5.6%	
11	Weak contract administration and claim management	5.3%	
12	Weak procurement planning	5.1%	
13	Contractual disputes due to poor framing of contract document	4.8%	
14	Project approvals without detailed estimates and assumptions	4.6%	
15	Inadequate/poor selection of technology	4.4%	
16	High cost of environmental safeguards and rehabilitation measures	4.2%	
17	Incremental financial costs (foreign exchange volatility, borrowing cost, etc.)	4.0%	
18	Location and connectivity of project site	4.0%	

For details on impact analysis working, refer to the study methodology in Annexures

# Our Point of View

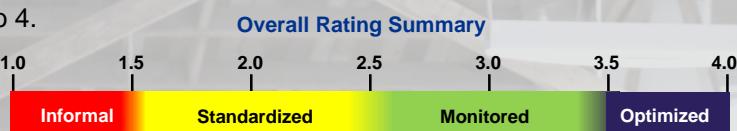
## Project management maturity assessment of case studies

KPMG in India leveraged its proprietary Major Projects Advisor Tool or MPA tool for conducting Project Management maturity assessment of case study projects. This tool is a globally integrated online tool that enables project controls assessment and benchmarking against leading practices. The assessment is based on globally and locally benchmarked project data, making the tool outputs most relevant for project stakeholders.

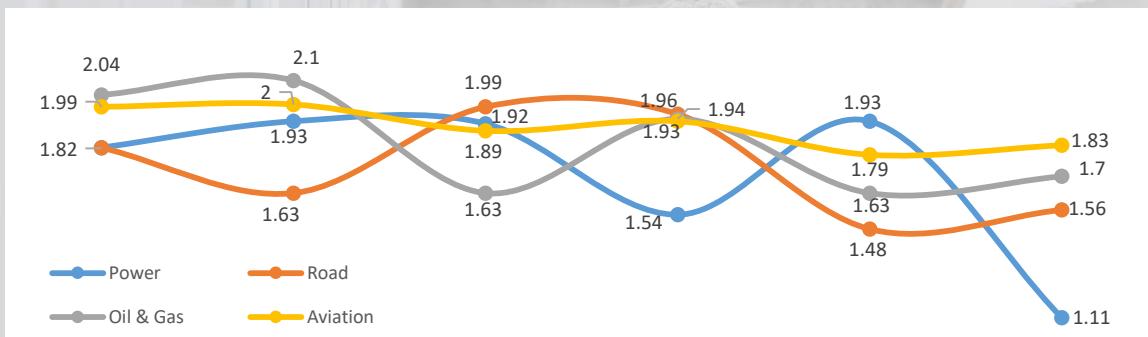
Project management maturity assessment of case study projects of four key sectors (Power, Road, Oil and Gas and Aviation) was conducted and maturity assessment ratings were provided against five key control categories (Cost , Schedule, Controls, Strategy and Procurement).

The assessment rating is on a scale of 1 to 4.

The results of maturity assessment ratings are displayed below, with select areas highlighted for further improvements.



Note: The assigned ratings show project management maturity assessment of only case study projects covered in this report and do not reflect a sectorial view.



### Overall Rating

Assessment rating for Procurement category is **standardized** for all the four sectors; from 1.63 to 1.99 with Road sector on top.

Key improvement opportunities identified in the contractor procurement process of case study projects are:

1. Implementing value-based bidding methods (other than L1)
2. Setting up a formal Contract Administration function for strengthening the contract management capacity
3. Strengthening of contract terms in line with leading contracting formats

### Cost Management

### Procurement Management

Assessment rating for Project controls and Risk Management category is **standardized** for all the four sectors; from 1.48 to 1.93.

The studied projects in Power sector had implemented risk management to an extent; with risk register's preparation and its continuous updates. This led to relatively higher rating of power sector projects. In all other sectors, a structured risk management process was missing.

Key Improvement areas identified are:

1. Risks management should become an integral part of contracts.
2. The agencies should continuously document and monitor risks (with quantification methods), from the feasibility/DPR stage to commissioning

### Program Strategy, Organization and Administration

Assessment rating for Schedule Management category for all sectors is **standardized** except Power where the rating is informal.

Limited to nil utilization of any scheduling tool and critical path monitoring was observed across all case studies, except one project in the Aviation sector, where in MS Project was implemented for schedule management.

Key Improvement areas identified are:

1. Realistic baseline/target plans preparation, linked with risk management
2. Contractors' inputs to be incorporated while planning
3. Integrated schedule should be prepared in a leading software tool.
4. Timely schedule updates

### Project Controls and Risk Management

### Schedule Management

# Leveraging Technology

The construction industry is constantly evolving. With new innovative technologies being introduced very frequently, the industry is witnessing a rapid technology transition. However, if compared to the global scenarios, India has a long way to go in exploring the extent of technology. While innovative technologies such as robotics, automation, mobile technology and powerful data analytics are widely being used in the international markets for design, engineering, construction and project management, the Indian central sector infrastructure projects have gradually started realizing the benefits of these tools.

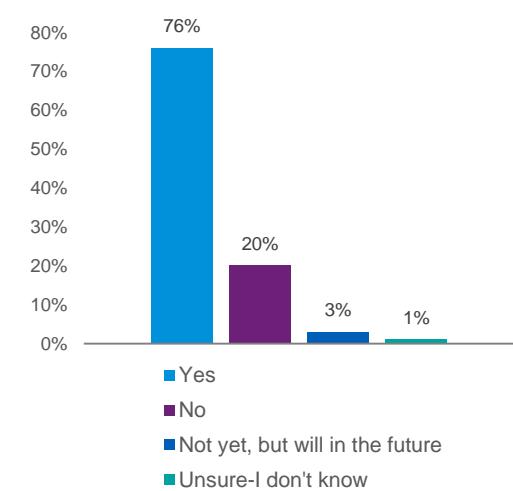
For example, the Dedicated Freight Corridor Corporation of India Limited (DFCCIL), a corporation under the Ministry of Railways, has used Unmanned Aerial Vehicle (UAV), also commonly called drones, for inspecting a mega rail project, the Dedicated Freight Corridor (DFC), to assess the on-ground progress. The Government has also granted permission to the Gas Authority of India Limited (GAIL) to use drones for aerial surveillance of its pipelines. In the roads sector, NHAI has signed a pact with the Indian Space Research Organization's National Remote Sensing Centre and the North East Centre for Technology Application and Research for the use of UAVs to aid in surveillance of construction work. (Source: Economic times, 26<sup>th</sup> June 2016)

In a separate study done by KPMG, the Global Construction Survey 2017, with various construction industry stakeholders across the world as participants, 76% of the Indian respondents mentioned that technology and innovation or use of data play a prominent role in their strategic plan or vision. About 20% respondents stated that technology will be a part of their strategy in future.

While the industry's intent to use technology is apparent, only 51% respondents stated that their organization has developed a data/technology strategy or road map. When asked to rank their organization with respect to technological maturity, 48% respondents stated they still consider themselves to be "followers" or "behind the curve", and the proportion that view their organizations as "cutting edge" remains at a mere 10%. However, 37% respondents stated they consider themselves as "industry leaders" which clearly indicates a paradigm shift in the infrastructure industry which is otherwise considered conservative.

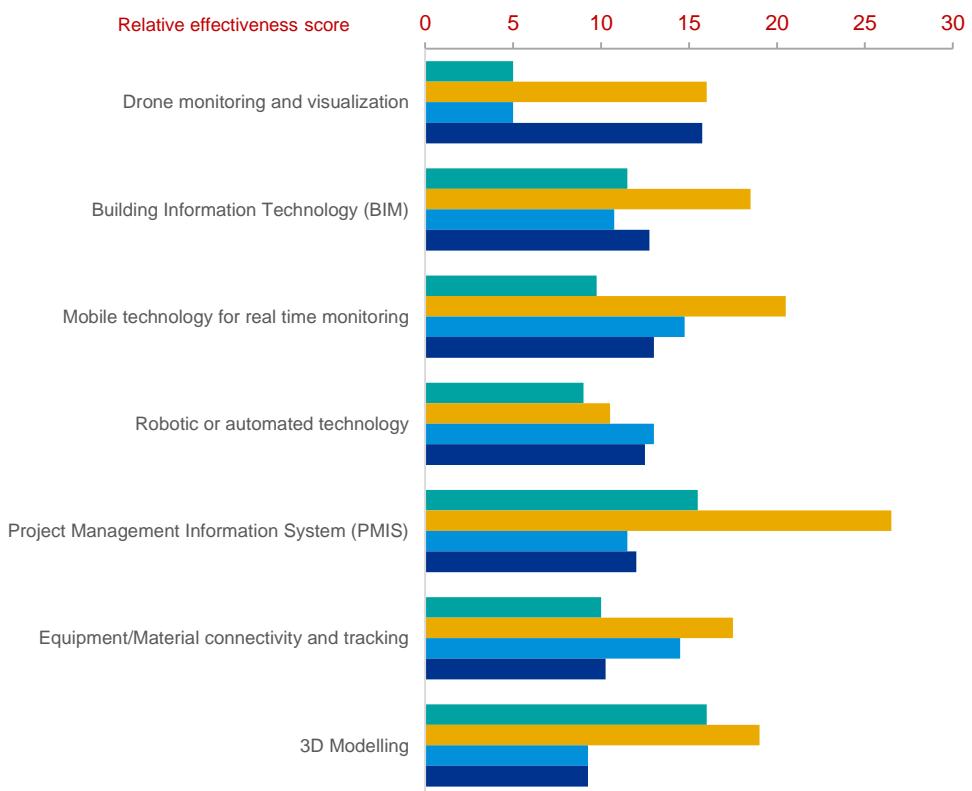


## Is technology, innovation or data prominent in your strategic plan or vision?



As infrastructure landscape in India is growing in scale and complexity, more and more project stakeholders are realizing that technology driven innovation in construction and project management is imperative to improve efficiency, control costs, boost safety and minimize construction timelines. The KPMG-PMI survey 2018 respondents unanimously reverberated that innovative tools and technologies for project management such as drone monitoring and visualization, building information modelling, mobile technology, PMIS and 3D modelling; all have a significant positive impact on project planning, time and cost bound execution and improved project monitoring.

In addition, respondents mentioned that technological interventions improve efficiency in operation and maintenance of infrastructure projects, which in turn indicates the promising value of technology across project lifecycle.



### **Relative effectiveness of tools and technology in achieving the following strategies for improved project performance and delivery**

- New and more efficient methods of construction
- Better planning, monitoring and forecast of costs and time
- Improved efficiency in operation and maintenance
- Early detection of defects to prevent wastage and downtime

Exhibit 5 below lists advanced technologies for moderating few reasons for time overruns. Though the mapping is indicative and varies based on the project type and organizational maturity, it is important to note that if applied proactively and effectively over project lifecycle, technology application can aid in addressing majority of reasons that lead to overruns.

#### Exhibit 5 - Use of technology to address key reasons for time overruns in projects

Reasons for time overrun	% impact on time overrun							
Design/scope change	5.2%	✓	✓					
Inadequate baseline/lack of planning	5.2%	✓	✓					
Delay in decision making	5.1%	✓					✓	
Claims and dispute	5.0%	✓					✓	
Absence of risk management	4.6%	✓	✓				✓	
Poor productivity of resources	4.5%		✓			✓		✓
Inadequate availability of skilled resources	4.5%					✓		
Lack of adequate contractor assessment	4.1%						✓	
Geological surprises	3.8%	✓	✓					
Inadequate use of modern equipment and technology	3.7%					✓		
Coordination issues with project stakeholders	3.6%				✓		✓	
Weak/ineffective project monitoring	3.0%	✓		✓			✓	✓

Technology list is not exhaustive



Drone monitoring and visualization



Robotic/automated technology



BIM



PMIS



Mobile technology



Equipment/Material connectivity and tracking

Exhibit 6 below lists advanced technologies for moderating few reasons for cost overruns, in addition to the reasons for time over-runs which indirectly lead to cost over-runs, especially in non lump sum turn-key contracts. It is noted that the budget preparation and planning activities of Implementation Agencies which significantly impact project cost, can further be strengthened using suitable technologies.

#### Exhibit 6 - Use of technology to address key reasons for cost overruns in projects

Reasons for cost overrun	% impact on cost overrun	Drone monitoring and visualization	BIM	Mobile technology	Robotic/automated technology	PMIS	Equipment/Material connectivity and tracking	Other
Suboptimal DPR, estimates/budgets	6.6%	✓						
Scope creep	6.4%				✓			✓
Inadequate baseline/lack of planning	5.9%	✓			✓			
Design changes/iterations	5.8%				✓			
Ineffective utilization of labour	5.8%					✓	✓	✓
Inadequate availability of skilled resources	5.6%						✓	
Weak contract administration and claim management	5.3%							✓
Project approvals without detailed estimates and assumptions	4.6%				✓			✓
Location and connectivity of project site	4.0%	✓				✓		

Technology list is not exhaustive



Drone monitoring and visualization



BIM



Mobile technology



Robotic/automated technology



PMIS



Equipment/Material connectivity and tracking

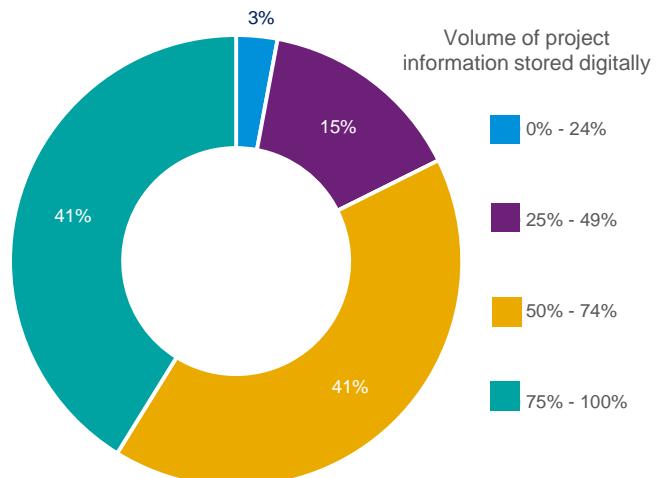
Project data and information are fundamental and critical ingredients for the effective use of any tool or technology. Owing to their long gestation periods, large scale and complex nature, infrastructure project data exists in huge volumes. It therefore becomes extremely vital to protect project data which is vulnerable to getting lost in time, misread or misinterpreted as it involves multiple stakeholders. Storing information digitally, hence is the first step towards securing project data which can then be fed into various tools and used for different technologies to improve project performance and delivery.

According to the KPMG-PMI survey 2018, 82% respondents stated they store more than 50% of their project data digitally. Despite this positive statistic, projects are prone to poor documentation, loss of information and ineffective data management. Data is stored in silos and is not being adequately analyzed due to lack of automated workflow. A comprehensive data storage and retrieval system coupled with technological intervention and digitization of all physical data is the way forward.

Data driven approach to measuring and analyzing project performance enable project managers to control projects more objectively and effectively. Project based data analytics give project managers the insight necessary to make more informed decisions based on facts and facilitate effective project delivery. As per KPMG-PMI survey 2018, 71% respondents stated that data analytics is effective in addressing project overruns while 26% respondents stated that it is somewhat effective. This metric highlights the popularity and usefulness of data analytics as a tool driving successful project implementation and delivery.

Although, the industry's inclination is visible towards use of project management tools and technology, the discussions with many project stakeholders in the KPMG-PMI survey 2018 reveal that only a small proportion of owners and contractors are using technologies routinely and have a cutting-edge vision towards embracing them. Many developers and contractors hesitate to park funds in huge initial investments involved to adopt new technologies. Moreover, organizations also need to invest in training their resources to use these technologies. Such investments can potentially allow a cost-competitive advantage and an opportunity to gain a step change in performance.

### Percentage of respondents who said their project information was stored digitally



Source: KPMG-PMI survey 2018

# Employment Base in Construction Industry

As per the latest estimates by the United Nations, Department of Economic and Social Affairs (DESA), Population Division, the current population in India stands at 135 crore with an average yearly growth rate of approximately 1.3% as recorded over the past ten years.<sup>50</sup> Out of the total population, 52.5% or approximately 71 crore is the working-age population (people or individuals who are currently employed or in search of a job).<sup>51</sup>

As per KPMG's study, the construction industry employed 4.54 crore individuals in the year 2015 with projections for the year 2020 and 2025 as 5.75 crore and 7.42 crore respectively. Assuming that the working population (labour force participation rate) has grown at the same rate as the total population in the country, the number of people employed in the construction sector as a percentage of total working population is as detailed in Exhibit 7. These numbers indicate significant contribution of the construction industry to the employment landscape in the country. Past trends also indicate that nearly one-third of new jobs added in the Indian economy post 1991 have been in the construction industry alone.<sup>52</sup>



**Exhibit 7**

Jobs in the construction industry			
Year	2015 (actual)	2020 (projected)	2025 (projected)
Total population (approximate numbers in crore)*	130	138	145
Labour force participation rate	55.9% <sup>53</sup>	59.5%	63.4%
Working population (in crore)	72.67	82.11	91.9
Employment base in construction industry (in crore)**	4.54	5.75	7.42
People working in construction industry as a percentage of total working population	6.24%	7.00%	8.07%

\* <https://www.worldometers.info/world-population/india-population/>

\*\*Primary interactions, NSSO 68<sup>th</sup> round of EU survey, Industry estimates, NSDC skill gap studies, KPMG analysis

**It is evident that the infrastructure industry will require an increased share of the working class to be employed in the construction sector in the next five to seven years. Additionally, the utilization and efficiency management of the existing labour force by contractors will dictate if this share needs to be increased further.**

50. <https://www.worldometers.info/world-population/india-population/>

51. <https://tradingeconomics.com/india/employed-persons>

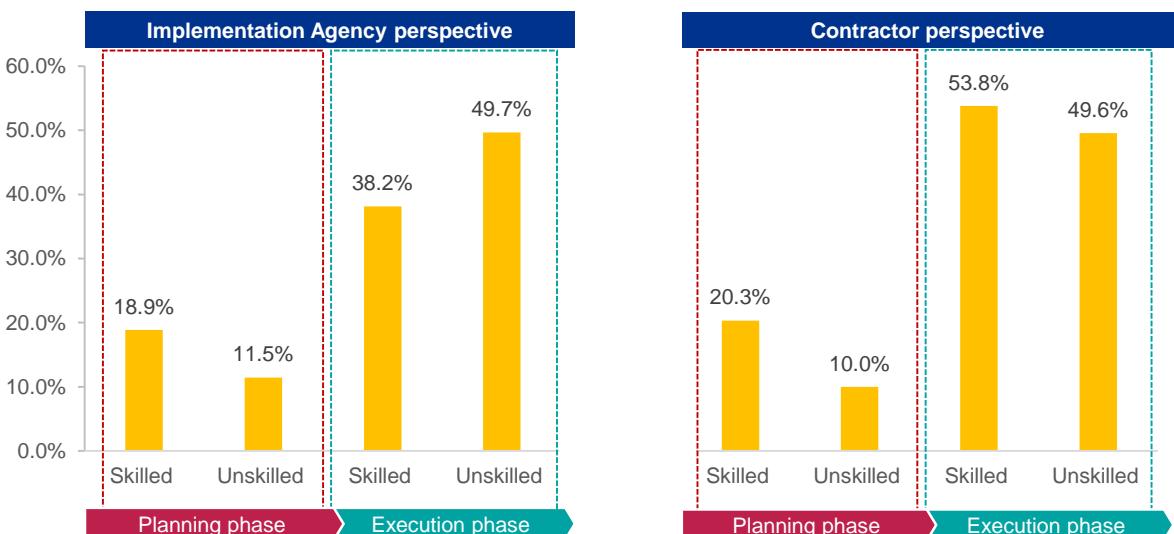
52. <https://www.livemint.com/Politics/7XXmUWyxkSEGKoWXJqUuHM/Which-are-the-top-sectors-that-generate-employment-in-India.html>

53. India Labour Market Update, ILO Country Office for India, July 2016

# Job Creation and Manpower Gap

At the commencement of a new project, the total requirement for skilled and unskilled manpower may or may not be fulfilled with the existing pipe of manpower available within an organization. This is also a function of project location. Hence, with every new project, some percentage of direct jobs are created for both skilled and unskilled labour. According to the KPMG-PMI survey 2018, respondents stated that a higher percentage of direct jobs are generated in the execution phase of a project. In addition, this percentage is higher in a contractor organization as compared to an Implementation Agency. The survey revealed that in a contractor organization, approximately 54% of the total skilled labour required on a project are new in the execution phase. This is a large percentage which is indicative of the potential for employment generation by the construction industry with every new project initiated. But this also brings the challenges of dealing with new set of labour or labour contractors.

**Average direct jobs created as a percentage of total manpower required in the project**



Source: KPMG-PMI survey 2018, KPMG analysis

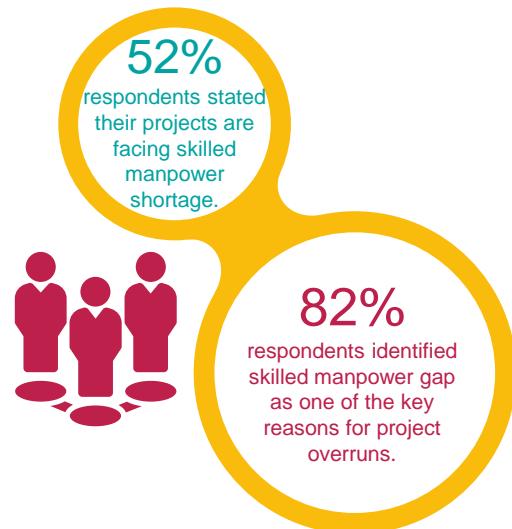
While these numbers seem huge, it is essential to note that most of this employment generation translates into low productivity and low wage jobs in the informal sector. For example, a labour contractor does not hire manpower on their payroll and deploy labour for jobs on temporary basis. This results in more workers performing the task that could be completed by lesser number of workers. This leads to a serious issue of underemployment which is a bigger threat and serious problem than unemployment in the industry. The imminent need is to promote and generate highly productive, sustainably paid and structured jobs in the infrastructure industry.



In the past few years, shortage of skilled manpower in the Indian construction industry has been one of the growing concerns for project stakeholders. Apart from the skilled labour class workforce, the demand for qualified construction professionals such as entry level civil engineers, project managers etc. is also much more than the available supply. While the rate at which new jobs are being created by the construction sector is huge, finding workers with the appropriate skills to fit these jobs remains a concern. In a time where the infrastructure and construction industry is witnessing a mushrooming growth, this acute shortage is impacting project performance and delivery.

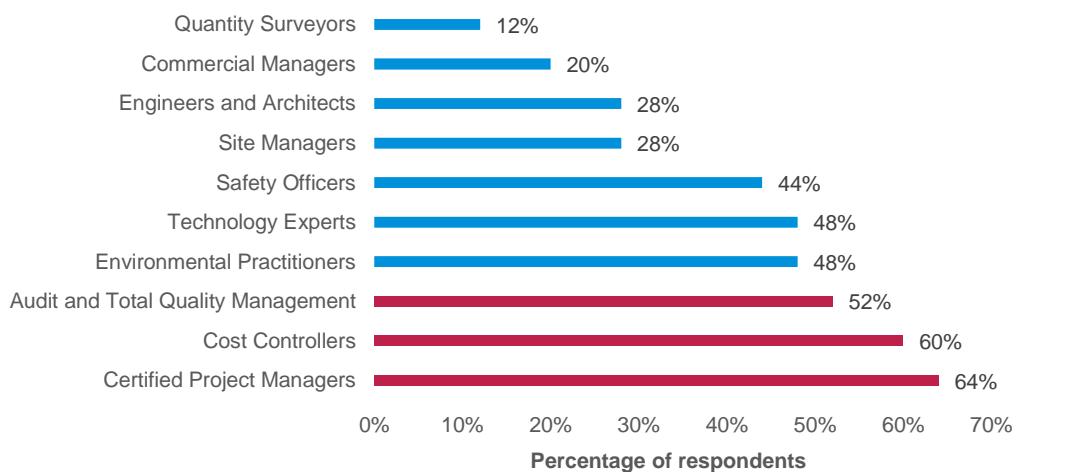
Echoing this sentiment, the KPMG-PMI survey 2018 results revealed that 52% of respondents stated that their projects were facing shortage of skilled workforce and 82% respondents identified skilled manpower gap as one of the key reasons for project overruns. Thus, a holistic and sustainable approach needs to be adopted to address the skill gap that can withstand the demand in the infrastructure industry.

In addition, the workforce is not exposed to adequate training at par with the changing landscape of the construction industry. Despite measures being taken by organizations towards promoting in-house or external project management trainings to their employees, according to the KPMG-PMI survey 2018, close to 80% respondents believe that their organization is facing shortage of one or more type of construction professionals with specific skill set.



The graph below demonstrates the percentage of respondents who opined the shortfall of key skilled professionals in their organization.

While this is not an indication of shortfall of project management delivery staff in the organization, which overall has seen a boost in numbers as highlighted in the section, "Impact assessment of 2012 study" of this report, it demonstrates that the industry is still facing a shortage of specific skill sets in the project management domain.

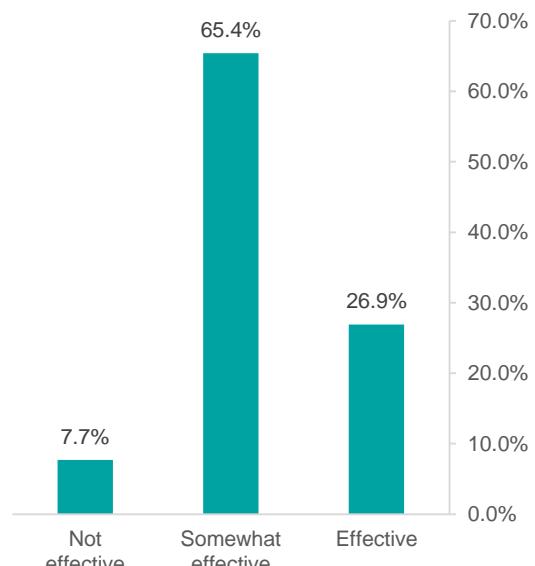


The Government too has recognized the issue of up skilling as one of its key agendas and objectives. Government's few key initiatives include; setting up of National Skill Development Corporation established to promote skill development in a holistic manner, and imparting vocational trainings through dedicated organization such as the Construction Industry Development Council (CIDC).

Even large private construction companies have established dedicated training centers for meeting their captive requirements.

As per the KPMG-PMI survey 2018, 26.9% respondents have stated that the Government's Skill India Mission initiative has been effective in addressing the need for skilled manpower in the infrastructure industry and 65.4% of the respondents mentioned that the Mission has managed to give a head start to address the demand-supply gap for skilled labor. The results indicate that despite steps and intent towards skilling manpower and improving capabilities, there still exists some scope for improvement and potential to adopt new initiatives to meet the skill requirements of the industry.

### How effective has the Skill India programme been in helping reduce the demand-supply gap for skilled labor in infrastructure industry?



Source: KPMG-PMI survey 2018



# Section 6

# Enablers for

# Successful

# Project Delivery





The root causes of time and cost over-runs established from the interviews and case studies are documented in the previous chapter, wherein a quantified approach has been adopted.

These causes point to a few pervasive issues ailing the Indian infrastructure industry today, which require systematic and well planned responses in the project delivery approach around three key areas:

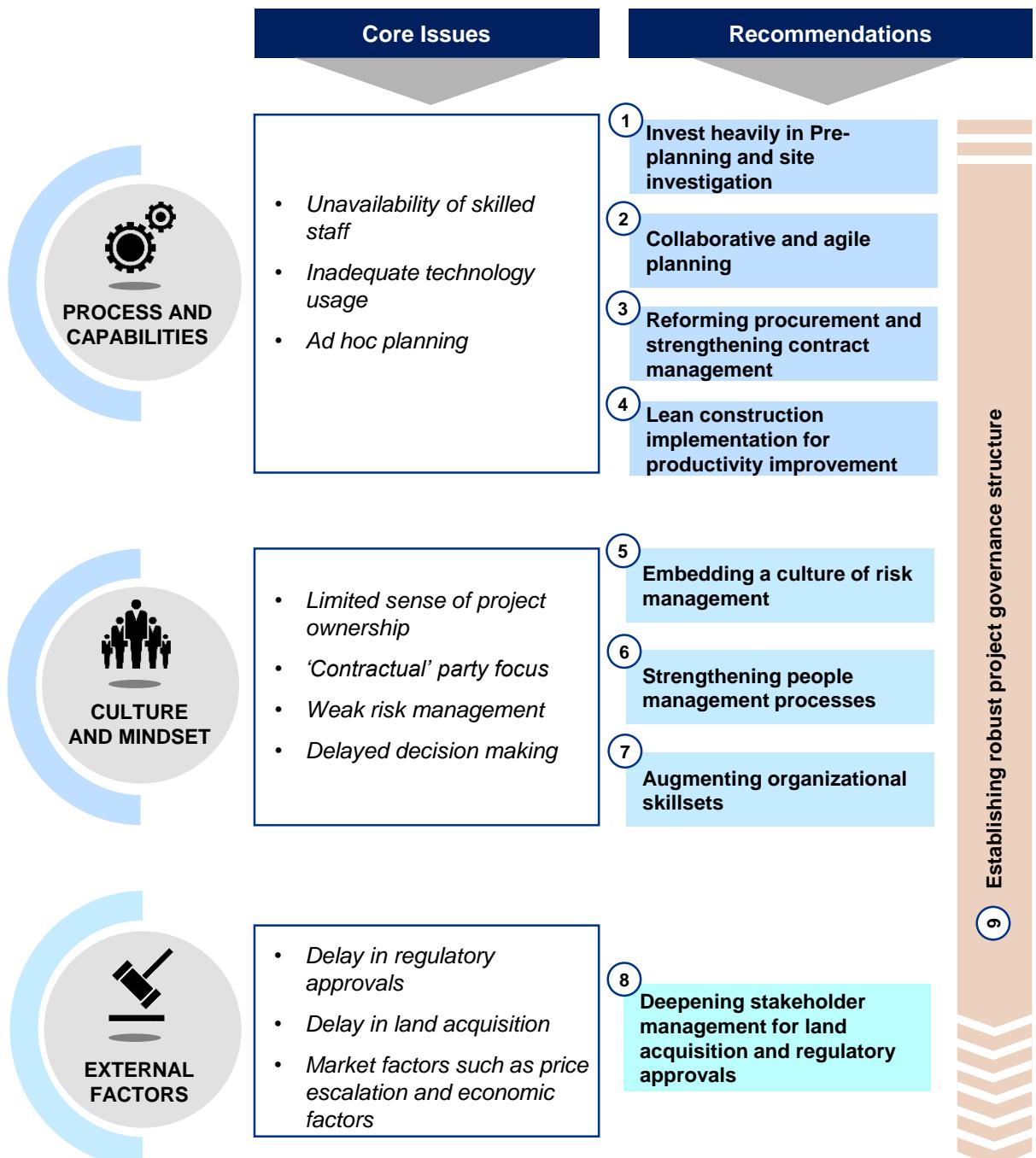
- **Process and Capability**
- **Culture and Mindset**
- **External factors**

The recommendations discussed in this section broadly address these three areas, for improvements in the delivery approach of Implementation Agencies/PSUs, contractors, and other stakeholders across the project value chain. Additionally, few recommendations complement the evolving global changes in the infrastructure sector, especially around disruption caused by technology.

These recommendations can facilitate preventing/mitigating time and cost over-runs to a major extent.

Few factors such as change in policy, law, market conditions etc. which are generally beyond the control of project stakeholders have not been considered for drawing the recommendations.

# Recommendations Summary



#1

## Invest Heavily in Pre-planning and Site Investigation

### Basis of Recommendation

It has been observed in the study that suboptimal feasibility report, incomplete geology/site/soil investigation and inadequate Detailed Project Report (DPR) are few major reasons of scope changes that lead to time and cost overruns. The reliability of the information contained in these reports, which are prepared for early assessment, has significant influence throughout the project delivery and its eventual operations.

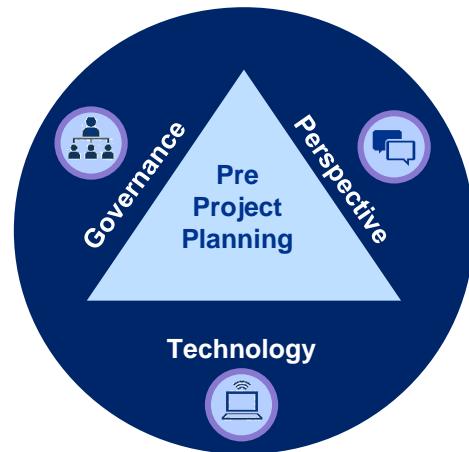
Four number of case studies highlighted that either the geological/soil investigation was not done completely or the DPR data was inadequate, which resulted in site surprises and scope changes. Specifically in one case study, the number of drill holes were inadequate, which led to significant differences in the geological strata predictions during DPR preparation and actual execution conditions that subsequently impacted the project with a time overrun of approximately three years. Hence, it is of utmost importance that these studies are done diligently as these have lasting impact on the project performance.

### Core Recommendation

Success of a project is dependent upon the level of effort and accuracy of scoping and planning in the initial phase of the project. Pre-project planning is an integral process of extracting the site data and preparing the critical information, basis which key risks can be identified and addressed as early as possible and/or the estimated budget and schedule can be adjusted. Adequate efforts should be invested at this stage to reduce uncertainty during execution and bring reliability in project budget and schedule.

It has been observed from the majority of interviews and case studies that the project initial budget gets firmed up without finalizing such preliminary studies which naturally impact the project cost after further details are uncovered. After having observed the project overruns in this study, the PSUs should invest appropriately in project pre-planning. Few measures towards this goal are recommended in the following page

**More than 56% of interview respondents quoted suboptimal feasibility reports as a primary reason for delay in planning stage of the project.**



## Core Recommendation

### 1. Stage-gate based project delivery framework

A project governance structure should be set-up and followed from the pre-planning stage. A stage-gate based approach may be adopted by the PSUs to ensure the completeness of project detailing at each stage before moving on the project phase. For example, the project budget should follow the stage gate process, aligning the approvals with the maturity and detailing of preliminary studies such as geological investigation, DPR and others. Site visits should be mandated as an initial gate check point for budget preparation.

A detailed plan for the preliminary studies should be prepared upfront with required quality and completeness checks. Standard procedures and benchmarks should be established to this objective. Studies have shown that usage of formal method such as the **Project Definition Rating Index (PDRI)** to evaluate the completeness of project scope definition has led to well defined projects and overall improvement in pre-project planning process.

### 2. Shifting from the 'Contractual' perspective to 'Investigation and preparedness' perspective

The preliminary investigation studies should be treated as a reliable base for preparing the execution and operation aspects of the project and not a mere contractual exercise. Sometimes, to cut cost, the investigation agencies resort to 'lean' methods which deprive such studies from properly drilling holes, specifying the full field conditions, or even visiting the site.

### 3. Leveraging technology

Available leading technologies should be leveraged for making the pre-project planning process more informed through improved efficiency and accuracy in collecting the site data. Refer 'Suggested Implementation Measures' for specific examples.

### 4. Clearly defined scope of work

At the bidding stage, scope of work should be well defined and include sufficient information to limit the scope of change orders and risks

- ✓ Basic design to be complete and mature
- ✓ All mandatory codes such as KPIs and design basis are pre-defined in the bid
- ✓ Shareholder agreement, state support agreement are included in the contract

### 5. Prequalification Criteria

Bidder pre-qualification criteria should be set to ensure that the Best Available Technology (BAT) is employed in the project.

### 6. Design Review

The detailed design should be reviewed by sound and certified project/program managers from a Project Management Consultant (PMC) with a proven track record. In addition, it is recommended that the design and critical components of design are also reviewed and commented upon by an Institute of Eminence (IoE) in parallel to the design consultant. The review and comments should be provided within a defined timeline of 15 days and be limited to compliance with the specifications and standards provided in the bidding documents. The risk and responsibility of compliance of the design would continue to vest with the contractor irrespective of whether the Implementation Agency has reviewed the same or not.

## Suggested Implementation Measures

### 1. Stage-wise budget approval

A three staged approach is suggested for preparing the project budget and approval. Refer the recommendation on 'Establishing a robust project governance structure' for further details.

### 2. Internal benchmarking data

Implementation Agencies should conduct proper benchmarking to assess the level of details covered in the initial studies and address any gaps before firming them up. The benchmarking can be based on past projects' data, which is the most common method used in the industry.

### 3. Implementing a revalidation process of preliminary studies

Post DPR approval, often projects undergo a long gap to reach the tendering stage. In such cases, re-validation of preliminary studies should be conducted before proceeding for the tender stage.

### 4. Leverage technology

#### a) Mobile mapping

Construction projects have historically relied on static instruments such as tripod mounted sensors for data collection. Deployment of Unmanned Ariel vehicles (UAV) and equipment fitted on automobiles is suggested for site data collection, especially in cases of difficult terrain and covering long distance in linear projects.

#### a) Geospatial analytics

This analysis builds maps, graphs, statistics and interpret historical shifts in a location. This shall help organizations anticipate and prepare for possible changes driven by changing spatial conditions in a geography.

Both the technologies provide faster, reliable data at affordable cost and help in eliminating survey errors and improves the quality of DPR. Such methods should be considered to be included in the contracts for preliminary studies.



## Example

The Oil and Natural Gas Corporation (ONGC) Limited has implemented a structured Stage-gate framework as a project delivery mechanism, comprising of project stages and gates in between. The incorporation of gates ensures that the project moves across the stages only after completion of all the deliverable/check-points for the respective gate.

Other Implementation Agencies should leverage this framework or develop a customized end-to-end Stage-gate project delivery framework for executing projects. Few of the expected benefits for Implementation Agencies include but not limited to:

- ✓ A transparent process known and understood by all key stakeholders; internal and external,
- ✓ Improved diligence in pre-planning (such as DPR, geological investigation studies etc.) and planning activities,
- ✓ Better confidence in the accuracy of budget and schedule baselines during project approval,
- ✓ A disciplined and consistent approach to project execution, and
- ✓ Built in cross-department/government inputs at all gates as check points such as land acquisition, regulatory approvals etc.

## #2

## Collaborative and Agile Planning

### Basis of Recommendation

**Project planning has been observed to be a key, yet often neglected area in this study.**

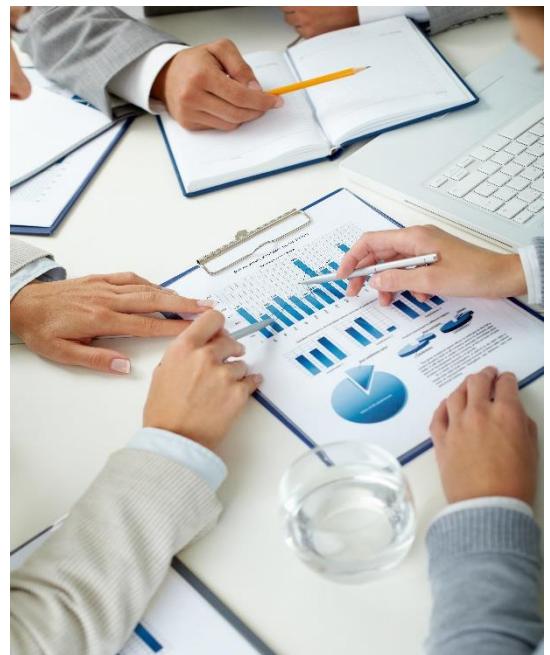
One case study highlighted that the project completion target defined by the agency did not account for contractor inputs. The contractors typically do not have much motivation to optimize the plan, if the completion targets are contractually directed by owner organizations. Therefore, during project execution, the project schedules were not updated in majority of cases, and even the basic level of critical path monitoring was not followed in one of the studied projects. Overall, the planning efforts spent on these projects have been insufficient, without taking cognizance of both cost and time optimization levers.



### Core Recommendation

Given the aggressive targets of infrastructure investments, adopting an integrated planning and governance framework prior to project initiation is imperative to address the constraints in project implementation lifecycle, hence it becomes critical that project planning be made realistic and holistic.

The studied projects' performance underscores the need that sufficient investments should be made by the Implementation Agencies in upfront planning, encompassing the inputs from various stakeholders. This warrants a paradigm shift in the overall planning approach, where in the Implementation Agencies need to move towards collaborative planning process, involving the downstream players (contractors/subcontractors) and key stakeholders (various departments, local communities etc.) for effective buy-in that leads to realistic targets.



## Core Recommendation

### 1. Collaborative planning for realistic targets

It is to be understood that project plans prepared in isolation (whether by Implementation Agency or contractor) are only contractual obligations but not the solutions or means for achieving the planned targets. This prevailing practice of silo planning often leads to fragile target completion dates which are devoid of any constraint's planning and optimization opportunities.

The project baselines should be established in consultation with various stakeholders including contractors and suppliers. This would also ensure that the Implementation Agencies, contractor organizations and consultants align on project requirements, and fix the project design as early as possible. Additionally, the collaborative planning would also ensure that the design/engineering process would be optimized, keeping the fastest and safest construction sequence and methodology in consideration.

**More than 50% of the interviewed organizations responded that integrated project delivery with collaborative planning will be an effective mitigation measure for project overruns.**



Involving the downstream players in upfront planning stages also provides the opportunity to discuss and optimize scope (such as design standardization, value engineering etc.). Moreover, studying the effect of the project on the surrounding areas rather than just the end user is seen as a major area for improvement. The socio-cultural aspects of capital projects are important determinants for decision makers while planning infrastructure investments. Providing livelihood support to project affected personnel may enable better stakeholder buy in.

### 2. Bring agility in planning

Infrastructure projects tend to be complex in nature and are exposed to uncertainties. Under such circumstances, keeping the project plans 'fixed and rigid' and continuing to report deviations is synonymous to *failing to plan*. Planning is an iterative process and project teams should be able to constantly respond to changing project situations and uncertainties, and adjust the plans accordingly. Both Implementation Agencies and contractors should jointly perform the plan adjustments, and mutually agree on the revised plan. The contract conditions need to facilitate this agility in planning and flexibility in completion targets instead of resorting to claims and disputes, which eventually hurts the project.

## Core Recommendation

### 3. Keep the plan up to date through regular contact sessions

The project plans need to be rigorously updated by contractors and reported on periodic basis as required. Additionally, conducting frequent contact sessions with stakeholders for seeking inputs and communication would make the update process more effective.

### 4. Considering total cost of ownership while planning

Traditionally, planning for infrastructure spend involves factoring only immediate cost implications or the capital expenditure and identifying 'capex' savings opportunities. It has been observed that there is a lack of focus on factoring the operational costs or 'opex' and its long-term implications while planning the investment. A typical Detailed Project Report should include set-up and operational aspects and the costs involved,

thus addressing total cost of ownership and covering the entire project lifecycle.

### 5. Factoring in 'cost of delay' or 'opportunity loss'

Schedule optimization levers should be explored upfront during planning stages and prioritized based on the trade-off with the opportunity loss or the cost of delaying the project. This will lead to a better informed planning approach and corrective decisions during execution.

### 6. Milestone based payment with incentives and penalties

Payments should be made for completion of milestones in construction work and not on supply of equipment/material. Early achievements of key targets should be incentivized while delays or non-performance of KPIs should be penalized.



## Suggested Implementation Measures

### 1. Preparing a joint project management plan

A detailed Project Management Plan should be prepared jointly with state governments (as applicable), contractors and consultants, and after conducting frequent stakeholder contact sessions at the start of the project. This would consist of project delivery/execution strategy, master schedule, expected role/responsibility of state governments, cost plan with cash-flow requirements. The combination of all these will constitute the baseline plan of the project.

### 2. Look ahead plans

Once the baseline plans are in place, look ahead plans should be prepared for detailed execution planning, constraints screening and monitoring. Last Planner® System of production control is recommended to be leveraged, which is explained in detail in the recommendation of 'productivity improvement'.

### 3. Incentivizing contractors and consultants

Contractual methods for incentivizing contractors and consultants for collaborative planning should be considered. This would result in realistic target setting.

### 4. Implementing a budget classification system

A standard budget classification system (such as Association for the Advancement of Cost Engineering or AACE or others) should be applied based on which the project estimate should have a predictive accuracy range.

### 5. Leverage and contractually mandate technology usage

Use of advanced tools/technology such as schedule analytics, Primavera, and Building Information Modeling for improved visualization, integration amongst stakeholders, and forecasting should be mandated in contracts. Application of such tools will streamline the planning process. Refer the subsection on 'Exploring the limits of technology' for details.



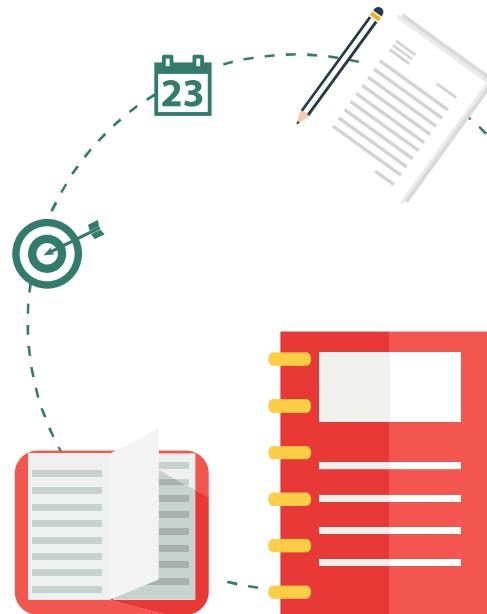
#3

## Reforming Procurement and Strengthening Contracts Management

### Basis of Recommendation

As per the World Bank's ease of doing business 2018 report, India ranks at 163rd position among 190 countries when it comes to enforcing of contracts even though it is improving in other parameters in ease of doing business ratings. It takes roughly ~ 1420 days for a contractual dispute to get resolved, which is 8-9 times higher than the time required in Singapore. With increase in India's economic activity and consequently disputes both at domestic and international levels, such issues need to be addressed in a concerted manner. This is essential to create a positive image, especially amongst foreign investors.

Recently, Cabinet has approved an ordinance to amend Commercial Courts, Commercial Division and Commercial Appellate Division of High Courts Act. In addition, Cabinet has also approved the Arbitration and Conciliation (Amendment Bill) 2018 to encourage institutional arbitration for settlements of disputes and make India a center of robust ADR (Alternative Dispute Resolution) mechanism. It is critical to ensure effective implementation of the positive steps being taken by the Central Government



**55%** of respondents stated that arbitration still takes over two years for resolution.

**87%** of respondents stated that contractor selection is a root cause for project performance shortfalls.

Source: KPMG-PMI Survey 2018

## Core Recommendation

The recommendations in this area are broadly categorized under the two categories of 'procurement related recommendations' and 'contracts and claims related recommendations'.

### A. Procurement Related Recommendations

#### **1. Waterfall Approach for Project Structuring\***

Waterfall approach should be adopted for selecting the right project structure and ensuring that projects are first checked for viability as a PPP (BOT) project, then as PPP (Annuity) project followed by EPC/Lump sum/Turnkey contracts. Item rate contracts may be discouraged and avoided.

#### **2. Implementation of model contracts advocated by NITI Aayog**

It is suggested that all PSU's implement model standard contract documents suggested by NITI Aayog for EPC contracts. It has been advocated by the highest policy making body that EPC contracts be used as much as possible and a conscious shift is made from the traditional item rate contracts.

The model contract agreement is devised in a way to allow better risk allocation, equitable sharing of responsibilities and has standard clauses for incentivizing or penalizing contractors for delay, provisions for addressing other techno-commercial scenarios between the parties and comprises formats for various contractual documentation.

Two model agreements were reviewed as sample in this study which have been suggested by the Planning Commission to be used by NHAI and railways. The same should be customized and adopted by other PSUs also for consistent maturity in contracts.

Few notable clauses included in Model EPC agreement are:

- i. Right of Way, utilities and trees
- ii. Bonus for early completion
- iii. Contract price weightages
- iv. Stage payments for work
- v. Time of payment and interest

#### **3. Supplement institutional capacity**

It is also pertinent to note that many organizations may lack adequate institutional capacity, experience and exposure to handle procurement and contracting for major capital investment.

In order to bridge this gap, there is a need for the organizations to engage with industry and policy making bodies such as NITI Aayog, which have relevant skillsets to guide or support Central PSUs, State PSUs and various Ministries or Departments in developing the right procurement strategy and devising the appropriate contract documents.

#### **4. Customized contracting strategy**

In many cases, it has been seen that EPC/turnkey contracts are better for accountability and execution where the contractor has strong experience and knowhow on designing and building such projects. Time and cost overruns are typically higher in item rate contracts and this also needs heavy deployment of manpower from the Implementation Agencies. Hence, the contracting strategy should be decided carefully acknowledging various factors involved in executing the contract and the project.

\*Note - The waterfall approach is suggested only for project structuring as a prioritization framework, which may be combined with agile approach in a hybrid model for managing the uncertain aspects of the project such as land acquisition and regulatory approvals.

## Core Recommendation

### 5. Assessment and deployment of different bidding methods

Lowest price bid selection has been the most preferred method for selection of contractors for capital projects. However, it has been observed that unrealistically low price bids are made by contractors in a bid to win the project, which later becomes unsustainable to complete the project. In view of the same, it is recommended that two stage bidding process may be encouraged which can restrict the competition commercially, while having specific focus on technical qualifications. A robust two-stage bidding process should comprise of a RFQ for shortlisting of bidders with proven track record and thereby obtaining most competitive financial proposal from the shortlisted bidders.



Other models of bidding may also be considered which are prevalent globally, with the goal to avoid unrealistic bids and award to technically and financially sound contractors. Few of these methods are enlisted below.

#### Average bid method and its variances

#### Most economically advantageous tender

#### Negotiated bidding

#### Alliance and relational contracts



### 6. Propagation of internationally accepted contract formats such as FIDIC

This will improve the perception and confidence of doing business in the country and will lead to larger global participation in the execution of projects.

### 7. Institute project management training and certification requirements for contractor/vendor onboarding

To increase the effectiveness of executing contractors/ vendors, project and program management should be included as a core competence, as evidenced by presence of qualified and certified project managers. This should be included in the technical part of a tender/ Request for Quotation (RFQ).

## Core Recommendation

### B. Contract and Claims Management Related Recommendations

#### **1. Fast tracking of the proposed setting up of “Arbitration Council of India”**

As per the proposed Arbitration and Conciliation (Amendment) Bill, 2018 ("Amendment Bill"), an independent body namely "Arbitration Council of India ("ACI") will be created. ACI will grade arbitral institutions and accredit arbitrators by laying down appropriate norms. The ACI will also take steps to promote and encourage arbitration, mediation and conciliation and evolve policy and guidelines for the establishment, operation and maintenance of uniform professional standards in respect of all matters relating to arbitration and alternative dispute resolution (ADR) mechanism. The creation of this institution needs to be fast tracked, as its creation would be a significant step in inspiring the confidence in contract enforcement and dispute resolution. This body is also supposed to act as a body of knowledge for promoting arbitration and alternate dispute resolution, so that commercial disputes have minimum grounds to go to already overloaded judiciary.

#### **2. Encourage mediation, conciliation and arbitration to avoid litigation**

All contracts need to be equipped with relevant clauses allowing any dispute to go through these processes of resolution before being taken to the court of law. The model agreement for EPC contract by NITI Aayog provides standard clauses for the same and this needs to be encouraged by every ministry. These methods also need to be strengthened for enabling enforcement.

**Example:** A new two tier mechanism is being put in place by the Central Government to fast track resolution of disputes involving central PSU's. This will involve a time bound (3 months for first tier) resolution of the commercial disputes.

#### **3. Incubate pool of SMEs for arbitration**

With the amendments of Arbitration and Conciliation Act, it is important to provide adequate number of professionals to facilitate cost effective and speedy disposal of arbitration cases. India has scarcity of Subject Matter Experts (SMEs) for arbitration panels, especially to understand and arbitrate commercial/ financial/economic matters. Arbitrators with finance/ economics/ commercial background may be included in the institutional pool of arbitrators along with experts in technical and legal field so that the industry can access this pool. The pool of SMEs may be incubated by Arbitration council/Institutions for arbitration. Presently, due to lack of infrastructure and regulator, there is no central portal available for training and registration of Arbitration professionals.

#### **4. Contract management capacity building and continuous monitoring of contracts**

While the above steps would be important to resolve disputes, more proactive and balance contract management can save many contracts from getting in disputes. Achieving this would require capacity building for contract administration and claims management. Contract administration by a professional contract administrator including timely contract correspondence, documentation, compliance tracking and highlighting risk areas is needed to ensure minimal scope of disputes. Such administration might require training of professionals and appointing professional third party agencies, wherever required.

## Core Recommendation

- 5. Build contingency/flexibility in contracts for various scenarios-** A typical large capital project is a multi year affair with many complexities involved around scope, multiple stakeholders, components, design, procurement etc. Many of these factors are inherently variable and thus impact the project's contractual commitments over the execution duration of the project. Hence, the contract needs to have enough provisions to address such situations.

**Example:** Including price escalation clause or providing optional pricing for some items which is not estimated but may later be required for the execution based on site conditions are examples of building contingencies in contract to help address various scenarios during project execution.

## Suggested Implementation Measures

### 1. Propagate Model Contracts

The model contracts and such resources been released by NITI Aayog may be propagated by various means to be available and understood by all CPSUs and SPSUs across the country. Ministries may be mandated to promote the use of model contracts for projects.

### 2. Conduct trainings and capacity building exercises

Ministries may be mandated to conduct trainings of personnel in procurement and contract management. Ministry of Personnel and Training may accordingly devise training plans so that PSUs may subscribe to the training plans and implement the same.

### 3. Guidelines on bidding method

The Central Government level may issue a notification to all CPSUs/State PSUs/Ministries and Departments to explore other bidding methods for capital investments/expenditure.

Two stage bidding may be an immediate step to be mandated for IAs, thus limiting the number of parties whose commercial bids are to be opened for evaluation based on technical qualification. In addition, more bidding methods such as variations of Average Bid method, Quality and Cost based selection etc. need to be evaluated and applied.

### 4. Promote Alternate Dispute Resolution (ADR)

Government has to promote alternate dispute resolution methods such as conciliation, mediation and arbitration over the usage of court for commercial dispute resolutions. This may also include mandating this requirement in the project investment approval processes.

### 5. Leverage professional experience

CPSU/SPSUs and Ministries should leverage professionally experienced hands for drafting of contracts. This is essential, since the conditions drafted goes a long way to ensure the success of a project. Hence, it is a crucial activity and in case of unavailability of internal experience, augmenting with external support should be considered.



#4

## Lean Construction Implementation for Productivity Improvement

### Basis of Recommendation

Construction is an unorganized sector in India and poor productivity, low utilization of resources, and site inefficiencies are natural offshoots. This coupled with scarcity of skilled resources impacts work eventually leads to reworks, errors, quality issues and delays.

Around 38% of interview respondents highlighted rework as a key issue and around 46% of interview respondents mentioned poor productivity/low availability of skilled resources having high impact on project schedules.

Additionally, ineffective labour and material management and acute shortage of skilled resources (despite having available work fronts) have caused high impact overruns in few case studies. Such issues require a systemic change in planning and managing construction at site level.



**Around 83% of the interviewed organizations responded that poor productivity and skilled labour unavailability has impact on timely performance of projects.**

### Core Recommendation

**Lean construction**, a globally accepted leading practice for large projects, improves work flow, reduces process waste and leads to optimization in whole (not in parts). Leading organizations have realized that despite fixing the baseline plans in coordination with the team, there is an impending need for converting them into reality with careful planning and coordination of different trades at production level. This can reduce waste and variability for delivering value, while making the best utilization of available resources.

Both Implementation Agencies and contractors should consider adopting lean construction principles, which are widely prevalent in other countries, both in public and private sectors. As a starting point for the Indian public sector projects, few select lean construction methods listed below should be considered to address the productivity issues that have been identified in the interviews and case studies.

<b>Lean Assembly</b>	<b>Last Planner® System</b>	<ul style="list-style-type: none"> <li>• Making the work “ready” and constraints free</li> <li>• Involving downstream players in upfront planning</li> <li>• Measuring commitments - ‘did’ vs ‘will’ (% of commitments)</li> </ul>
	<b>Work Sampling</b>	<ul style="list-style-type: none"> <li>• Identifying and eliminating ‘wastes’ in construction process</li> <li>• Use of digital platforms for automatic data reporting</li> </ul>

## Core Recommendation

### 1. Moving from dates to commitments; implementing system such as the Last Planner® System

Contractors may adopt system such as the **Last Planner® System** for lean work structuring and production control at site level and the agencies should facilitate and monitor its implementation. The Last Planner® System advocates involving site foreman/site supervisor (the last planner) in screening the upcoming assignments from the master schedule and accordingly planning the weekly work. This process establishes a network of commitments from the last planner which becomes the basis of weekly work planning.

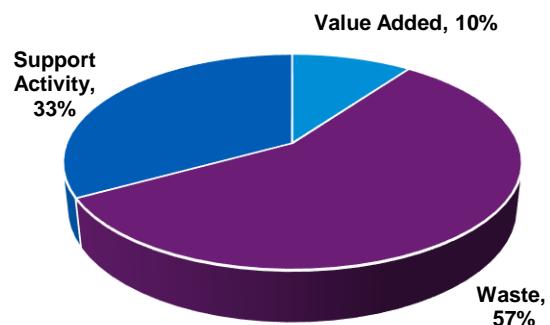
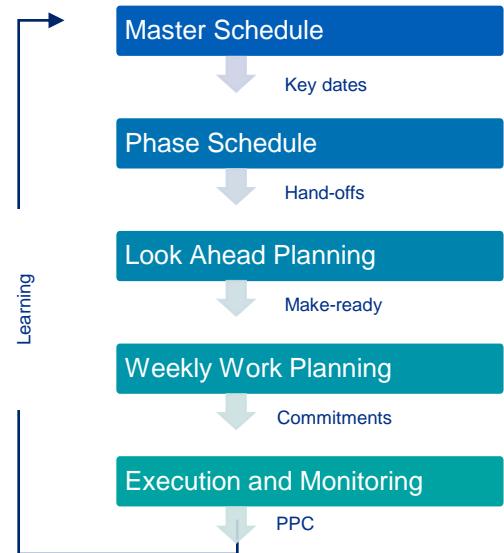
**Percentage of Planned Commitments (PPC)** is a key metric which is tracked on a weekly basis to assess the planning reliability. Typically, PPC has been observed to have a strong correlation with the productivity and project progress.

Both Implementation Agencies and contractors need to work together to monitor PPC as a KPI in addition to the work progress and dates.

### 2. Removing wastes and variability from site operations

The process waste in construction site operations is estimated to be more than 50% at global level and the figures are much inferior in Indian context. The prevalent variability in through-puts/hand-offs of different crews exacerbates this further. The only way to address this is to apply 'production control' which is a missing element in the existing scenario of construction management. Site operations need to be observed with *muda* (waste) glasses to identify and remove multiple sources of wastes and variability to improve the efficiency and utilization of available resources. This becomes all the more important when the availability of skilled resources is scarce in the Indian infrastructure sector.

**The contractors should re-evaluate the site operations and apply lean principles for removing waste for the best utilization of available skilled resources. Using digital technology such as Internet of Things (IoT) can further aid in identifying the sources of waste and monitoring resource utilization. (Refer sub-section, 'Exploring the limits of technology' for details)**



## Suggested Implementation Measures

### 1. Training of project management staff

Adequate training should be provided to the project management staff and field supervisors of agencies and contractors for implementing the lean construction practices.

### 2. Required discipline in following Master schedule

Project master schedule should be maintained and followed rigorously by all stakeholders, as the implementation of system such as the Last Planner® System is contingent on following the conventional critical path monitoring system.

### 3. Complementing Last Planner® System with Master schedule

Look ahead schedules should be based on master schedules which should become the basis of the last planner discussions. In addition to the typical KPIs of dates, progress etc., KPI of PPC should be monitored and reported on weekly basis.

### 4. Time motion/work sampling of repetitive operations

Contractors should identify few select execution operations (such as concreting, earthwork etc.) as 'optimization cases' for improving their output, which should improve the overall project through-put as well. Sample time-motion/work sampling studies should be conducted for such cases for waste removal.

### 5. Strengthening contracts

Implementation Agencies should contractually mandate the requirements of improving contractors' resource utilization and productivities through new methods such as lean construction. The agencies should demand the reporting on PPC and utilization of contractors' resources in addition to monitoring the headcount.



## Examples

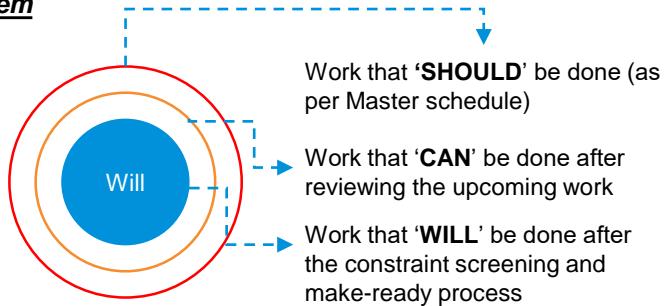
Both Last Planner System and Work sampling or time-motion studies are proven techniques to reduce waste and variability. KPMG teams have utilized these techniques on multiple projects in power, transmission, manufacturing, and real estate sectors, which improved the productivity and output by more than 20%.

### Few achieved benefits:

- Slab Cycle time reduced by 25%
- Labour Efficiency up by 72%
- Crew Utilization up by 95%
- Batching Plant output increased by 27%
- Crane utilization up by 20 %

### Implementation of Last Planner® System

**The Last Planner® System was implemented to move from 'SHOULD' to 'WILL' after taking commitments from the Last Planner against which the PPC was measured.**



Group	Project	Activity	Responsibility	Completion Plan												Constraint Category
				M	T	W	T	F	S	S	M	T	W	T	F	
1		Concreting of Footing F2			x											
1		Concreting of Footing F3				x	x									
2		Concreting of Footing F4					x	x								
2		Concreting of Footing F6						x								
3		Concreting of Footing F7							x							
3		Concreting of Footing F8								x						
4		Concreting of Column (GF)									x					
4		Concreting of Column (P)									x					
5		Shuttering of Footing F2										x				
5		Shuttering of Footing F3										x				
6		Shuttering of Footing F4										x				
6		Shuttering of Footing F6										x				
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#5

## Embedding a Culture of Risk Management

### Basis of Recommendation

A structured risk management process is warranted to adequately plan for project uncertainties.

Despite a high response rate in interviews, it was observed in all the case studies conducted that majority of risks were not factored in upfront planning stages, which subsequently led to cost and time overruns. Few uncontrollable risks such as land acquisition and weather conditions could have been planned for with adequate buffers/contingencies, while the impact of controllable risks could have been mitigated to an extent. This lack of preparedness is a result of absence of a robust risk management process and its governance across the project value chain, transcending the Implementation Agencies, contractors, and other stakeholders.



**Around 56% respondents quoted suboptimal feasibility reports as a primary reason for delay of projects in the planning stage**

### Core Recommendation

Projects are to be dealt as businesses and risks are to be considered as inevitable aspects not as bi-products. Many agencies are not fully aware of risks due to lack of an appropriate risk culture and/or a mere understanding of risks. Risk management should become an integral part of the project value chain of Implementation Agencies; right from concept/feasibility stage to commissioning stage. The agencies should embrace and adapt risks instead of neglecting or simply transferring them to contractors.

#### 1. Institutionalize a risk management policy

Institutionalizing a robust policy on project risk management would drive entrenching the risk culture and cascading it down to all the key stakeholders; be it contractors and/or other respective departments/agencies. Addressing risks by the agencies should begin right at the outset. For example, the project approval process should necessitate inclusion of a thorough risks analysis with risks quantification and mitigation planning, based on which the proposed budget and timelines should be sensitized to the respective boards. These risks should be carried forward in the project lifecycle for continuous monitoring. Therefore, the policy should demand risks assessment and documentation through-out project execution.

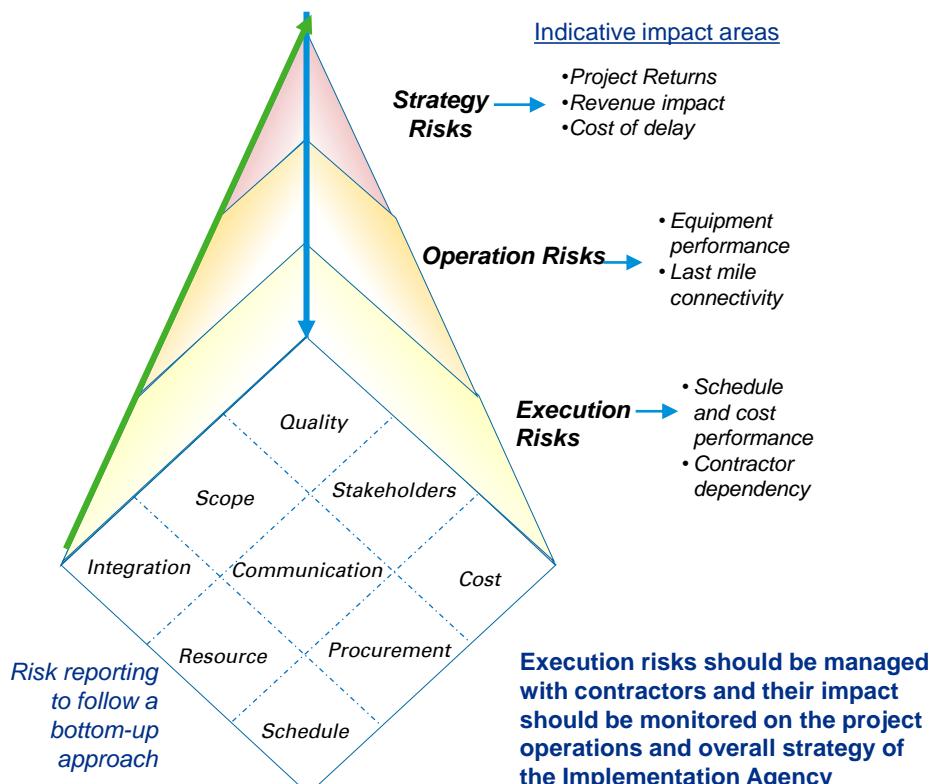


## Core Recommendation

### 2. Implement a framework of risk management

Agencies should prepare and implement a risk management framework across the project lifecycle, which should include all the functional management areas of project delivery. The framework should be supported by a comprehensive risk universe as a standard for all types of projects against which risks applicable to a specific project may be identified and included in the project's risk register. Additionally, both internal and external risks should be considered at different levels; Enterprise/Strategy, Projects, and Operations.

*Risk impact assessment should follow a top-down approach*



### Functional management areas of a Project

Risk weighted planning may be adopted, which would lead to applying risk factors at the planning stage, with the outcome of multiple scenarios. It aids the team in contingency planning for each scenario. This scenario analysis and associated schedule impacts can be considered for planning risk mitigation action plans.

## Suggested Implementation Measures

### 1. Setting up a core risk management committee

An independent risk management committee should be considered for enforcing the policies and framework of risk management, an objective risk evaluation of projects, and to apprise the senior management of Implementation Agencies on risk impacts and corrective actions. State governments also should be involved in this committee, as applicable.

### 2. Include risk management procedures in contracts

Contract mechanism should be leveraged to drive contractors risk behavior and ensure accountability. The risk transfers should be based on 'natural ownership' between contractors and agencies to position the best party to manage risks in the interest of the project.

### 3. Follow risk based contingencies

While budgeting and scheduling projects, the agencies should shape the contingencies, linking it with the outcome of risk assessment.

### 4. Maintain risk discipline and continuity

Regular risk workshops should be conducted between agencies, state governments, contractors, and other respective departments. The project team should routinely validate and/or update existing risk assumptions, constraints, and analysis of potential impacts

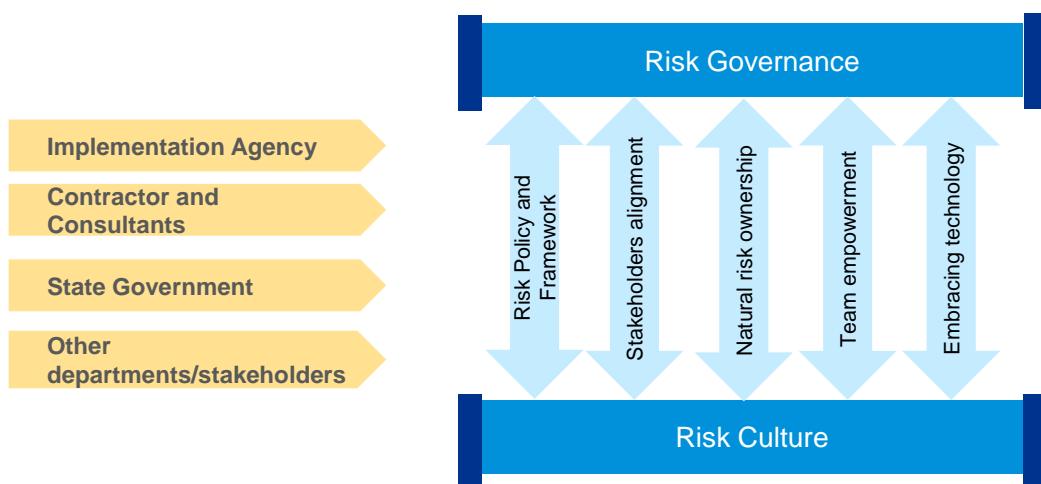
### 5. Leverage technology

The available technology/tools should be utilized for facilitating risk management across the stakeholders. Such tools enable risk profiling of the projects, generating risk heat maps, assigning risk ownerships, and tracking the mitigation plans. Few advanced tools provide capability of running simulations in project schedules to calculate probabilistic estimated completion.

### 6. Train the team

The agencies should continuously be trained in conducting thorough risk management with practical approach and tools.

## Key enablers of an effective risk management implementation



## Strengthen People Management Processes

**#6**

### Basis of recommendation

Slow decision making and lack of structured project communication are two critical issues, which have emerged from the study as root causes for time and cost overruns. These reasons can be attributed to certain organization wide process and culture which need revamping in the interest of projects.

The Indian infrastructure industry is primarily driven by public institutions, where need for transparency and intense public scrutiny on any decision is the usual backdrop. Still, decisions have to be driven by data, sound information and accurate analysis. For improving the decision making ability, the decision makers need to be **truly motivated, well trained, completely informed and adequately empowered.**

**Above 38%**  
respondents say that delayed decision making by Implementation Agency adversely impacts project during planning phase.



### Core recommendations

#### A. Process related recommendation

##### 1. Clear responsibility charter with delegation of decision making process

Processes and practices need to be innovated to ensure effective decision making. This may require clear responsibility charter. Additionally, delegation of authority needs to be encouraged at respective levels to have the right balance between centralized and decentralized decision making. This is an important aspect to ensure that decisions are taken at the right time and at right level and employees need to be encouraged to take decisions.

##### 2. Adopting technology

Technology adoption across processes and locations can lead to higher efficiency and almost real time information flow to ensure appropriate

decision making. Technologies to connect remote sites through cloud based dashboards, live view of sites during review meetings, inventory monitoring through IoT, collaboration and project monitoring through platforms such as India Investment Grid (IIG) portal, mobile technology for reporting amongst others, should be adopted. Further, organizations should be encouraged for shifting to e-file movement and making their offices paperless through adequate reward mechanisms.

##### 3. Overcoming legacy challenges

Many decisions are delayed due to old and ambiguous/conflicting policies, procedures and protocols, that get complicated due to legacy challenges of large organizations over a long period of time. Hence, periodic reviews should be conducted for these orders/polices/rules to keep them current and relevant.

- ✓ Proper delegation of authority to be ensured at every level
- ✓ Processes and practices need to be modified and implemented strictly at times to ensure decisions are taken at the right level

#### Adopting Technology

- ✓ Technology adoption to facilitate informed decision making
- ✓ Technologies to connect remote sites through IoT, cloud etc. for real time information flow

- ✓ Periodic reviews of conflicting/ambiguous rules
- ✓ Rejection and overruling of procedures/rules that have been irrelevant over time

#### Empowering Employees

#### Overcoming legacy challenges

## Core recommendations

### B. People related recommendation

#### 1. Change in HR policy

The Implementation Agencies need to rethink and revamp their strategy towards human resource management including hiring, developing, training and motivating employees.

**1.1 Specialized skill based hiring, requirement based flexibility in hiring process** are some specific areas of development. Capabilities should be enhanced in the areas of contracts and commercials, project monitoring, and project financing.

#### 2. Project specific organization structure

There is also a necessity to have a separate organization structure dedicated to any major capital expenditure above a certain threshold value (example- above INR 1000 crore). This can insulate the decision makers for such projects from regular operational aspects of the organization to focus mainly on the project. This also brings in accountability and responsibility and provides potential to incentivize the team for better project performance or take necessary action for under performance.

## Examples

### Mechanisms across the world



- Individual Performance Appraisal system
- Performance related pay



- Performance Appraisal system & Pay for performance
- Lateral hiring from private sector



- 60% of compensation is linked to performance and 40% is fixed



- Selects & trains the best students on a renewable contract basis

### Other mechanisms

Mechanisms	Rewards	Sanctions
Funding	Increase funding to the agency. Maintain status quo on agency funding. Increase the staff budget. Provide management and employee bonuses.	Reduce or restrict agency funding. Eliminate agency funding. Cut the staff budget.
Flexibility	Allow the agency to retain and carry over efficiency gains. Allow flexibility to transfer funds between different programmes and/or operating expenditures. Exempt the agency from certain reporting requirements.	Return all funding to the centre. Restrict ability to transfer funds. Increase reporting requirements. Order a management audit of the agency.
Public recognition	Publicly recognise the agency's achievements.	Publicly criticise the agency's performance.

Source: Paper on "Improving Public Sector Efficiency: Challenges and Opportunities" by Teresa Curristine, Zsuzsanna Lonti and Isabelle Joumard

#### 1.2 Merit based performance evaluations

evaluations by linking compensation to performance appraisal and setting up a transparent performance appraisal system across the organizations should be considered. Many countries around the world use performance based appraisal system for higher productivity and better performance from employees, especially in the government sector. This system has potential to boost motivation levels of high performers and increase performance of low performers.

#### 3. Manpower/succession planning

Organizations may also consider planning for successions at leadership and higher management roles through structured succession planning programs. This may include grooming high performing individuals, implementing specified training programs and encouraging cross functional expertise to develop.

## Suggested Implementation Measures

### 1. HRD policy level interventions

The Department of Public Enterprises (DPE) has issued an HR advisory to all Central Public Sector Enterprises (CPSEs) on professionalization of below Board level management in CPSEs. The measures recommended in the advisory include defining critical roles in CPSEs and mapping of competency framework of incumbents for future readiness, institutional mechanism for appraisal of performance of personnel, regular trainings and capacity building activities and succession planning to ensure timely availability of high-performance individuals for critical leadership roles in the organization. The DPE proposed best practices to be adopted by CPSEs in the areas of -

- a) Alignment of HR strategy with business
- b) Rewards and recognition
- c) Promotion and career management
- d) Employee engagement
- e) Training and development
- f) Leadership development

These measures need to be taken up on high priority for implementation in the public sector across all organizations.

(For more details, please visit the weblink <https://dpe.gov.in/professionalization-below-board-level-management-cpses>)

### 2. Empowering employees

This culture has to be enforced from the top of the organization with adequate policy support to the working level. While delegation of authority is available in many cases for decision making in the organizational manuals, it is not strictly followed and decisions are delayed.

In other cases, the effectiveness of the delegation powers has lost relevance over time. Hence, the process needs to be relooked at and modified by the Boards of

the organization and the policy needs to be put into action through strict implementation.

### 3. Awards scheme for adopting technologies

Organizations can be incentivized for introducing and adopting technologies and showcasing the same through collaborative mediums. The Central Government may introduce a scheme for encouraging CPSU's to adopt latest technology to improve project performance. A time bound implementation and demonstration of results across projects can earn the best PSU's an award. The Central Government may introduce an annual award for PSU's adopting latest technology and showcasing the technology transform project performance.

### 4. Review of all business rules

Organizations may also review its business rules for implementing any capital projects. These rules may be categorized into Engineering standards, Procurement philosophy, Construction practices, Commercial conditions etc. Such reviews should be carried out periodically and business rules be contextualized to the current time, thus making the rulebook relevant.

### 5. Encourage project organization

Projects over a certain threshold size and value needs to have project specific organization to drive the project. A focused and project dedicated team helps keep the focus and delivering the project in good time and cost.



## #7

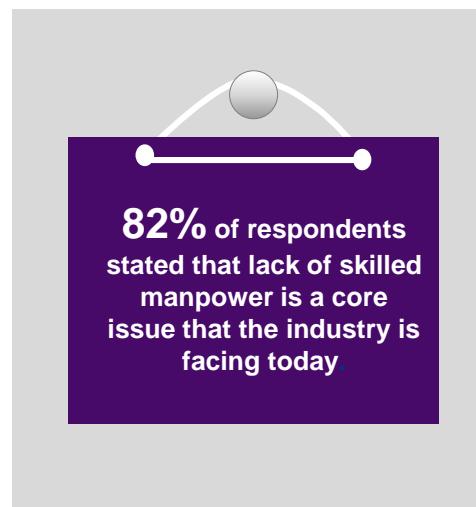
## Augmenting Organizational Skillsets

### Basis of Recommendation

Capacity of resources or availability of skilled resources have traditionally been a major bottleneck in the infrastructure industry. These skilled resources can broadly be classified into two categories; 1) skilled manpower for field work and 2) technically qualified professionals for project administration.

While the former is scarce because of lack of adequate training facilities and unattractiveness of the career, the latter has now become a challenge due to changing technology and minimal effort in continuous learning.

Hence, capacity building is a core area of focus for the industry and Government at Central and State level needs to do much more to infuse the skilled manpower into this industry.



### Core Recommendation

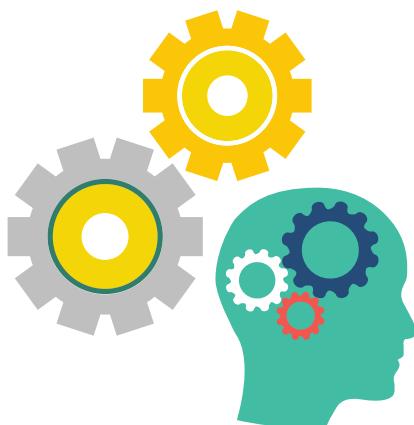
The following measures would help the industry reduce the skill gap and increase capability of the existing and future manpower.

#### 1. Skill gap assessment

The Central PSUs need to set up a process to assess skill gap in the organization through a third party assessment. This will enable them to map current skills available across various functions such as engineering, procurement, construction, finance etc. This can also include skill gap associated with primary skilled worker shortages faced for field/construction works taken up directly by the organization or through the contractors/sub-contractors employed by the organization.

#### 2. Set up institutional tie-ups

For enhancing the knowledge base in core areas such as project planning, monitoring, contract management, and risk management, tie-ups with institutions and industries both at local and global levels should be explored. This would provide easy access to training curriculum, materials and interactive knowledge sharing sessions, and would also bring in global leading practices.



## Core Recommendation

### **3. Encourage formal training with certification in project /program management for professionals**

Adoption of project and program management best practices would enable the Government enhance the likelihood of realizing project benefits, save taxpayer money, improve service delivery, and perhaps most importantly, boost infrastructure development. The Government and Implementation Agencies thus need skilled and certified project and program managers to deliver public projects effectively and efficiently. Relevant government departments should take steps in getting their personnel trained and certified in project and program management, especially those who are deployed in various projects considering the strategic role played by them in planning, implementing, and monitoring projects/programs.



### **4. Set up multi level learning programs for executives**

Based on the skill gap assessment, executives/engineers need to have a learning program. Technology can bring the required learning within reach of everyone. Hence, large organizations need to implement career spanning multi level learning programs, which can include junior management program/middle management program/leadership program. Upgrading skills to adopt technologies such as BIM, virtual reality, drone based surveying, autonomous measurement techniques, and lean construction techniques should be considered.

### **5. Skilling workers for construction industry**

Ministry should take up an assessment of courses/curriculum being offered for skilling workers for the industry, to ensure that more new and advance skills are targeted, which can be rewarding enough to offer a promising career. These may include operating high end construction machinery, heavy duty construction vehicles, top end cranes, drone and LIDAR based surveying etc. This may also require collaboration with specialized equipment manufacturers.

**Example:** NSQF (National Skill qualification framework) is a competency based framework that organizes all qualifications according to a series of levels of knowledge, skills and aptitude. All training and skilling institutes need to be compliant to NSQF for providing any certification, thus bringing standard and quality to the qualification process.

## Suggested Implementation Measures

### 1. Organization level skill gap assessment

PSUs may commission a study by a third party agency to identify specific skill gaps, current skill availability, employee-skill mapping, industry-skill mapping and future skill requirement for the operations of the organization. Based on the study, the skill gap can be analyzed and accordingly strategy can be prepared by organizations specific to their needs.

### 2. Organizations to plan programs

Organizations may plan the bridging of skill gaps identified by various techniques such as:

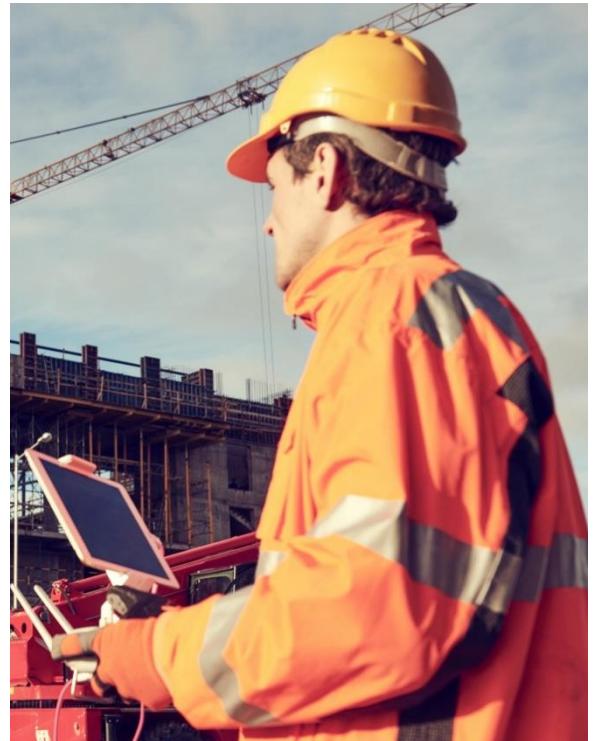
- a) Long term plan for career development through multi level learning program,
- b) Short term skill development/certification programs, and
- c) Bringing in industry knowledge leaders/specialized staff for one-off requirements

### 3. Organize peer to peer knowledge sharing programs

It can be used as a medium to collaborate with industry and can be facilitated by Ministries, with participation from relevant organizations. These knowledge sessions may follow a structure over a period of time, culminating in adoption of leading practices by organizations for high performance of projects.

### 4. Facilitate hiring/recruitment of skilled workers and enable a decent career path

Bringing construction industry workers into a formal employment market is one of the biggest challenges today. This can be initiated by employing the workers who are highly skilled in using new technology, heavy equipment and machinery. Further, organizations recruiting NSQF certified persons may be encouraged or incentivized.



#8

## Deepen Stakeholder Management for Land Acquisition and Regulatory Approvals

### Basis of Recommendation

Delays in acquisition of land, obtaining Right of Way (RoW), shifting of utilities and delays due to agitations which lead to stoppage of works on site by certain stakeholders impact the project budget, time and operational life of the asset. When adequate work front is not ensured, the construction progress suffers, the budget becomes inaccurate, resource efficiency dives and resource idling ensues. This increases the risk of hefty claims from contractor or increases the financial burden to a point where the contractor may refuse to mobilize resources. Additionally, if these issues are not dealt at the pre-planning and planning stage of the project, it increases the risk of change in engineering, scope, and unviable contract consideration.

These processes involve multiple stakeholders including State Government, local authorities and more importantly citizens who are impacted by the project. Hence, these activities need highest level of stakeholder management.

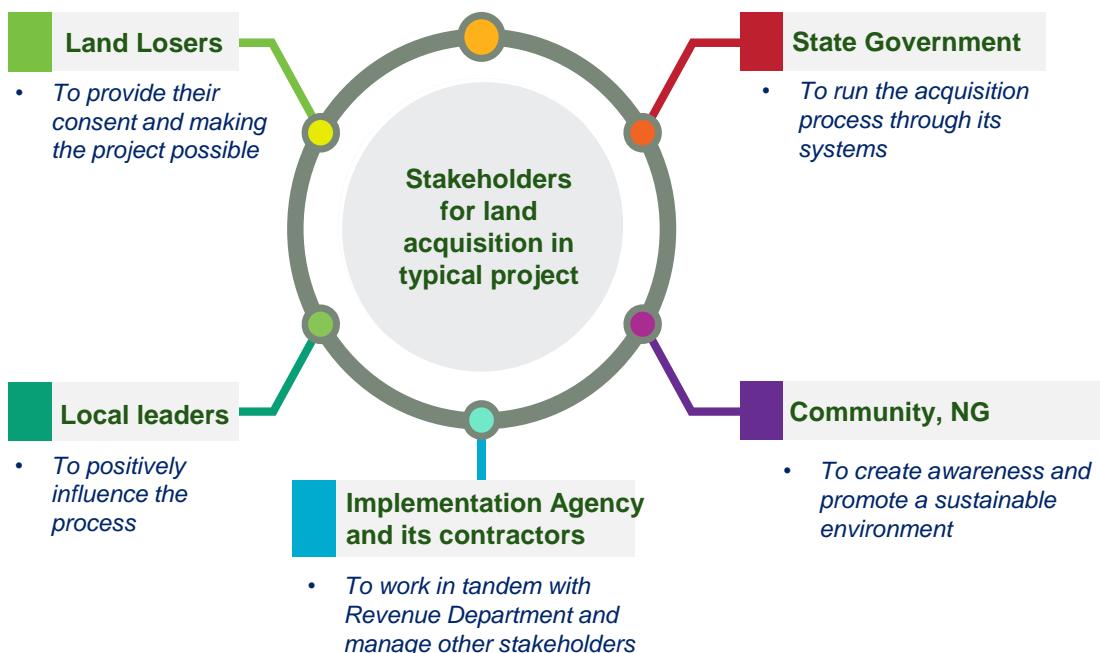
**74%** of respondents stated that land acquisition and its cost is a major concern for projects suffering time and cost overruns



## Core Recommendation

### 1. Implement a Stakeholder Management Plan

It is important that the project Implementation Agency anticipates and identifies stakeholders, carries out a thorough need assessment, and obtain key stakeholder buy-ins. A meticulously carved out Stakeholder Management Plan (SMP) can help guide the authority in navigating through the complex areas such as Land Acquisition, obtaining right of way, responding to agitations etc. The SMP can include plan for offices at various levels to be involved in the process. **An important aspect of stakeholder management would be to make the local population aware of the benefits of the project, run campaigns in support of the project and have multiple stakeholder meetings to obtain buy-ins. Each stakeholder has separate expectation from the process and the SMP should allow the project team to develop a consensus amongst all the stakeholders.**



### 2. Linking project sanctioning and award with regulatory processes

Many projects are taken up, approved and awarded by implementing agencies with insufficient progress in these regulatory process. This typically leads to multiple problems such as incorrect baselining of cost, time, unavailability of fronts for contractors leading to idling resources etc. Hence, a guideline is needed that a project budget can be arrived and approved by the Ministry only after sufficient understanding of costs and time involved for land acquisition/utility shifting or avoiding potential agitations. Further, awarding of a project may be taken up only after significant percentage of land has been acquired.

**Example:** As per report of “Committee of Public Undertaking 2017-18 on NHAI”, it is recommended that no project will be awarded to a contractor before **80% of the required land for the project has been acquired** including forest clearances.

## Core Recommendation

### 3. Implement social cost benefit analysis for projects

Social cost benefit analysis (SCBA) may be mandatorily implemented for all projects over a certain threshold value and requiring significant land acquisition or rehabilitation. The result of SCBA may be made public to ensure that enough awareness is generated on the benefits expected from the project, which can generate a goodwill and positivity around the project, thus facilitating land acquisition.

### 4. Advance buy-in of competent authorities

It is necessary to proactively liaise with bureaucratic counterparts in central and state agencies – police, land acquisition officers, district administration and forest officers – electricity boards, oil and gas agencies, telecom companies and other local authorities to expedite removal of hindrances and for obtaining timely approvals of estimates and certification of running bills of the deputed contractors engaged for the utility shifting in order to make available encumbrance free land for the development activities. **Engaging State Govt. as a financial stakeholder** may incentivize the participation of the state government in the project. Thus, early completion of the project would then

be linked to repayment of its investment. This may expedite the administration machinery.

### 5. Digitization of land records and workflow for land acquisition and explore technology such as blockchain

Another important aspect of delay in land acquisition is the delay due to manual process for creating and maintaining records. Hence, it is highly critical that land records should be digitized and technology should be leveraged for land maps and records to be geo-referenced. This will help expediting the process immensely, while also reducing chances of litigations on these matters and better compliance. Using advanced technology such as block chain may also be explored for better record keeping and ease of transaction.

### 6. Market rate database for land

While the LARR act 2013 has shifted the compensation focus from circle rate to market rate, efforts are required to have market rate databases and possibly even look at value appreciation which typically makes land a valuable resource for land losers. It is important that Govt. departments collaborate to have central databases for market rates of land and scientific methods to arrive at futuristic rates, which can then be used to decide compensation of land acquisition.



## Suggested Implementation Measures

### **1. Mandatory acquiring of minimum 90% land**

Projects going into tendering process need to have acquired at least 90% of land. Similarly, any project going for tendering should have obtained the Environmental Clearances and Stage 1 Forest Clearances.

### **2. Mandate Stakeholder Management Plan (SMP) as part of Investment Approval**

Project implementing agencies may be directed to include a stakeholder management plan for any project where land acquisition and regulatory approvals are to be taken up. SMP should identify all stakeholders, document expected impact and interest on the project and come out with a management strategy for each stakeholder's interest.

### **3. Social Impact Assessment or Social Cost Benefit Analysis to be standardized**

A standard framework for conducting Social Impact Assessment or Social Cost Benefit Analysis to be mandated immediately, as it helps build stakeholder buy in and expedite the acquisition process.

### **4. DPR to incorporate SIA suggestions**

DPR to be prepared considering the recommendations in SIA/SCBA and cost estimates to reflect the same. This is required to be implemented by Implementation Agency before the land acquisition is initiated.

### **5. Promote collaborative Centre-State model**

Land acquisition being a concurrent subject, requires law at both levels to be followed. Thus, it calls for coordinated efforts with both Central and State Government. Thus, MoUs may be signed for projects of national importance to ensure better coordination and cooperation in the land acquisition process.

### **6. Completion of land records and process digitization**

Land records digitization has been an activity in progress for most part of the last two - three decades. This needs to be completed at the earliest across states including geo-referencing of paper records. Further, the process of land acquisition and title transfer process need to be digitized for e-land procurement. This digitization drive needs to be accompanied by extensive training, capacity improvements and awareness campaigns.

### **7. Setting up a cell for assistance in obtaining right of way (RoW) issues through State Revenue Department**

Many projects go through the difficult process of obtaining right of way (RoW) for the project, as in the case of pipeline or transmission lines project. Mostly, the right of way is left to be obtained by the executing agencies by managing negotiations at the ground level. However, state level assistance in this can be of immense help for the implementing and executing agency.

## Examples/Benchmarking

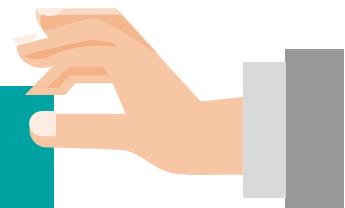
**Andhra Pradesh Land Pooling Method:** This model was followed by the AP Government to develop their newly constituted capital city Amravati. Below is an excerpt from an article in a newspaper in 2017.

*“Farmers have “voluntarily offered” about 90 per cent of the 38,581 acre land required for Andhra Pradesh’s new capital at Amravati under the pooling system, a state government official said. The central government think tank NITI Aayog has lauded the ‘land pooling’ method as a “model to the nation” in land acquisition. A farmer who surrenders his land would get Rs 30,000 per acre for ten years and also 1,300 square yards (one fourth of one acre) after it is duly developed.”*

Source: <http://indianexpress.com/article/india/farmers-offer-33000-acre-land-for-andhra-capital-at-amravati-4710013/>

**Rajasthan, Karnataka, Gujarat and Haryana** have computerized their land allotment process right from identification of land parcel to title transfer. This helps in defining specific period of time and accountability for processes, thus helping the estimation process for any project. This also helps in expediting the process and bringing in visibility at various stages of the project.

Source: A report on “Ease of Doing Business in Northern Region”, a survey conducted by CII-KPMG in 2014



## #9

## Establishing a Robust Project Governance

### Basis of Recommendation

Project governance drives project performance and lack of governance impacts decision making, ambiguity in roles and responsibilities and internal or external conflicts.

Infrastructure projects involve multiple stakeholders and the development spans across many years. Hence, these projects need to be governed at various levels both internally by the Implementation Agency and externally by the State and Central Government.

Hence, it is recommended that these projects may be governed strategically for various parameters by an independent and objective set of organization / professionals.

**80% of survey respondents felt there is a lack of effective Program/Project Governance**



### Core Recommendation

#### 1. National Level Project Evaluation and Control Cell

A national level project evaluation and control cell should be considered for continuous evaluation of projects for which investment approvals have been provided either by creating a new platform or leveraging the existing project platforms of the Central Government like the India Investment Grid (IIG) portal.

This cell may track and monitor the performance/execution status of the projects and suggest on key action or decision points by various authorities. This may also include periodic review of the further investment decision based on the project performance till date.

This cell may also critically view project integration issues which require multiple stakeholder involvement such as Central Ministries, State Governments, other quasi-government bodies etc. and facilitate early resolution by highest level escalation such as PMO/PMG.

#### 2. Strengthen Role of Investment Promotion Agencies (IPAs)

The role of Invest India, the national investment promotion and facilitation agency, should be expanded to help facilitate investments, and state level IPAs similarly strengthened. The coordination between central and state IPAs should be developed.

## Core Recommendation

### 3. Expanding the role of MoSPI in monitoring program implementation

While MoSPI's Infrastructure and Project Monitoring Division (IPMD) is currently involved in collating and maintaining project performance data for projects over a certain value, the role is limited to data collation and periodic report publication. This role can be further broadened in following ways:

#### a. Data Analytics

Data analytics should be leveraged to analyze projects progress and over-run trends, study exceptions, provide insights, which can help in taking strategic decisions to improve project performance and/or to optimize investments in projects. Multiple tools are available for data analytics which can be used by MoSPI.

*Refer 'Data Analytics' in the subsection of 'Exploring the Limits of Technology' for more details.*

#### b. Sector level insights

Detailed analysis of sector performance (such as railways, roads, power) should be conducted by MoSPI based on targeted projects reviews in respective sectors. Projects may be selected based on the extent of over-runs. Such performance reports would bring out the challenges unique to a sector and also the common issues which require broader intervention at the center level.

#### c. Knowledge sharing

MoSPI should facilitate creating a common platform for capturing project learning and best practices across Implementation Agencies. Cross-sectorial workshops should be conducted to address common issues (such as land acquisition, skilling etc.), present successful project case studies and disseminate project management practices. Both short term target improvements and long term policy level improvements may be included in the framework.

#### d. Third party project evaluation

For select critical projects above a threshold value, MoSPI may consider conducting project performance evaluation with support from third parties. Such evaluation should be conducted periodically. Focus should be on project level issues, their likely impact on the outcomes, and mitigation strategies, which are jointly arrived with the Implementation agencies.

#### Capacity building of MoSPI

For the suggested expanded role of MoSPI, the Ministry should consider conducting an in-house skill assessment and prepare a manpower ramp up plan. Specific skills which may be considered include but not limited to:

1. Certified project management professionals,
2. Construction management professionals,
3. Experienced civil, electrical and mechanical engineers, and
4. Sector experts such as power, oil and gas, and roads for select sectors.

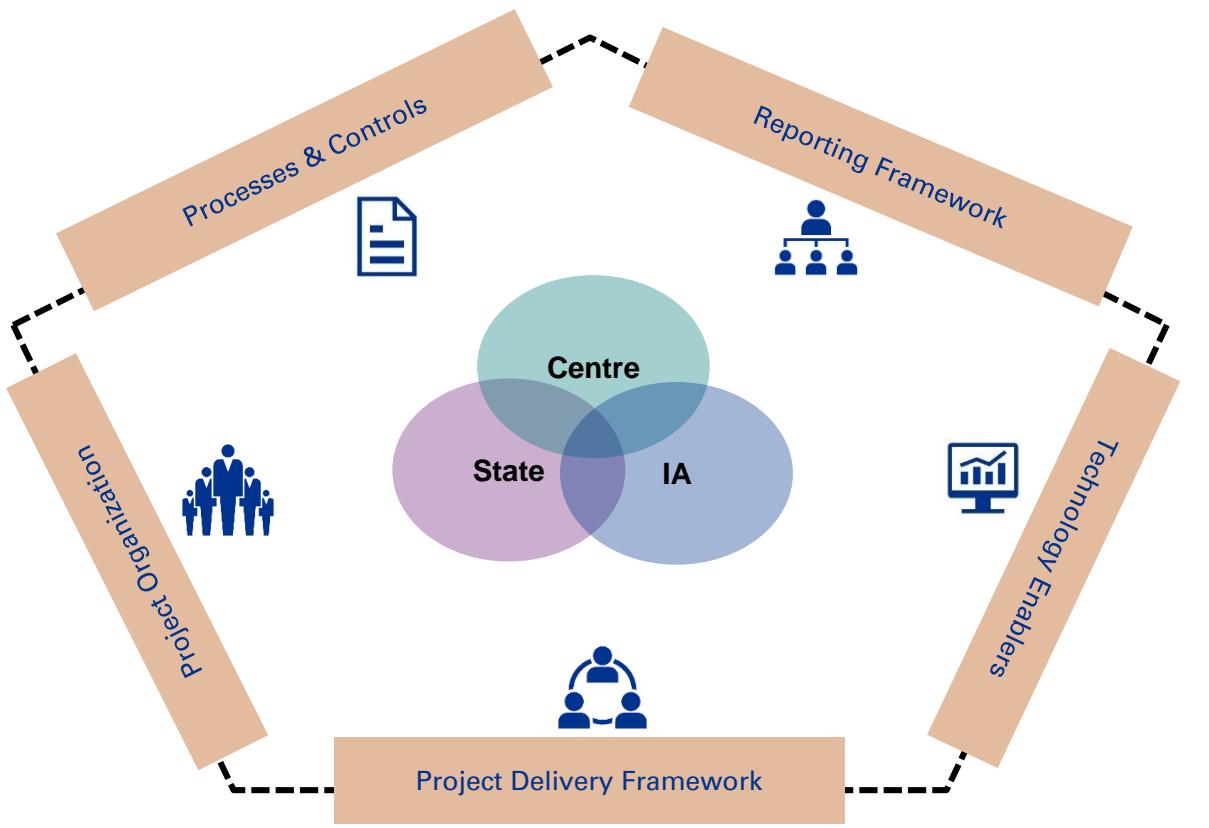
*(Refer the recommendation of 'Augmenting organizational skill sets' in this section for more details.)*

## Core Recommendation

### 4. Collaboration between States and Centre

Central Government and State Government need to work collaboratively for successful implementation of large infrastructure projects. With this view, Central Sector Projects Coordination Committees (CSPCCs) has been set up to act as high powered committee under the chairmanship of Chief Secretaries of States.

This is an important step to ensure better collaboration between the State and the Centre, which is essential to ensure that key issues of the project such as land acquisition, rehabilitation, forest/wildlife clearances, utilities shifting, law and order etc. are addressed in a time bound manner for projects taken up by Central PSUs or ministries. Successfully implemented projects with excellent track record of collaboration may be given incentives, which can spur other states to ensure collaboration.



Typical Project Governance Framework

## Suggested Implementation Measures

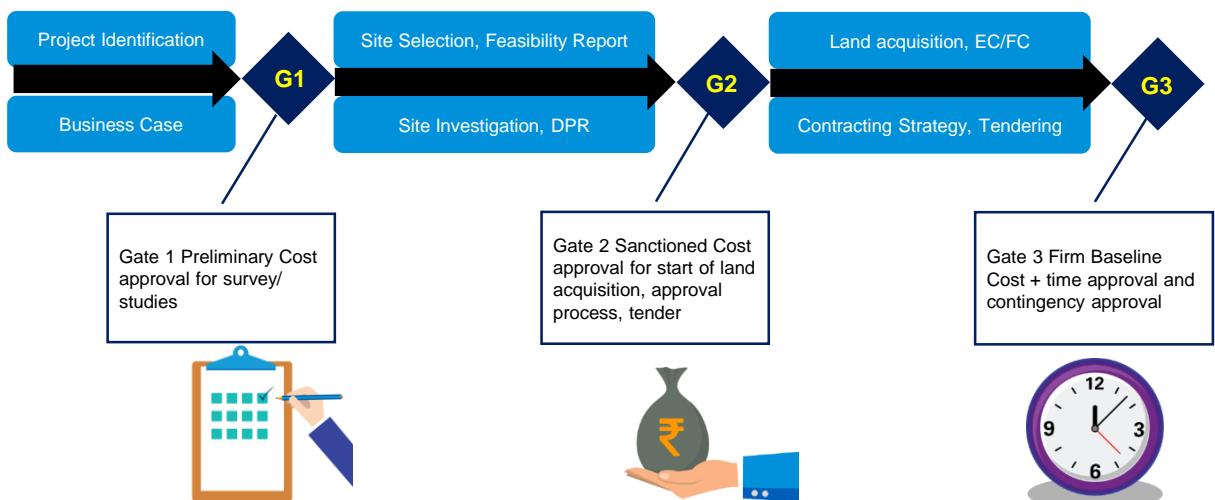
Defining and implementing a structured project governance framework is not a standardized procedure. However the aspects to be covered in the framework can be standardized.

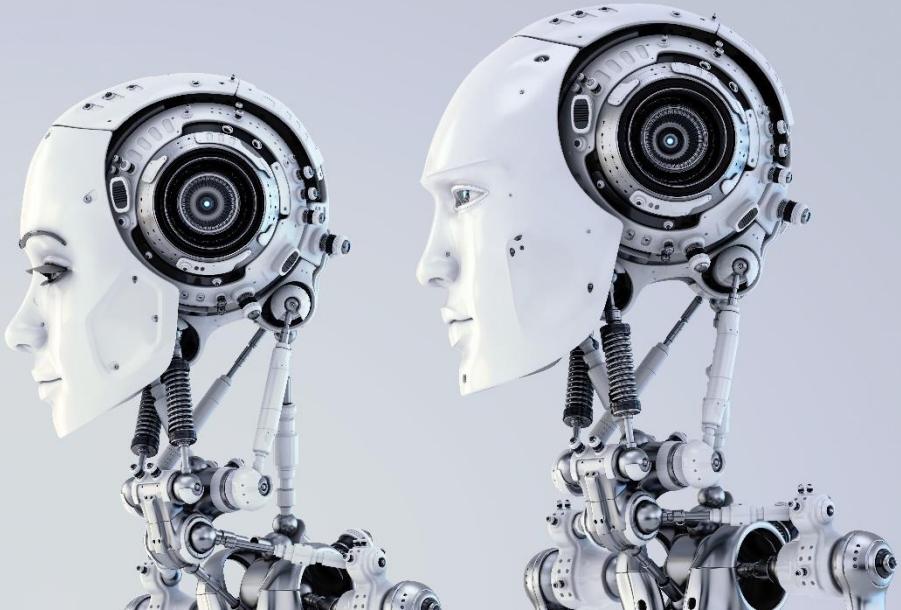
Following are few general checkpoints for implementing the project governance framework:

- The board has the overall responsibility for governance of effective project management processes.
- The project business case is supported by relevant and realistic information that provides a reliable basis for making authorization decisions; A statement of requirement which sets down the boundaries (e.g. time, cost and performance), project constraints, dependencies, and the interfaces with other projects.
- All projects have an approved plan containing authorization points, at which the business case is reviewed and approved; decisions made at authorization points are recorded and communicated.
- Disciplined governance arrangements, supported by appropriate methods and controls, are applied throughout the project life cycle.

- The detailed project governance arrangement for each project phase is prepared before the phase starts and focuses on the specific needs of the project for that phase.
- Stakeholders and their roles are identified for difference phases of the project.
- Criteria for reporting project status and protocols for escalating risks and issues to levels required by the organization are clearly defined. A formal reporting structure and feedback mechanisms is in place prior to project initiation.
- The organization fosters a culture of improvement and internal disclosure of project information.
- Project stakeholders are engaged at a level that correspond with their importance in the organization and in turn fosters trust.
- The board (or its delegated agent) decides when independent scrutiny of projects and independent project management systems is required, and implements such scrutiny accordingly.
- Post project evaluations are carried out for example benefits tracking and realization assurance, lessons learnt to name a few.

For implementing the measures suggested above, a stage-gate approach, as illustrated below, may be considered at least up to the project award stage for the project approval and sanction process. A similar stage-gate approach has been successfully implemented in ONGC for capital projects execution and is recommended for other implementation agencies as well.





## Exploring the Limits of Technology

Technology disruption is going to outpace its matured adoption in the construction sector, if organizations do not fully cope up with the required systemic changes. Despite substantial investments in technological innovation, the decision makers are surprisingly hesitant in leveraging and encouraging the full use of technology in construction.

The KPMG Global Construction Survey of 2017 highlighted few core challenges that are constraining this technology adoption. For some organizations, the cost and risk of adopting new technologies outweigh the perceived benefits. Few other organizations may not be willing to move out of their comfort zone.

## Adoption level of technology in Indian infrastructure industry so far...

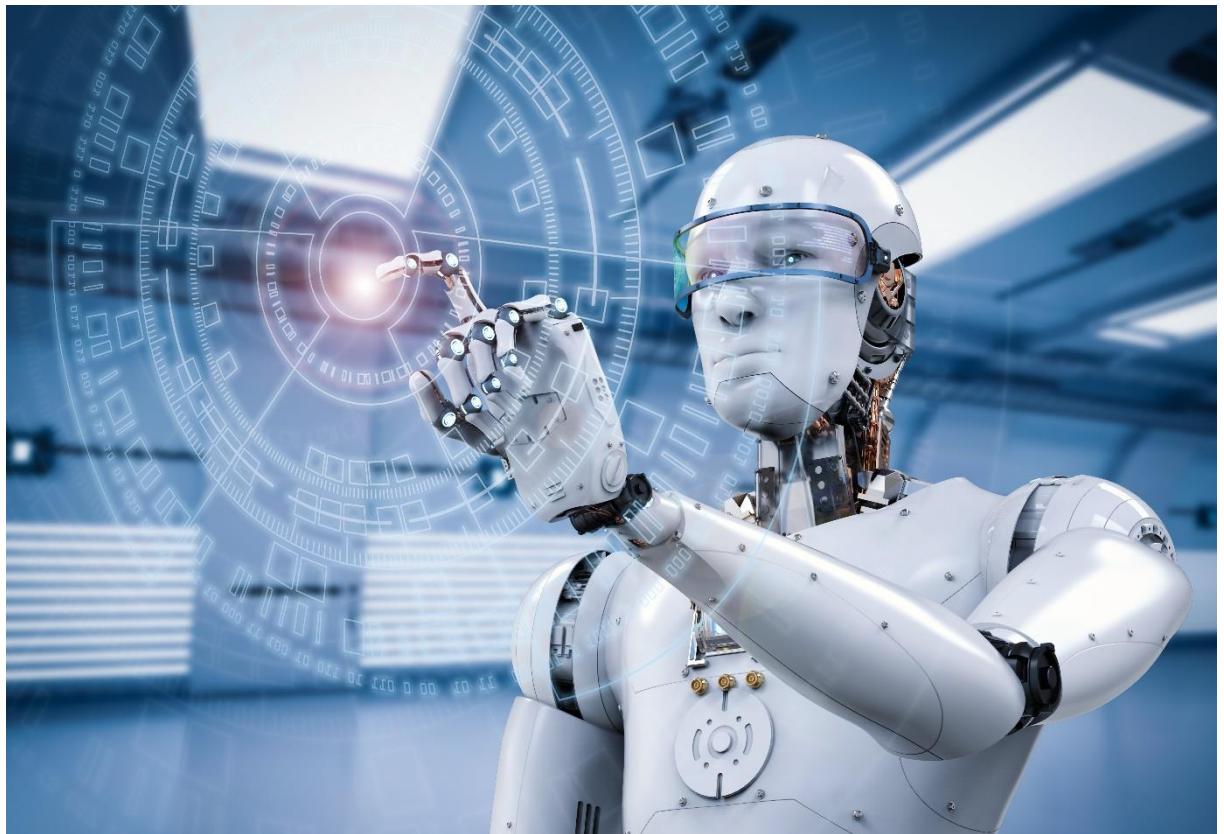
While technology advancements are shaping major industries, majority of construction companies and project owner organizations still operate in the traditional way, characterized by manual processes which are not integrated neither efficient.

A culture change is the need of the hour, which can address change management initiatives by accepting the use of technology in construction and project implementation.

**The Implementation Agencies/PSUs should consider enforcing the increased use of technology in their tendered terms as an effective measure of improving technology use.**

The faster the government, owners, and contractors embrace the technology, the greater will be its collective contribution to the infrastructure sector development.

The interviews conducted in this study revealed that a small proportion of Implementation Agencies and contractors are leveraging technologies fully or routinely and even have a cutting-edge vision towards embracing it.



This section encapsulates few relevant and leading technologies which have proven to be effective in project management and improving overall performance, and are expected to have profound impact in the construction sector. These technologies should be considered by Implementation Agencies, contractors, and other stakeholders in the project value chain.

## UAVs Application



Unmanned Aerial Vehicles (UAVs)/drones have wide application across the project lifecycle, from land identification and survey in the conceptualization stage to discovery of snags in the commission phase, it allows users to take the right decision at the right time, implementing strategies with speed and transparency. Visualization backed by a UAV addresses the need for quick reporting, transparency, and faster decision-making. UAVs can provide aerial footage of the project site/capital asset, on the basis of which an independent analysis on key metrics can be carried out. To name a few; an Audio Visual (AV) report that provides the management and decision makers with crisp and actionable insights, a 3-D model for quantity estimation and quality compliance, and even thermal imagery map to identify hot/leak points.



KPMG was engaged by one of the largest EPC contractors in India to perform aerial analysis to monitor their 2x660 MW Supercritical Thermal Power Plant.

### Few Benefits Accrued:

- Real time visual construction monitoring
- Better utilization of management time by fast decisions
- Enabled quick decision to benefit project in time and cost
- Insightful analysis, MIS and financial models are part of report

## Dashboards and Mobile Technology for Real Time Monitoring



Real time dashboards and mobile applications provide management information into one unified view. Project managers have a lot to keep track of and such technology allows information to be collected, processed and sent to office seamlessly, eliminating the need to sift the information from multiple spreadsheets and trails of paper. Thus technology helps collect and process lot of data to streamline collaboration and communication among different stakeholders.

For a leading State Transmission Utility in India, KPMG facilitated the development and implementation of mobile application and web dashboard for project monitoring and reporting for multiple portfolios of transmission and sub-station projects.

### Few benefits accrued:

- Reduction in Average project delay from 22 months to 12 months over period of three years.
- Increase in number of project charged by 200%.





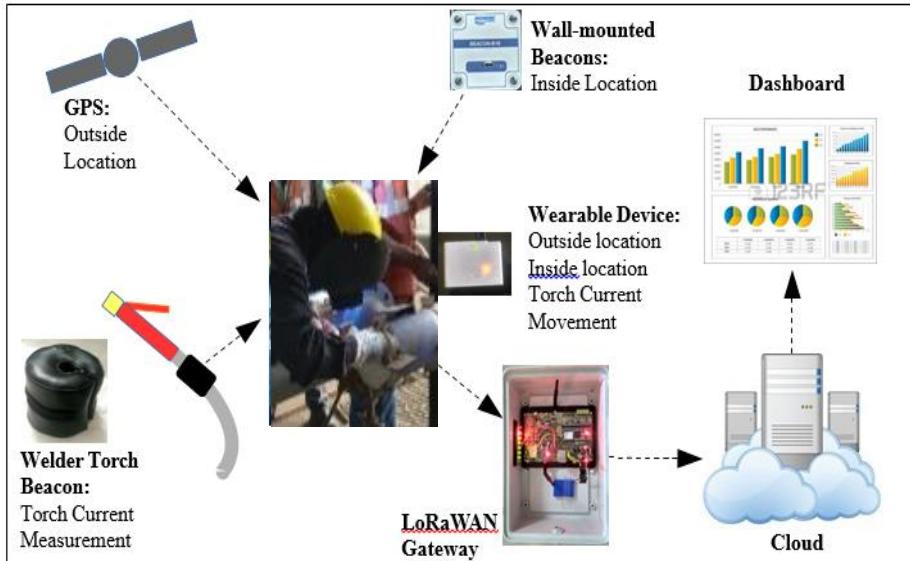
## Internet of Things (IoT)/Smart Sites

Construction projects are bleeding due to poor productivity, inefficiency and under-utilization of resources. Implementing Smart Sites digital solution using IoT to centrally connect Man-Machine-Material and monitor them on real time basis can identify wastes in resource utilization and drive value by enhancing productivity and efficiency.

KPMG assisted implemented IoT in a phenol manufacturing plant construction to track and improve the welder gangs' productivity. The welding process was thoroughly observed with data feed on labour utilization and efficiency on real time basis.

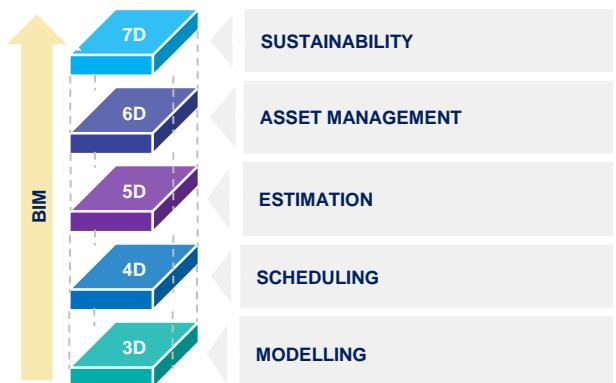
### Few Benefits Accrued:

- Labour Efficiency up by 72%
- Crew Utilization up by 95%
- Welding output up by 25%



## Building Information Modeling

BIM (Building Information Modeling), a 3D model-based process improves visualization, facilitates constructability reviews, provides a multi-dimensional planning and monitoring mechanism, and brings all key stakeholders on a common platform. If deployed effectively, it helps in cost reduction over project lifecycle and improves multidisciplinary collaboration during execution.



## Data Analytics



With the amount of data generated during capital projects delivery, untapped opportunities reside in the Indian infrastructure sector, to apply real time and cloud powered analytics for extracting meaningful insights. These insights can further shape forward looking corrective measures and project optimization strategies.

Big fragmented data come from multiple sources; ERP system, sensors, individual computers, and even hard copies of the reports generated at site, which need to be harnessed using technology by owners and contractors for making better decisions. For instance, simply conducting a rate analysis of multiple orders for any commodity may uncover anomalies on price trend and order quantity, and establish the opportunity loss. Similarly, performing analytics on the cycle time for drawings submission and approval by various agencies may lead to optimization decisions for the overall engineering duration.

Deployed effectively by contractors, data analytics can also aid in predicting potential safety events and making construction sites safer involving large number of labour and plant and machinery. The Implementation Agencies can gain from improved governance through exception based reports..

KPMG has developed and implemented its proprietary data analytics tool, the Capital Projects Data Engine (CPDE) on multiple large projects to identify the improvement areas; both for the owners and contractor organizations.

### Few Benefits Accrued:

Improved visibility on:

- purchase decisions for economic ordering and volume optimization
- inventory holding and carrying cost

### KPMG CPDE Tool Modules



#### ***Engineering Module***

Analytics on engineering delays, drawing submission and approval cycle time for critical and non-critical drawings



#### ***Procurement Module***

Analytics on price trends, major vendors, volume discount opportunities, bid reviews, and performance of different divisions regarding procurement



#### ***Construction Module***

Analytics on utilization and productivity of labour, plant, and equipment on site and losses due to underutilization and breakdowns.

## Opportunity to ride the next wave

The technological advancements are happening at an exponential pace in multiple sectors such as finance/banking, retail, agriculture etc. and construction organizations will invariably adopt such new developments to sustain profitability and even survive in a competitive environment. It is not a matter of choice anymore. The business models of the implementing agencies/PSUs, contractors, and engineering consultants need to be aligned for adapting to these new developments.

Creating Technology Innovation Centers by the government and PSUs will promote research, development, and implementation of new technology in the infrastructure sector. Moreover, organizations also need to invest in training their resources to use these technologies.



**It should be noted that Technology may have enormous potential but construction and engineering companies and owners/developers/Implementation Agencies cannot neglect the fundamentals of good project management. Technology is an enabler which needs to be used with the project management fundamentals to address the prevailing problems of cost and time overruns.**

# Potential Level of Adoption of Recommendations

The suggested recommendations are subject to varying adoption levels in the Indian infrastructure sector. In order to establish this, Exhibit 8 tabulates the potential adoption levels based on the KPMG-PMI survey 2018 and successful practices observed in select sectors. Notably, the adoption levels largely range from 'High' to 'Very High', though these are indicative and would fluctuate on case to case basis for respective Implementation Agencies based on their current level of maturity.

**Exhibit 8**

Recommendation	Potential of adoption from survey responses	Potential of adoption from case studies	Potential level of adoption (average)	Remarks (Survey Response)
1 Invest heavily in pre-planning and site investigation	 ~56%	60% 	High	56% respondents quoted suboptimal feasibility reports as a primary reason for delay of projects in the planning stage.
2 Collaborative and agile planning	 ~40%	80% 	High	40% respondents stated that inadequate planning and base lining is a key challenge in the industry.
3 Reforming procurement and strengthening contract management	3a. Procurement related recommendation  ~55%	60% 	High	55% of respondents stated that arbitration still takes over two years for resolution.
	3b. Contracts and claims management related recommendation  ~87%	80% 	Very High	87% respondents stated that contractor selection is a root cause for project performance shortfalls.
4 Lean construction implementation for productivity improvement	 ~83%	80% 	Very High	83% respondents stated that poor productivity and skilled labour unavailability have impact on project performance.
5 Embedding a culture of risk management	 ~56%	80% 	High	56% respondents quoted suboptimal feasibility reports as a primary reason for delay of projects in the planning stage.
6 Strengthening people management processes	 ~38%	80% 	High	38% respondents stated that delayed decision making adversely impacts project during planning phase.
7 Augmenting organizational skillsets	 ~82%	80% 	Very High	82% respondents stated that lack of skilled manpower is a core issue that the industry is facing today.
8 Deepening stakeholder management for land acquisition and regulatory approvals	 ~74%	60% 	High	74% respondents stated that land acquisition and its cost is a major concern for projects facing overruns.

## Sectors

 Roads and Highways  
 Power

 Oil and Gas  
 Civil Aviation

## Potential Level of Adoption (Average)

< 25% - Low	50 – 75% - High
25 – 50% - Medium	> 75% - Very High

# Potential of Recommendations for Addressing OVERRUNS

The implementation of suggested recommendations can lead to debottlenecking of infrastructure projects by incrementally addressing the root causes of time and cost overruns. Exhibit 8 and 9 depict this build up from each recommendation, which collectively can lead to greater relief in project performance.

The percentages shown are indicative, which are derived from the root-causes' quantified impacts in the previous chapter. These percentages also suggest the relative importance of recommendations for implementation, though the effort levels may vary across organizations.

**Exhibit 8**

Category	Recommendations	Time Overrun % to be potentially addressed
Process and Capabilities	Invest heavily in pre-planning and site investigation	4%
	Collaborative and agile planning	15%
	Reforming procurement and strengthening contract management	14%
	Lean construction implementation for productivity improvement	5%
Culture and Mindset	Embedding a culture of risk management	5%
	Strengthening people management processes	5%
	Augmenting organizational skillsets	4%
External Factors	Deepening stakeholder management for land acquisition and regulatory approvals	10%
Total Potential		62%

**Exhibit 9**

Category	Recommendations	Cost Overrun % to be potentially addressed
Process and Capabilities	Invest heavily in pre-planning and site investigation	7%
	Collaborative and agile planning	12%
	Reforming procurement and strengthening contract management	16%
	Lean construction implementation for productivity improvement	6%
Culture and Mindset	Embedding a culture of risk management	12%
	Strengthening people management processes	11%
	Augmenting organizational skillsets	6%
External Factors	Deepening stakeholder management for land acquisition and regulatory approvals	6%
Total Potential		76%

A photograph of a construction site at sunset. In the foreground, several workers wearing hard hats and safety vests are working on a steel reinforcement grid. In the background, a tall orange tower crane stands against a sky filled with wispy clouds. A blue lattice boom crane is positioned to the right, its arm extended towards the top right of the frame.

# Annexure

- Participant Profile
- Study Methodology
- List of Abbreviations
- List of Definitions

# Invest India

Invest India is the national investment promotion and facilitation agency, mandated to facilitate investments into India. It operates as a non-profit venture under the Department of Promotion of Industry and Internal Trade (DPIIT), Ministry of Commerce and Industry, Government of India, and serves as the preferred point of reference for global investors considering a location, industry or partner in India.

Invest India helps potential investors bridge the gap between intent and execution by providing them end to end facilitation, including regulatory clearances, issue redressal and policy formulation. It is also tasked to work closely with State Governments and other organizations for facilitating public and private projects of infrastructure or other investments.

## **India Investment Grid (IIG)**

A critical initiative of the Government to provide impetus to investments in India and enhance the ease of doing business, the **India Investment Grid (IIG)** is an interactive and dynamic web portal that showcases investment opportunities across states and sectors in India. Developed and managed by Invest India, IIG connects domestic and foreign investors to project promoters across India.

IIG serves as the central repository of investment opportunities in India. The platform provides holistic information on investment opportunities from both the government and the private sector. The opportunities are showcased in a standardized format making it easy for interested investors to compare and select opportunities. Additionally, the Analytics dashboard allows one to compare and evaluate opportunities across states and sectors.

IIG offers a free platform to Indian promoters to add projects through an easily navigable interface. For an investor looking for an opportunity in India, this is a one-stop platform to browse and filter according to his needs and preferences.

IIG as a tool can enable project implementation and monitoring, through the entire lifecycle for the ecosystem. Collaboration between project promoters and investors at the planning and the pre-tendering stage also allows for setting realistic timeframes and milestone targets through early inputs. A transparent, publicly accessible global platform also increases the sense of project accountability and ownership among project promoters, laying the onus of regular monitoring and updates. The search and comparison capabilities also increase transparency through comparison and efficiency in implementation through real time connect and collaboration, which leads to better procurement at the pre-implementation stage.

IIG also enables central ministries and state governments to monitor progress of projects across both government and private sectors under their domain, access comprehensive investor information, review economic activity in respective states / districts and provide a seamless connect between industry and government.

## Project Monitoring - Invest India Cell (PMIC)

With the merger of the Project Monitoring Group (PMG) with Invest India in February 2019, a special cell namely **Project Monitoring-Invest India Cell (PMIC)** has been set up in Invest India. It seeks to enlist the unresolved project issues in respect of all mid and large sized Public, Private and 'Public–Private Partnership' (PPP) projects and takes up fast-tracking of approvals, sectoral policy issues and removing bottlenecks for expeditious commissioning. DPIIT has been mandated to be the nodal ministry for review of investment oriented public and private projects facing challenges, and the Project Monitoring- Invest India Cell (PMIC) of DPIIT will specifically monitor and facilitate all such projects and their issues.

Key sectors in which projects are taken up through PMIC are:

- ✓ Road Transport & Highways, Railways, Civil Aviation
- ✓ Inland Waterways, Ports & Shipping
- ✓ Petroleum & Natural Gas
- ✓ Chemicals, Fertilizers and Petrochemicals
- ✓ Power
- ✓ Coal and Mines
- ✓ Cement, Construction and Steel
- ✓ Urban Development
- ✓ Health and Family Welfare
- ✓ Textiles
- ✓ Tourism
- ✓ Telecommunication and IT services

*(The above information has been provided by Invest India. For further details please visit [www.indiainvestmentgrid.com](http://www.indiainvestmentgrid.com))*

# Participant Profile

KPMG-PMI survey responses were collected and documented through a survey questionnaire from various Public Sector Undertakings and private contractors organizations. This survey was conducted between November-2017 and May-2018.

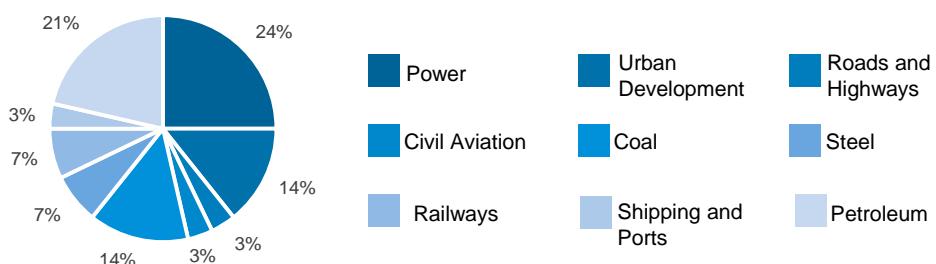
Nine projects were also studied in-depth as case studies across five sectors namely Power, Roads, Railways, Civil Aviation and Oil and Gas for understanding the on-ground issues in these projects, which represents a sample of infrastructure projects with cost and time overruns.

The interviews were setup through MoSPI and PMI, while KPMG professionals with project management expertise conducted these interviews and case studies.

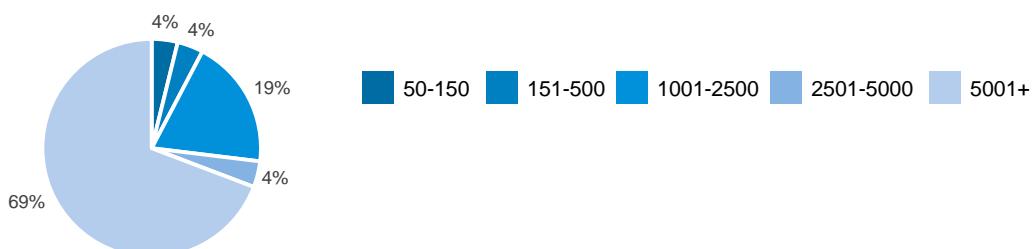
**Percentage of respondents in different organization types**



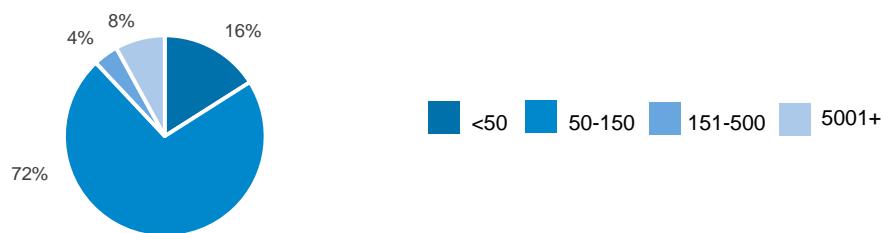
**Percentage of respondents in different sectors**



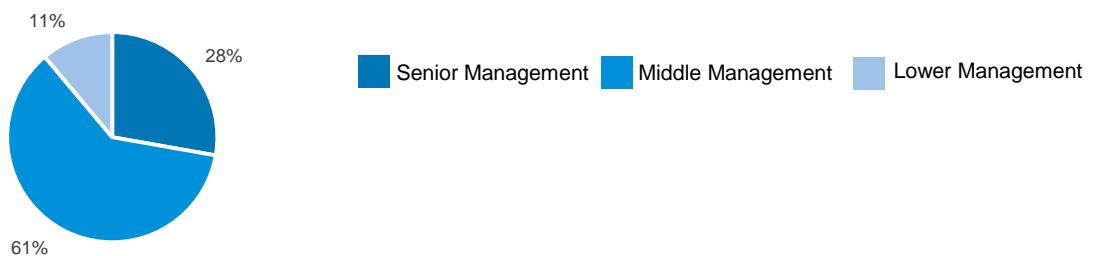
**Percentage of company turnover (INR crore) in respondents organizations**



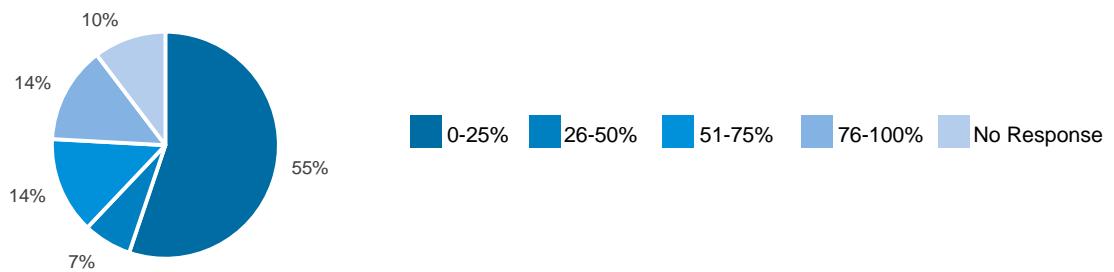
### Percentage of on-going projects in respondents organizations



### Percentage of respondents at different management levels



### Percentage of underperforming projects in respondents organizations



# Study Methodology

The KPMG-PMI study was undertaken using a combination of primary and secondary research. This includes exhaustive coverage of key sectors driving the infrastructure industry, detailed discussions with various stakeholders across different levels in various PSUs directly related to the infrastructure development, interaction with professionals from private contractor organizations and deep diving into select projects across five sectors by conducting specific case studies.

The work steps for the study are as follows -

1. January 2018 industry database of 1304 infrastructure projects was sourced from MoSPI and taken as base data for the purpose of the study.
2. A detailed questionnaire with comprehensive coverage on infrastructure related topics was prepared to aid collection of information and facilitating interviews with project stakeholders from PSUs.
3. Organizations and participants were identified for the interview process in agreement with MoSPI. Focused interviews and survey through questionnaire was conducted with 31 participants across 25 PSUs and 4 participants across 4 private contractor organizations.
4. The outcome from these interviews were gathered and consolidated in a customized response collection framework for further study and analysis. Due to the depth of study conducted in the case studies, the information collected via discussions and data analysis of project documents is also accounted in the response collection framework for questionnaire. The weightage given to each case study is equal to 5 respondents.
5. For case studies, 9 projects across five sectors namely roads(2), power(2), petroleum(2), railways(1) and civil aviation(2) were identified by MoSPI from the January 2018 MoSPI database of projects based on extent of time and cost overruns.
6. Case studies were conducted by visiting project sites and holding detailed discussions with project teams, contractors and vendors to understand the on-ground issues and challenges in infrastructure projects. The site visits were used for collecting project data based on which the findings of the case studies were developed.
7. Extensive industry data was collated from other secondary sources (please refer footnotes in report) through desktop research for the report.
8. All information, data points and findings from secondary and primary research were consolidated and analyzed. This analysis highlighted key reasons for time/cost overrun, leading practices adopted in the industry, and current industry performance, which were summarized.
9. Considering the high impact and controllable root causes for time and cost overruns, the recommendations were developed based on detailed reviews and stakeholder discussions. The recommendations are designed for PSUs/Government bodies and other stakeholders towards improved project performance and delivery.

## **Methodology for Exhibit 3 and 4 – Impact analysis of reasons for time and cost overrun**

Respondents were asked to rate the impact of reasons for time and cost overruns on a qualitative scale (high, medium, low, not applicable).

The following weights were assigned to the four options – High – 0.5, Medium – 0.35, Low – 0.15, Not applicable (NA) - 0

Relative score for impact of each reason was calculated using the following formula

$$\begin{aligned} \text{Score of each reason} = & \{ \text{Number of respondents who responded "high"} \times (\text{Weight of option}) \} + \\ & \{ \text{Number of respondents who responded "medium"} \times (\text{Weight of option}) \} + \\ & \{ \text{Number of respondents who responded "low"} \times (\text{Weight of option}) \} + \\ & \{ \text{Number of respondents who responded "NA"} \times (\text{Weight of option}) \} \end{aligned}$$

$$\text{Percentage impact of reason} = \{ \text{Score of each reason} / \text{Sum of all scores} \} * 100$$

Respondents were also asked to rate each reason for its degree of controllability on a scale of 1 (controllable) to 5 (highly uncontrollable). The degree of controllability and impact on time and cost overrun were plotted on a graph.

# List of Abbreviations

AAI – Airports Authority of India	MoCA – Ministry of Civil Aviation
ACI – Arbitration Council of India	MoEF – Ministry of Environment and Forest
ADR – Alternative Dispute Resolution	MoRTH – Ministry of Road Transport and Highway
BCM – Billion Cubic Meters	MoSPI – Ministry of Statistics and Programme Implementation
BIM – Building Information Modelling	MoU – Memorandum of understanding
BHEL – Bharat Heavy Electricals Limited	MVA – Mega Volt Amp
BPCL – Bharat Petroleum Corporation Limited	MW – Mega Watt
CAGR – Compounded Annual Growth rate	NA – Not Applicable
CCL – Central Coalfields Limited	NBCC – National Buildings Construction Corporation
CEA – Central Electricity Authority	NCLT – National Company Law Tribunal
CIDC – Construction Industry Development Council	NCR – National Capital Region
CIL – Coal India Limited	NEC – New Engineering Contract
Ckm – Circuit kilometer	NEEPCO – North Eastern Electric Power Corporation Limited
CPGU – Central Procurement Guidance Unit	NH – National highway
CPPP – Certificate Program in Public Procurement	NHIDCL – National Highways and Infrastructure Development Corporation
CPSU – Central Public Sector Undertaking	NHAI – National Highway Authority of India
CREDAI – Confederation of Real Estate Developers' Associations of India	NHPC – National Hydroelectric Power Corporation
DDUGJY – Deen Dayal Upadhyaya Gram Jyoti Yojana	NPA – Non performing asset
DEIAA – District Environment Impact Assessment Authority	NSDC – National Skills Development Council
DESA – Department of Economic and Social Affairs	NTPC – National Thermal Power Corporation
DGCA – Directorate General of Civil Aviation	O&M – Operation and Maintenance
DMRC – Delhi Metro Rail Corporation	ONGC – Oil and Natural Gas Corporation
DPR – Detailed project report	PAP – Project Affected Person
EIL – Engineers India Limited	PGCIL – Power Grid Corporation of India Limited
EPC – Engineering Procurement Construction	PMG – Project Monitoring group
FDI – Foreign Direct Investment	PMGSY – Pradhan Mantri Gram Sadak Yojana
FII – Foreign Institutional Investor	PMP – Project Management Professional
FY – Financial Year	PPC – Percentage of Planned Commitment
GAIL – Gas Authority of India Limited	PPP – Public Private Partnership
GDP – Gross Domestic Product	PTCC – Power and Telecommunication Co-ordination Committee
GIS – Geographic Information System	PSB – Public Sector Bank
GoI – Government of India	PSU – Public Sector Undertaking
GST – Goods and Services Tax	PWD – Public Works Department
GW – Giga Watt	QCBS – Quality and Cost based selection
HFA – Housing For All	R&R – Resettlement and Rehabilitation
HPCL – Hindustan Petroleum Corporation Limited	RCS – Regional Connectivity Scheme
HR – Human Resource	RINL – Rashtriya Ispat Nigam Limited
HUDCO – Housing and Urban Development Corporation	RoW – Right of Way
IA – Implementation Agency	RVNL – Rail Vikas Nigam Limited
IBEF – India Brand Equity Foundation	SAIL – Steel Authority of India Limited
ICA – Indian Council of Arbitration	SCCL – Singareni Collieries Company
IDC – Interest during construction	SECL – South Eastern Coalfields Limited
IIT – Indian institute of technology	SEZ – Special Economic Zone
IMF – International Monetary Fund	SME – Subject Matter Expert
INAMPRO – Infrastructure and Material Providers	SMP – Stakeholder Management Plan
INR – Indian rupee	SPSU – State Public Sector Undertaking
InvIT – Infrastructure investment trust	THDC – Tehri Hydro Development Corporation Limited
IoT – Internet of Things	ToD – Transit Oriented Development
IOCL – Indian Oil Corporation Limited	ToT – Toll operate transfer
IT – Information technology	UAVs – Unmanned Aerial Vehicle
km – Kilometer	UMTA – Unified Metropolitan Transport Authority
kWh – Kilo Watt Hour	USA – United States of America
LPS – Last Planner® System	USD – US Dollars
MBPT – Mumbai Port Trust	VGF – Viability Gap Funding
MIS – Management Information System	
MMT – Million metric tons	
MMTPA – Million Metric Tons per Annum	

# List of Definitions

## 1. Painshare - Gainshare Model

The Painshare - Gainshare model aims to foster a win-win, lose-lose mind set. All stakeholders win or lose as the case may be. The joint financial incentive for a project to reach clearly defined goals fuels the collective approach towards project delivery.<sup>54</sup> The pain share gain share mechanism is fair to both the client and the contractor.

## 2. Stage Gate Process

Stage gate process is a project management technique in which a project is divided into distinct stages, separated by decision points (known as gates). At each gate, the decision to continue ahead is made based on a checklist to assess the project readiness to move to next stage. The organization should ensure the project fulfills certain basic criteria such as business case, risk analysis etc. to cross the gate in order to commit resources for the next stage.

## 3. Average Bid Method

In average-bid method, contract is awarded to the contractor whose price is closest to the average of all bids submitted. In general, the winner based on the average bid method is the contractor whose bid satisfies a certain relationship with the average of all bid prices. Different average bid methods use different procedures for calculating the average, or use different criteria for determining the winning bid. For example, some use an arithmetic average or a weighted average, while others use the average of the remaining bids after all bids that differ more than a certain percentage from the average of all bids are eliminated. Similarly, the winner might be the contractor whose price is closest to the average, or the contractor whose bid is closest to, but less than the average.<sup>55</sup>

## 4. Negotiated Bidding

In negotiated bidding, minimum of three contractors are selected based on strictly on their qualifications by the owner who then negotiates a guaranteed maximum price or lump sum (depending on the project) with the highest rated team.<sup>56</sup> In this method for tendering, contractors do not compete against each other for the lowest quoted price.

## 5. Most Economically Advantageous Tender

The most economically advantageous tender (MEAT) criterion enables the contracting authority to take account of criteria that reflect qualitative, technical and sustainable aspects of the tender submission as well as price when reaching an award decision.<sup>57</sup> The method allows the contracting party to award the contract based on aspects of the tender submission rather than just price.

## 6. Alliance Contracts

Alliance contracts are incentive-based relationship contracts in which the parties agree to work together as one integrated team. Defining characteristics of an alliance project are a culture of cooperative decision-making, risk sharing, no blame and no dispute, and financial transparency.<sup>58</sup>

## 7. Last Planner® System (LPS)

The Last Planner® System as developed by the lean construction institute is a collaborative, commitment-based planning system that integrates should-can-will-did planning (pull planning, make-ready, look-ahead planning) with constraint analysis, weekly work planning based upon reliable promises, and learning based upon analysis of PPC (plan percent complete) and reasons for variance.<sup>59</sup> LPS brings together those who will execute the work (the team) to plan when and how work will be done through a series of conversational processes. It requires the team to collaboratively remove constraints as a team and to promise delivery of each task.<sup>60</sup>

54. Thomson Reuters, Construction Blog, November 301, 2015

55, 56. Average Bid Method – An Alternative to Low Bid Method in Public Sector Construction Procurement in Nepal, Santosh Kumar Shrestha, Journal of the Institute of Engineering, Vol. 10, No. 1, pp. 125–129

57. <https://www.felp.ac.uk/content/most-economically-advantageous-tender-meat>

58. Alliance contracting, Christopher Hirst, March 2013, <https://www.reminetwork.com/articles/alliance-contracting/>

59. <https://www.leanconstruction.org/learning/education/glossary/>

60. [https://www.designingbuildings.co.uk/wiki/Last\\_Planner\\_System](https://www.designingbuildings.co.uk/wiki/Last_Planner_System)

# List of Definitions

## **8. Work Sampling**

Work sampling is the a lean construction technique for determining the proportion of time spent by workers in various defined categories of activity for example setting up a machine, assembling two parts, idle time etc. It permits quick analysis, recognition, and enhancement of job responsibilities, tasks, performance competencies<sup>61</sup>, and identification and removal/minimization of time wastage.

## **9. Block Chain**

A blockchain is a decentralized database which chronologically and securely records transactions. A transaction can be of crypto currency such as Bitcoin. However, blockchain transactions can further represent the transfer of value on systems. Value might be a service, a product or an approval in the form of a smart contract.<sup>62</sup> The blockchain is visible to everyone who is participating in a transaction, whether that be financial or a data exchange. Blockchain has this name because, at scheduled intervals, information on transactions is recorded and added to the chain as a block. This 'blockchain' is a continuously growing necklace of information records, giving us historical transaction transparency and chronological fulfilment.<sup>63</sup>

## **10. Digital Twins**

A digital twin is a virtual model of a process, product or service. This pairing of the virtual and physical worlds allows analysis of data and monitoring of systems to head off problems before they even occur, prevent downtime, develop new opportunities and even plan for the future by using simulations.<sup>64</sup> A concept of having a real-time digital representation of a physical object, usually, digital data is formed by sensors that continuously monitor changes in environment and report back the updated state in the form of measurements and pictures.<sup>65</sup>

## **11. Self-heal Materials**

Self-healing materials are artificial or synthetically created substances that have the built-in ability to automatically repair damage to themselves without any external diagnosis of the problem or human intervention.<sup>66</sup>

## **12. 3D Printing**

3D printing or additive manufacturing is a process of making three dimensional solid objects from a digital file. The creation of a 3D printed object is achieved using additive processes. In an additive process an object is created by laying down successive layers of material until the object is created. Each of these layers can be seen as a thinly sliced horizontal cross-section of the eventual object.<sup>67</sup>

61. Groover, M. P. Work Systems and Methods, measurement, and Management of Work. Pearson Education International, 2007

62. The Impact of Blockchain Technology on the Construction Industry, Dave Hughes, February 2017,

63. From BIM to Blockchain In Construction: What You Need to Know, Mathew Ramage, January 2018

64. Forbes-What Is Digital Twin Technology - And Why Is It So Important?, Bernard Marr, March 2017,

65. <https://www.intellectsoft.net/blog/advanced-imaging-algorithms-for-digital-twin-reconstruction>

66. Sahith Reddy Madara et al 2018 IOP Conf. Ser.: Mater. Sci. Eng. 346 012011

67. <https://3dprinting.com/what-is-3d-printing/>

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# About PMI

Founded in 1969, PMI delivers value for more than 2.9 million professionals working in nearly every country in the world through global advocacy, collaboration, education and research.

Project Management Institute is the world's leading not-for-profit professional membership association for the project, program and portfolio management profession. Founded in 1969, PMI delivers value for more than 2.9 million professionals working in nearly every country in the world through global advocacy, collaboration, education and research. PMI advances careers, improves organizational success and further matures the profession of project management through its globally recognized standards, certifications, resources, tools academic research, publications, professional development courses, and networking opportunities.

PMI India office was established with the sole goal of advancing project management profession and inculcating a project management culture within the establishments across government, academia, and industry. PMI has eight chapters across the country in Mumbai, New Delhi, Bengaluru, Hyderabad, Chennai, Pune, Thiruvananthapuram, and Kolkata. These chapters provide a platform for knowledge transfer and networking for its members and also support PMI India's advocacy activities.

PMI India has undertaken many initiatives to promote the project management profession, including the establishment of the PMI India Awards Program (since 2009). It is the highest recognition for the project management community in the country. This award recognizes and honors a project team that has delivered superior results through exemplary application of project management principles. The awards are given away at the annual PMI India Project Management National Conference. Awards have also been established for recognizing the contribution made to this domain by academia.

Additionally, PMI India has undertaken multiple pro-bono initiatives towards capacity building and advancement of the project management profession across India.

# About KPMG in India

KPMG in India, a professional services firm, is the Indian member firm affiliated with KPMG International and was established in September 1993. Our professionals leverage the global network of firms, providing detailed knowledge of local laws, regulations, markets and competition. KPMG has offices across India in Ahmedabad, Bengaluru, Chandigarh, Chennai, Gurugram, Hyderabad, Jaipur, Kochi, Kolkata, Mumbai, Noida, Pune, Vijayawada and Vadodara.

KPMG in India offers services to national and international clients in India across sectors. We strive to provide rapid, performance-based, industry-focused and technology-enabled services, which reflect a shared knowledge of global and local industries and our experience of the Indian business environment.

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