



Building blueprints of tomorrow

Emerging themes

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Table of contents

Foreword	4
Preface	6
Setting the context	8
Theme 1: Resilience in project planning	12
Theme 2: Smart procurement and enforcement of construction contracts	18
Theme 3: Faster and smarter construction practices	26
Theme 4: Automation and technological enablement	32
Theme 5: Decarbonisation in construction sector	38
Theme 6: Innovative finance	42

Foreword

Early in this financial year, India overtook China to become the world's most populous country by reaching a population mark of ~1.43 billion according to population estimates by United Nations. While India being a country where ~ 36 per cent of the population is urban, the level is expected to reach 40 per cent. Hence, improving the quality of living for India's urban population and enhancing their access to better livelihoods are key to meeting India's aspirations as a nation. The needs of a burgeoning urban population can be sufficed by infrastructure development at a faster rate than the rate of increase in urban population.

While the scale of infrastructure development anticipated in the country is unprecedented, there is a huge opportunity for construction technology solutions providing resilient and inclusive development. The Indian construction technology landscape is well poised to achieve sustainable and resilient development, which is necessary to realise the aspirations of the nation.



Vinodkumar Ramachandran

Partner and Head Business Consulting
Global Head - Industry 4.0
KPMG in India

We are proud to share with you this knowledge paper 'Building blueprints of tomorrow – Emerging themes', delineating the six key themes which will be the guiding force for advancing the infrastructure and construction sector. The six key themes are expected to play a key role in driving economic growth and improving the quality of life of urban population, by enabling local development and harnessing technology.

We hope that the point of view presented in this document will stimulate insights and contemplation, aiming to expedite the growth of our built environment in an efficient and sustainable manner.

We welcome you to 9th Smart City and 31st Convergence India Expo 2024. We are hopeful that the discussions at this forum will contribute towards shaping the dialogue and refining thinking that will help us on our journey towards the urban India of the future.

Foreword

In the last century, the global population has doubled twice to exceed a figure of 8 billion – putting tremendous pressure on the planet’s natural resources and pushing various parts of the globe to the brink. This alarming trend has necessitated the need for governments to review their plans and forge global alliances to unearth dynamic solutions to ensure economic growth while also maintaining a healthy and sustainable ecosystem for their respective populations.

Today, at the very core of societal development lies sustainability, adoption of the latest technology, and switching to green energy solutions. This has given rise to the concept of ‘Smart Cities’ as a pivotal solution to address the challenges posed by rapid population growth and escalating urban migration.

Traditionally, a Smart City is built around digital solutions for better resource use and to enhance the efficiency of traditional networks and services. In recent years, India’s smart city technologies industry has registered remarkable growth and attracted large-scale investment across the urban planning and construction verticals. While government spending on smart infrastructure is the primary factor, the private sector is helping provide momentum by investing in smart construction technology and solutions to improve scheduling, budgeting and safety. Notably, ‘green buildings’ are fast gaining popularity, and there’s a 37 per cent increase in the green certification of such buildings. This is good news for the sector and crucial for the end goal of sustainability.



Chandrika Behl

Managing Director
Exhibitions India Group

This Thought Leadership report – ‘Building blueprints of tomorrow – Emerging themes’ by KPMG in India discusses integrating the latest technology and solutions, such as AI, smart sensors, energy management systems, prefabrication techniques, etc., to envision a ‘smarter built’ environment and achieve financial efficiency while reducing the carbon footprint of a project. While chapters such as ‘Smart Procurement and Enforcement of Construction Contracts – Innovative Tie-ins’, ‘Automation and Technological Enablement – the Agile Sprinter’, and ‘Smarter and Faster Construction Practices – speed matters’ explore the impact of technologies such as AI, ML, robotics, etc., the report also studies how we can support decarbonisation, not to mention gain access to green finance in order to make all this a reality.

To summarise, this document is an amalgamation of the latest trends in commercial construction, not only in India but globally. Therefore, I invite the construction industry to study the report and take from it learnings that are poised to transform the sector going forward.

I would like to thank KPMG in India for authoring this Thought Leadership report, and also for their continued support as Knowledge Partners to the Smart Cities India and Convergence India Expo.

Preface

India's GDP is expected to surpass the USD4 trillion mark in 2024-2025 as per recent International Monetary Fund's (IMF) forecast. Given that over one-third of India's population resides in urban areas accounting for more than 60 per cent of the total Gross Domestic Product (GDP), the manner in which the urbanisation will unfold will be pivotal in achieving our nation's growth aspirations and Sustainable Development Goals (SDG).

For realisation of our vision for urban India and provide a better quality of life for urban population, concentrated efforts spanning across many aspects and sectors are needed, including upgradation of capabilities and capacities at grass root level.

This knowledge paper, 'Building blueprints of tomorrow – Emerging themes' will provide various insights on the six key themes for helping our urban areas create the infrastructure and built environment required for transformational growth in a sustainable manner.

We have made a humble attempt to delineate the six key themes for smarter, efficient and sustainable construction which we believe will play a prominent role in the construction sector for the decades to come and change the overall built environment landscape. These are derived from our collaborative

experiences of supporting and working closely with various government and private sector entities across geographies.

The intent behind this knowledge paper is to draw attention on the ideas, aspirations and probable solutions that can not only facilitate but also accelerate the adoption of innovative trends for successful and sustainable infrastructure asset creation. The focus is on bringing up the importance of these themes and the impact that these themes can bring in terms of sustainable creation of infrastructure and built environment.

This document seeks to provide you a perspective to ponder on the key six themes which are focussed around the importance of resilience in project planning and successful implementation of projects. Recommendations for key stakeholders to accelerate the implementation of smart procurement, enhance enforceability of contracts, improve construction practices, deploy digital technologies, promote decarbonisation and leverage innovative financing solutions have been suggested. We firmly believe that these themes shall facilitate the growth potential and development of built environment in our cities.



Nilachal Mishra

Partner & Head, Government and Public Services
KPMG in India





Setting the Context

Setting the context (1/3)



The global population is growing at an alarming pace of approximately 1.1 per cent annually and is expected to reach 8.6 billion by mid-2030 and to 9.8 billion by mid-2050¹. This global surge in population is fueling an unprecedented scale of infrastructure development with disruption in the economics of built environment and its associated ecosystems.

In India, by 2036, it is estimated that around 600 million people will be living in urban cities in India, representing 40 per cent of the population. This will eventually lead to additional pressure on the already stretched urban infrastructure and services of Indian cities – with increased demand for clean drinking water, reliable power supply, efficient and safe road transport, health services, sanitation and other services. A World Bank report estimates that India will need to invest USD840 billion over the next 15 years – or an average of USD55 billion per annum – into urban infrastructure to effectively cater to the needs of its fast-growing urban population².

The escalating demand for accelerated infrastructure development is poised to

significantly shape the evolution of construction sector. Several key trends and shifts are anticipated in the construction industry with increased emphasis on ‘Smart, Efficient and Sustainable Construction’

Global outlook in construction sector

Global construction sector is experiencing a dynamic shift in urban cities driven largely by technological advancements, sustainability imperatives, and a heightened focus on efficiency and safety. Embracing this shift is a key differentiator for navigating the complexities of modern construction and contributing to resilient, sustainable and technologically advanced city infrastructure worldwide.

New age construction practices have been implemented in several countries like Japan, Dubai, Singapore to name a few, where smart construction technologies such as 3-D printing, Internet of Things (IoT) sensors, Building Information Modelling (BIM), drones, modularisation and pre-fabricated construction has been used extensively to construct transport, social and commercial infrastructure.

1. World population to reach 8 billion this year, as growth rate slows’; United Nations; July 2022

2. India’s Urban Infrastructure Needs to Cross \$840 Billion Over Next 15 Years: New World Bank Report’; The World Bank; Nov 2022 and ‘Population of India (2023)’; Worldometer; United Nations; July 2022



A few of the global case examples that signify the pace of construction and new age construction methodologies across different geographies which are leading to city-wide regional impact are below:

- (i) **NEOM City** in Saudi Arabia, a USD500 billion programme funded by the Public Investment Fund on behalf of the Saudi Arabian government, is a recent example of modern construction³.
- (ii) **Grand Paris Express** is the largest public transportation and urban development project in Paris, France with a total investment of USD47.7 billion⁴ targeting a reduced carbon emissions of 14.2 million tons by 2050 by revolutionising urban mobility.
- (iii) **New Administration Capital (NAC)** in Egypt is a smart cities programme launched to become the sustainability capital of the Middle East while also responding to its rapid population growth and waning transport facilities in Greater Cairo.

The common thread running across the above developments is a sharp focus on zero-emission and carbon-positive ecosystem, usage of eco-friendly construction material and optimised design using Building Information Modelling (BIM) that provides longevity and resilience against natural elements, efficient construction methods, smart technologies in construction machinery and real time monitoring and management.

Though the global construction technology market is estimated to reach USD24 billion by 2033, growing at a CAGR of 16.9 per cent over the forecast period⁵, the industry is continuing to deal with disruptions in innovation and technology.

As per KPMG's Global Construction Survey 2023⁶, an average of 75 per cent of the respondents find focus on innovation and adoption of technology to be the most important attributes that influence organisations' success or failure in dealing with constraints. In spite of the importance of technology and innovation, there are between 57 – 60 per cent of the engineering and construction firms that have not adopted technologies like robotics, artificial intelligence, and 3-D printing.

Evolution of the construction sector in India

The nation's construction sector has grown by leaps and bounds in recent years and is poised to become the world's third largest construction market in the next 2-3 years. There is a significant outlay of about USD300 billion for urban infrastructure in National Infrastructure Pipeline (NIP) to effectively meet the needs of the fast-growing urban population and improve connectivity.

Some of the key programmes like Atal Mission for Rejuvenation and Urban Transformation (AMRUT), Railway Station development programme, City Gas distribution project, Pradhan Mantri Awas Yojana (PMAY), Smart City Mission, Swachh Bharat Mission (Urban), metro rail investments, etc. are being undertaken with a focus on sustainability, eco-friendly practices, faster implementation, and innovative construction practices.

Given the scale of infrastructure development in the country in the next 25 years, incorporating resilience planning, innovation, sustainability and technology into construction practices will result in significant financial efficiency gains and decrease in carbon footprints

3. 'What is Neom? The \$500 billion Saudi Arabian 'smart city' is 33 times the size of New York'; The Standard ; William Mata; October 2023
4. Grand Paris Express, France; Railway Technology ; May 2023

5. Construction technology market expected to reach \$24 billion by 2033' ; Future Market Insights ; Aug 2023

6. 2023 Global Construction Survey : Familiar challenges — new approaches ; Geno Armstrong, Clay Gilge, Kevin Max, Suneel Vora ; Jun 2023

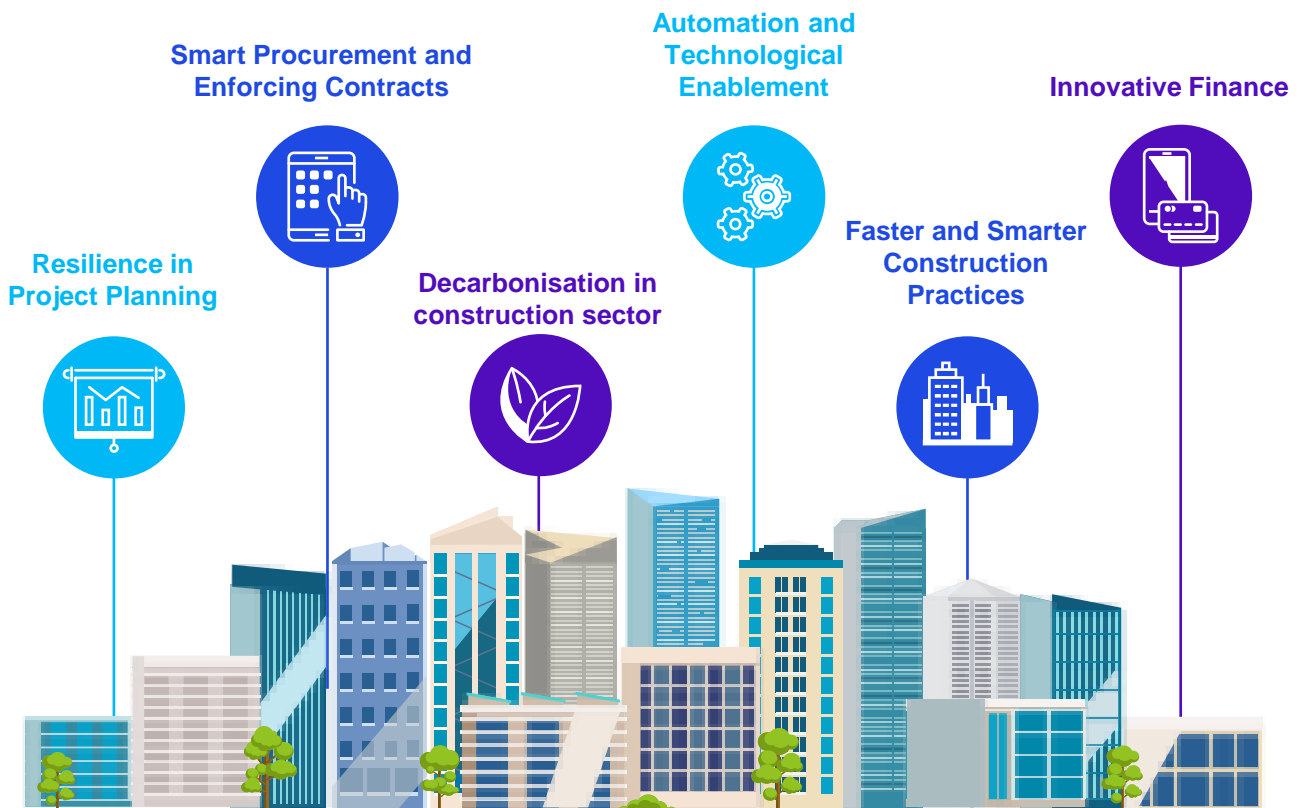
Setting the context (3/3)



Trends for smarter, efficient and sustainable construction

While there are various themes and trends playing out in the construction sector for accelerated and sustainable implementation, we have identified six key themes that we believe will play a predominant role in next 5-10 years and transform the overall built environment landscape.

Themes to propel smarter construction in urban India



These six themes impact all the important phases of a project life cycle of infrastructure projects.

While resilience planning influences the planning stage of the project, it has a profound impact across the value chain of the project during construction as well as the operation phase, especially considering the ever-increasing volatility and uncertainty due to global events and natural disruptions.

Since project performance in the area of procurement, contract management, execution and monitoring significantly impacts the success of the project, we have identified themes on smart procurement and enforcing contracts, smarter and faster construction practices and automation and technological enablement as the most crucial for building blueprints of tomorrow.

Decarbonisation in the construction sector is imperative to mitigate climate challenges, with the industry responsible for generating nearly 40 per cent of global energy related carbon dioxide. Sustainable and energy efficient practices will be an important requirement and cornerstone for the future of construction and therefore an important theme to be considered.

The last and probably the most pivotal theme is on innovative finance. Given that the infrastructure spend is likely to double to USD1.7 trillion between fiscals 2024 and 2030 compared with 2017-2023, innovative finance will enhance the ability to address the financing challenges and ensuring sustainable infrastructure growth for the future.



Theme 1:
**Resilience in
project planning**

Prep gets you there



India is rapidly growing its infrastructure, driven by a surge of public investment, which is forming the bedrock for the country's journey towards the third largest economy by 2027 and a developed nation by 2047.

According to Ministry of Statistics and Programme Implementation (MOSPI), Government of India report dated October 2023², which monitors progress of Indian infrastructure projects worth more than USD18 million, cost overrun of more than USD 5,189,240 million was estimated in 411 infra projects and 837 infrastructure projects were delayed with average time overrun of around 37 months. Disruptive events such as the pandemic, and geopolitical forces were some major reasons for this.



At the same time, disruptions in the form of global events such as environmental hazards like cyclones, earthquakes or urban flooding; economic downturns; pandemics; armed conflicts, etc. as well as local events such as invocation of Graded Response Action Plan (GRAP) in few Indian cities, create a volatile environment leading to issues in supply chain management, rising inflation of energy and materials, creation of excessive wastage, shortage of labour and other critical resources¹.

Further, with over half of the global population residing in urban areas and estimated loss from natural disasters alone amounting to USD110 billion in the first half of 2023³, it is of paramount importance to prepare capital intensive urban infrastructure and construction projects to absorb and

adapt in a changing environment and undertake implementation within the constraints of such volatility and achieve intended purposes within schedule, budget and scope.

Resilience planning plays a crucial role in fortifying infrastructure systems, enabling them to adeptly endure shocks, swiftly recover and sustain efficient operations proactively.

The construction planning and project implementation ecosystem prevailing currently needs to think beyond typical risk management and recognise that resilience, as a tool, must be operationalised and treated as a key strength, to ensure stability, adaptability, and long-term sustainability⁴.



1. Familiar Challenges New Solutions, KPMG, 2023
2. 455th Flash Report on Central Sector Projects, Ministry of Statistics and Programme Implementation, October 2023

3. Disaster Risk Management, World Bank, October 2023
4. 2021 Global Construction Survey, KPMG, August 2021

Importance of resilience planning in infrastructure development

A strong focus on assessing, prioritising, and responding to risks, and a full understanding of the impact of future disruption on the economy, workforce, infrastructure requirements, operations, costs, revenue and reputation shall enhance our preparedness to volatility and ensure sustainable business and project continuity.

- **Resilient infrastructure** reduces the economic impact of disasters and disruptions by minimising damage and enabling swift recovery. In Bangladesh, accounting for climate change in the design of infrastructure through additional flood protection measures increased capital requirements by USD560 million but could save up to USD1.6 billion⁵
- **Ensuring continuous service delivery:** By enhancing the ability to bounce back from disruptions, resilient infrastructure ensures that essential services are maintained, preventing prolonged downtime.

- **Protecting human lives:** Around 85 per cent of all disaster fatalities are observed in the low-income and lower middle-income countries⁶ which are more vulnerable. Resilience planning contributes to the safety of communities by reducing the vulnerability of infrastructure to disasters, ultimately safeguarding lives.

- **Fostering sustainable development:** Integrating resilience into infrastructure planning promotes sustainable development practices, addressing impending challenges.

Key components of resilience planning

As per Global Construction Survey 2023 by KPMG, 84 per cent respondents have recognised that effective risk management and resilience planning are very important in dealing with disruptive events⁷ Embracing resilience planning and enabling an environment conducive to implement it, requires a holistic approach towards key components of risk assessment and mitigation, adaptability and flexibility and sustainability.



Components of holistic approach for resilient planning

1. Risk assessment and mitigation

- Identification of potential risks such as natural disasters, climate change impacts, and technological failures and development of strategies to mitigate risks through robust design, redundancy, and smart infrastructure solutions. Fukushima, a city in Japan which has endured in the past tsunami and nuclear disaster, is a case in point. The city has taken several pioneering steps towards resilience such as using advanced space technology to protect subways from flooding, earthquake resistance and preparedness through core column (shinbashira) vibration control system in tall structures, collection of seafloor seismograph data for sensing tremors up to 20 seconds earlier than the conventional method.⁸
- An integrated risk management approach with linkages among enterprise, portfolio and projects, collaborative approach to risk sharing between owners, implementing agencies and other stakeholders is required. It is due to this robust approach that a container ship “Ever Given” that ran aground in Suez Canal, was within a week’s time freed through a complex operation which was made possible due to the readiness and risk response planning⁹.
- Preventative and predictive approach to risk management by identifying emerging risks with focus on impact, probability, interconnectedness, and velocity is vital.

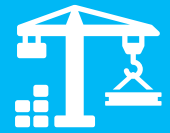
5. Disaster Preparedness Offers Big Payoffs for Utilities, Open Knowledge Repository beta, Oguah, Samuel, Khosla, Sunil, October 2017

6. Integrating Climate and Disaster Risk into Development, World Bank, November 2013

7. Familiar Challenges New Solutions, KPMG, 2023

8. Resilient Japan, Cabinet Public Affairs Office of Japan, accessed on 06 January 2024

9. Eos, AGU, Deepa Padmanaban, May 2022



2. Adaptability and flexibility

- Design of infrastructure systems that can adapt to changing conditions, ensuring flexibility in operations and maintenance.
- Incorporation of innovative technologies that enable real-time monitoring and adjustment of infrastructure functions.
- Achievement of diversified procurement through alternative sourcing channels, sourcing from multiple local vendors, indigenisation, mapping value chain and identifying critical dependencies, high risk geographies, clusters and cartels to achieve supply chain resilience.
- Achievement of resilient urban planning by land use-transportation integration, Transit oriented Development (ToD) and efficient neighbourhood planning. Development of sponge cities and nature-based solutions aid in flood impact reduction. Proactive approach towards development of hazard

responsive or adaptive infrastructure through climate-based solutions and community participation is being proactively adopted as against the post hazard responsive approach.

- Innovation in project management with adoption of agile and lean concepts, modular technology, data analytics, adaptive infrastructure has become quintessential.

Masdar city in Abu Dhabi adopts climate responsive planning, vernacular and passive design making it 10 degrees cooler than downtown Abu Dhabi. Resilience in desert landscape has been achieved through architectural solutions such as orienting buildings to create shaded spaces for heat reduction, designing narrow alleys to create wind tunnels and reducing openings to create thermal comfort at the settlement level¹⁰.



3. Sustainability

- Prioritise environmentally friendly practices in infrastructure development to minimise negative ecological impacts. Integrating renewable energy sources and eco-friendly materials to enhance sustainability.
- Emphasis on Environment, Social and Governance (ESG) with a focus on climate change and extreme weather events, workplace demographics, safety and wellbeing, governance around

business continuity planning, diversity in regional operations, ethics and enabling culture is to be incorporated.



The authorities of FIFA World Cup 2022, Qatar managed supply chain risks by enforcing Sustainability Sourcing Code requiring suppliers to agree to be monitored and evaluated on sustainability performance to ensure responsible practices in sourcing of goods and services¹¹.

10. Masdar City Website, accessed last on 6 January 2024

11. FIFA World Cup 2022™ First Sustainability Progress Report, INSIDEFIFA Website, October 2020

Steps to accelerate wider adoption of resilient planning

To plan and manage urban infrastructure and construction projects effectively amidst disruption and volatility, some of the important actions required from the key stakeholders are outlined below.

 Government	 Industry bodies	 Private sector
<ol style="list-style-type: none">1. Promote community driven urban planning like adopted by Japan incorporating local knowledge and needs into disaster preparedness plans. Example - Japan involves residents in disaster preparedness plan2. Fostering international collaboration for adoption of best practices in areas of flood protection, earthquake resistant buildings, climate resiliency and supply chain disruptions and alternative sustainable materials3. Further promote Make in India initiatives for building resilience in supply chain, promote local material usage and build agility in norms, regulations to deal with unforeseen events4. Promote adoption of BIM and digital twin in urban infrastructure planning for simulations and advanced risk preparedness.	<ol style="list-style-type: none">1. Jointly develop centres of excellence in areas of resilient planning like having standard risk response guidelines2. Advocate for policy level changes and incentives for resilient urban infrastructure development3. Develop platforms to communicate between members regarding common and specialised emergency response equipment during emergencies.	<ol style="list-style-type: none">1. Investment in robotics and automation not only to improve efficiency but to provide flexibility in the face of work force challenges2. Be future ready with developments along the emerging regulatory environment and market demand like Net Zero etc. Build resilience in each of the pillar of ESG3. Invest in collaborative platforms to enhance communication, reduce conflicts, and improve overall project resilience.

Resilience planning is the guiding thread that stiches together the fabric of enduring cities. Government, private sector and industry must synchronise their efforts to embrace resilience in construction to ensure stability, adaptability, and long-term sustainability of urban infrastructure.





Theme 2:

Smart procurement and enforcement of construction contracts

Innovative tie-ins



The construction industry, signified by its dynamic nature, time and cost pressures, demand innovative approaches to procurement and the enforcement of contracts.

Construction procurement and the subsequent enforcement of contracts is a complex process, often marred by inefficiencies and delays. As per the latest Ease of Doing Business ranking released by World Bank in 2019¹, India was ranked 163rd among 190 countries on the parameter of "Enforcing Contracts".

Criteria for rating by World Bank for "enforcing contract"



Use of good practices promoting quality and efficiency



Days to resolve a commercial dispute through the courts



Attorney, court and enforcement costs, as percentage of claim value

Impact of Contractual Disputes- Singapore, China and India



164

Average days taken to resolve contractual disputes in Singapore which makes it #1 worldwide

496

Average days taken to resolve contractual disputes in China which makes it #5 best worldwide

1455

Average days taken to resolve contractual disputes in India

25%

of the value of cost claims required to resolve disputes in Singapore

16%

of the value of cost claims required to resolve disputes in China

31%

of the value of cost claims required to resolve disputes in India



1. Doing Business 2019: Training for Reform – A world bank flagship report, World Bank Group, 16th Edition, 2019

Disputes in India take **over 1,455 days to resolve and cost over 31 per cent of the cost claims**, whereas Singapore (ranked #1 on this parameter) takes 164 days and costs around 25 per cent of cost claims and China (ranked #5 on this parameter) takes 496 days and around 16 per cent of the cost claims².

Similarly, procurement process in construction sector is protracted in India. As per an internal analysis by KPMG, the time lapsed from **project approval to bid award ranges from 5-6 months** without any re-tendering and may stretch beyond **16-18 months** in case of re-tendering.

In the last few years, the government has taken multiple steps to improve both procurement processes for capital projects as well as enhance efficiency of enforcing contracts in India. There have been revision of public procurement manuals and guidelines to address some burning issues like prescribing strict timelines for payments, timely release of payments to Micro, Small and Medium Enterprises (MSME), use of electronic measurement books, alternative methods for selection of contractor including using quality parameter for faster and efficient procurement.

Alternative dispute resolution is being promoted and there have been multiple revisions in Indian Arbitration and Conciliation Act in recent years to encourage use of alternative dispute resolution. Similarly, the Central Government had notified Mediation Act 2023 to promote and facilitate mediation for dispute resolution, enforcement of mediated settlement agreements, and to provide a body for registration of mediators to strengthen the mediation process and bring it at par with the effectiveness as witnessed in Singapore over the years. Further, institutional arbitration is being promoted with establishment of various institutions in Hyderabad, Mumbai, Delhi to institutionalise alternative dispute resolution methods. On the same lines, we have also witnessed the encouraging trend of arbitration awards being recognised and implemented.

As urban landscapes evolve, innovation and technological advancements in procurement and contract management can reshape the way projects are executed. It becomes paramount for stakeholders to adopt progressive strategies and to bring in the right investments.

Innovative practices for smart procurement and enforcement of contracts

While there are multiple innovative approaches available and discussed, we have identified the following top four practices which can elevate the procurement and contract management facets of the construction industry significantly.



2. Revamping Project Management: Assessment of infrastructure projects and corrective recommendations for performance improvement – A joint study by conducted by PMI and KPMG in India on infrastructure projects in India, Supported by Ministry of Statistics and Programme Implementation (MoSPI) , PMI & KPMG in India, June 2019



1. Increase usage of alliance contracting

Alliance contracting is a collaborative project delivery approach that emphasises cooperation and shared goals among stakeholders in the construction industry. It encourages a shift away from adversarial relationships to create a more cooperative and integrated project delivery model. Alliance contracting exists in the forms provided in figure below.

It may appear that alliance contracting may pose a challenge in procurement for public sector funded projects, particularly for defining public value and ensuring competitive tension for arriving at the Target Overrun Cost (TOC) and Key Performance Indicators (KPIs). However, many governments in certain countries have successfully implemented alliance contracting using various approaches like collaborating with multiple consortia to develop TOCs and KPIs before finalising on one consortium. Similarly, an independent consultant is put in place to develop the TOC, which is then used to compare the TOC developed by consortium and proposed alliance team. To encourage the adoption of this model of delivery, certain countries have developed and issued frameworks / guidelines for owners to implement alliance contracting. Further,

there have been many examples of successful alliance contracting around the world, particularly in US, Canada, Australia and New Zealand amongst other countries.

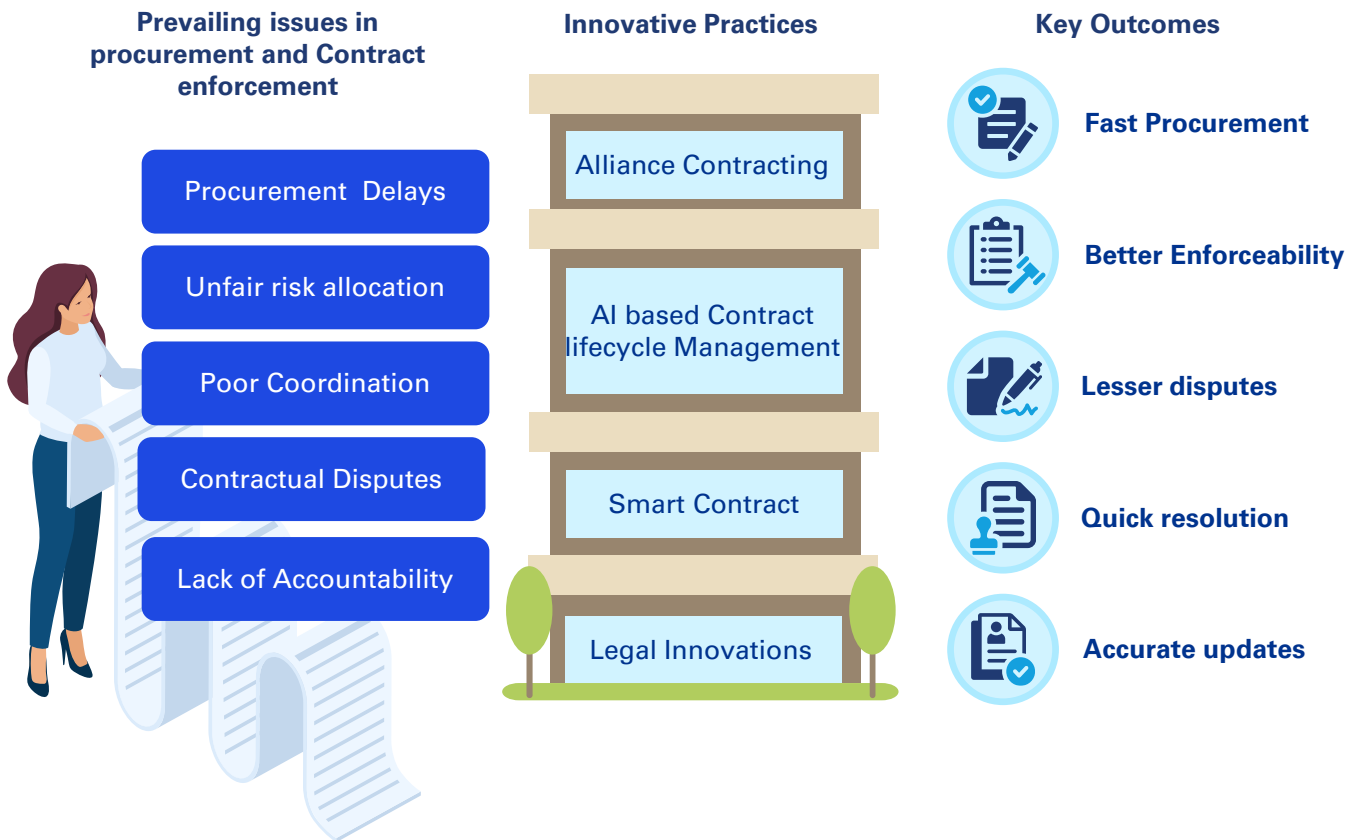
The completion of Australian National Museum in 2001³ on time and under budget by USD20-30 million is one such example wherein core construction contracting bottlenecks related to risk sharing and teamwork were resolved using alliancing. Department of Infrastructure and Regional Development, Government of Australia also released the National Alliance Contracting Guidelines in 2015 as an alternative to traditional contracting. Similarly, Department of Transport and Main Roads in Australia⁴ delivered the Ipswich motorway project, which was completed in 2012 within budget and six months ahead of time by following alliancing contracting. It was one of the most challenging brownfield projects in a busy corridor being used by more than 90,000 vehicles per day. The project involved widening of 8 km of motorway from 4 lanes to 6 lanes, as well as building a network of service lane, 25 km of shared pedestrian and cyclist facility, 26 new bridges and upgraded interchanges.

Forms of Alliance Contracting



3. Project alliancing at national museum of Australia – Collaborative Process, Griffith University, Queensland Australia, Hauck AJ, Walker, Hampson, KD, RJ , 2024
4. Leveraging Project Procurement & Delivery Approaches for Positive Outcomes: How and When to use Alliance Contracting, WSP, February 2021

Innovative practices for smart procurement





2. AI based contract lifecycle management tool

Artificial Intelligence (AI) based contract lifecycle management can help manage multiple contracts and mitigate various risks and disputes through higher automation and improved efficiency. AI in contract lifecycle management imparts benefits like assistance in clause drafting process using clause library, bidding process and vendor negotiation by providing benchmarks and reference points from past projects⁵. Digital maintenance of contractual records and documentation has paid huge dividends over the years and current technological innovations are making it more accessible and adaptable. One of the key reasons for

Singapore's success story over the years has been early adoption of technology when in year 2000, it enabled all document filings in civil cases to be done digitally. In Operations and Maintenance (O&M) phase, contract lifecycle management tools can help improve productivity by expediting compliance checks, implement predictive maintenance, inventory planning, claims management and dispute resolution by quick data review, delay analysis, meta data extraction from bulky documents and unstructured data sources⁵.



3. Smart Contracts

Smart contracts powered by blockchain technology have the potential to be a gamechanger. These self-executing contracts get automatically executed once predefined terms and conditions are met and the record which gets generated in blockchains is secure, time stamped and difficult to meddle. In addition to this, the disruption to project progress resulting

from the inefficiencies in the supply chain, delay in bill settlement, acknowledgement of change orders can be greatly reduced by combining BIM with the blockchain technology⁶. In contracts with milestone-based payment, BIM embedded with a smart contract can help in faster and accurate measurement of physical progress and faster settlement of bills.



5. AI and Construction Disputes: The Road Ahead!, HKA, Anand Udayakumar and Daniel Chua, October 2021

6. BIM, Blockchain & Smart Contracts, Construction Institute, Nancy Greenwald (Executive Director), 13 January 2021



4. Changes and innovations in the legal system

Innovations in contract enforceability extend to the legal frameworks governing construction agreements. Dispute resolution mechanisms have evolved beyond traditional litigation. Alternative Dispute Resolution (ADR) methods, such as arbitration and mediation, offer faster and more cost-effective ways to resolve conflicts. These mechanisms provide flexibility and allow parties to tailor the resolution process to the specific needs of the construction projects.

While India has seen an uptick for disputes being resolved through alternative methods, the practice needs to be widespread, which will not only help commercial dispute resolution to be faster

but also help the legal system to be more effective. Referring to the dispute resolution environment in Singapore would be prudent to understand the effectiveness, where 67 per cent of disputes referred to Singapore Mediation Centre (SMC) are resolved⁷ and construction disputes account for about 40 per cent of SMC cases.

Faster adoption of technology in all alternative dispute resolution methods, operationalising institutions and skilling manpower to embrace alternative dispute resolution are three of the major steps that need to be taken for higher adoption of alternative dispute resolution.



7. mediation.com.sg last accessed on 4 January 2024

Steps to accelerate wider adoption of smart procurement and enforcement of contracts

Highlighted below are the key steps recommended by KPMG in India for market players which will lead to wider adoption of the suggested innovative and technology enabled practices in the area of procurement and contracts

 Government	 Industry bodies	 Private sector
<ol style="list-style-type: none">1. Digitisation of contract management for efficient communication and documentation2. Promotion of smart contracts and blockchain for transparency and automated execution3. Updating legal frameworks to recognise and enforce smart contracts4. Investment in training programmes to equip public officials with necessary skills5. Research and innovation funds to support advancements6. Preparing framework and standard contract documentation for alliance contracting for procurement of complex public infrastructure projects7. Creation of pilot projects to test and validate innovative approaches.	<ol style="list-style-type: none">1. Development of industry-specific guidelines for smart procurement and contract enforceability2. Facilitation of knowledge-sharing platforms such as conferences and workshops3. Collaboration with educational institutions to ensure widespread knowledge of smart procurement and contract enforcement practices.	<ol style="list-style-type: none">1. Investment in research and development for innovative procurement solutions2. Strategic partnerships with technology providers for specialised expertise3. Exploring alliance for complex projects4. Wider adoption of digital tools for procurement and contract management.

With the growing infrastructure needs of urban India, innovative approaches in procurement and contract enforceability can reshape the landscape of the construction sector. From leveraging technology like BIM and blockchain for smarter procurement to incorporating AI for risk prediction, the industry is at the cusp of transformative change. The construction sector stands poised to benefit from these advancements, fostering efficiency, sustainability, and improved project outcomes.



Theme 3:
**Faster and smarter
construction
practices**

Speed matters



The global construction narrative is unfolding with breathtaking speed and imagination. Skyscrapers are getting built in a matter of days; roads are getting laid in mere hours and entire city is emerging as if painted by the strokes of a futuristic urban canvas. The realisation of these marvels is possible by the global beacons of innovation.

Take for instance, recently, a 10-storey residential building in China's Changsha city was built in just 28 hours and 45 minutes¹. Similarly, a 1000 bed hospital - Huoshenshan and Leishenshan Hospitals in China was built in matter of 10 days². Both projects involved prefabricated components and modular construction method.

In December 2022, a 2,400 square-foot residential property - "House Zero" was printed in less than two weeks in Austin, Texas³.

Further, 100 houses are being printed at Austin, Texas⁴. Similar developments in mass housing projects using 3D printing technology are in pipeline across many counties.

The above are few examples of faster and smarter construction taking place globally. These developments are possible due to the convergence of innovative technologies and forward-thinking methodologies, giving rise to a new era of construction, one marked by speed, efficiency, and sustainability.

India is also on a fast-track mode embracing advancements taking place in construction practices like standardised, modularised and prefabricated components, 3D printing and robotic automation in construction coupled with other improvements that are discussed in other sections of the document and are paving the way for scripting the growth journey towards becoming a developed nation by 2047.

Innovative construction practices for faster and smarter construction

Five innovative construction practices anticipated to impact the execution of infrastructure

Standardisation

Standardisation offers cost savings, minimises interface challenges, ensures predictability, and lowers maintenance costs.



Modularisation

Enhances customisation, flexibility, and unlocks prefabrication's potential in a controlled factory environment. Improves timelines by 20 to 50 per cent.⁶



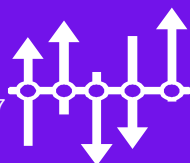
Prefabrication

Boosts construction efficiency, improves sequencing, and mitigates weather delays, improves labour retention and offers additional cost saving by 20 per cent.⁶



3D printing

With the promise of reducing construction time and waste, 3D printing is a game-changer, especially for affordable housing projects. 3D printing offers saving of 60 per cent of the time on the job site and 80 per cent in labour.⁷



Robotic automation in construction

Transforms construction with precision and efficiency as robots optimise tasks, enhance productivity and contribute to safer work environment like demolition of buildings, lifts and position heavy loads.

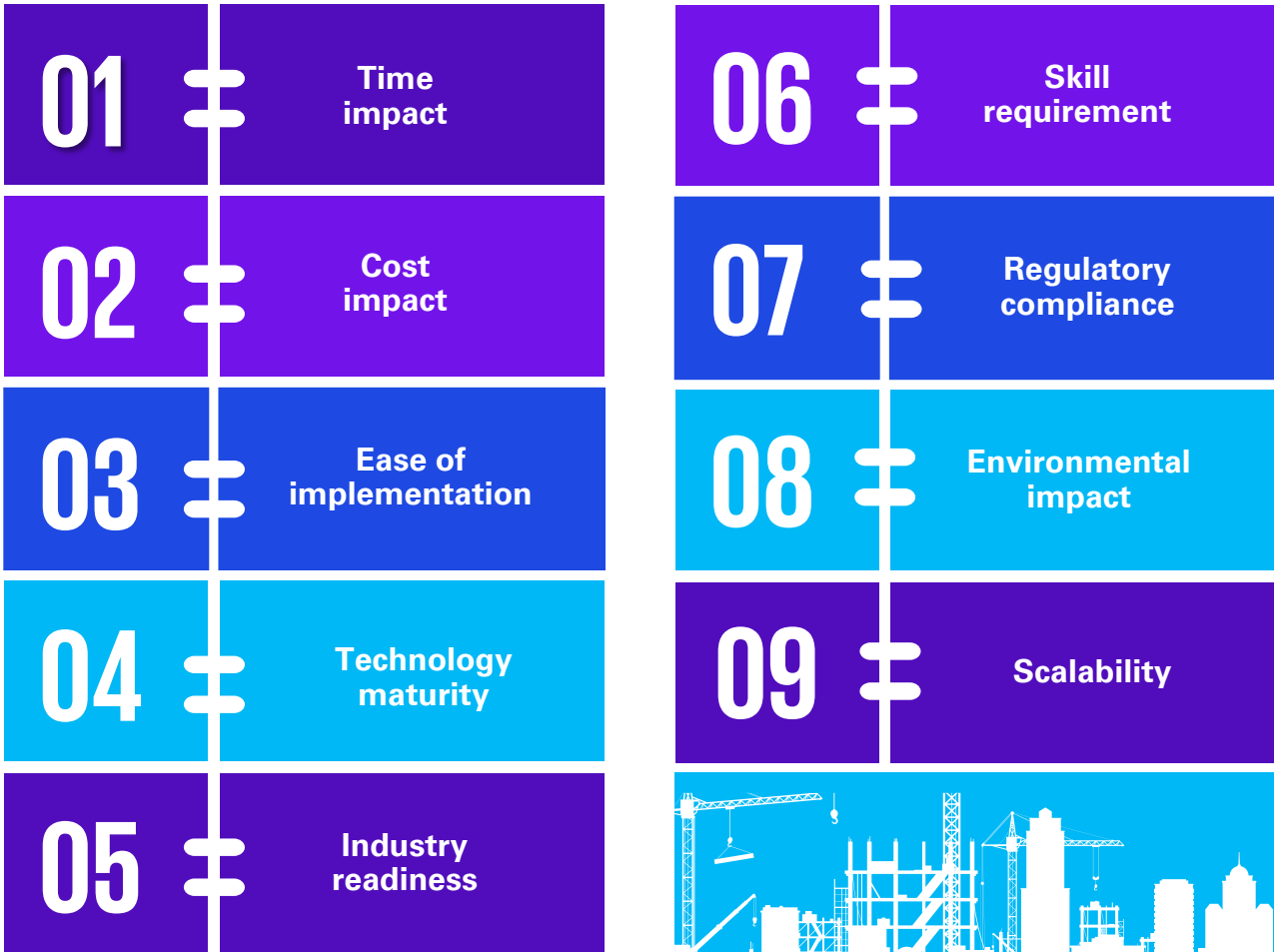


1. Chinese developer builds 10-storey building in Changsha in just over 28 hours | The Business Standard, 20 June 2021, last accessed on 8 January 2024
2. Modular Hospitals: 3 Examples of Prefab COVID-19 Hospitals, Autodesk, Matt Alderaton 20 October 2021, last accessed on 3 January 2024
3. Residential Construction – House Zero, ICON, ICON Team, 3 February 2022 last accessed on 8 January 2024

4. This is how 3D printing could help solve the US housing crisis, World Economic Forum, 24 February 2023, last accessed on 2 January 2024
5. Modular construction: From projects to products, McKinsey & Company, June 18, 2019, last accessed on 13 January 2024
6. 3D Printing in Construction: Growth, Benefits, and Challenges Updated, Autodesk construction cloud, 18 February 2022

The adoption of these construction practices varies due to the influence of several factors and the unique characteristics and requirements of each sector.

Key factors influencing the adoption of faster and smarter construction methods/tools



The degree of influence of these factors ranked in a scale of 1 to 10 (1 being lowest and 10 being highest) coupled with unique characteristics and requirements of each sector when analysed provides the broad understanding of the suitability of adoption of a particular solution in that sector.



Sector and solution matrix based on industry adoption

Sector - Urban Infrastructure		Solutions - Technology or Tools for faster and smarter construction		
Urban Infrastructure Sectors	Urban Infrastructure Sub - Sectors	Standard, modular and prefabrication	3D Printing	Robotic Automation
Urban Transport	Roads	●	●	●
	Airport	●	●	●
	Rail & Metro	●	○	●
Real Estate	Housing	●	●	●
	Commerical	●	●	●
	Institutional	●	●	●
	Healthcare	●	●	●
Wet Utilities	water supply	●	●	●
	water treatment	●	●	●
	Waste water	●	●	●
Communication	Telecom	●	●	●
	Broadband and internet	●	○	●
Power Utility	distribution	●	●	●
	Renewable integration	●	●	●


Industry adoption ● - Very High ● - High ○ - Moderate ○ - Low

The evaluation above can help the market players in making strategic and investment decisions for accelerating the adoption of these construction methods that are faster, efficient, sustainable and contribute toward realising the growth and profitability aspirations.

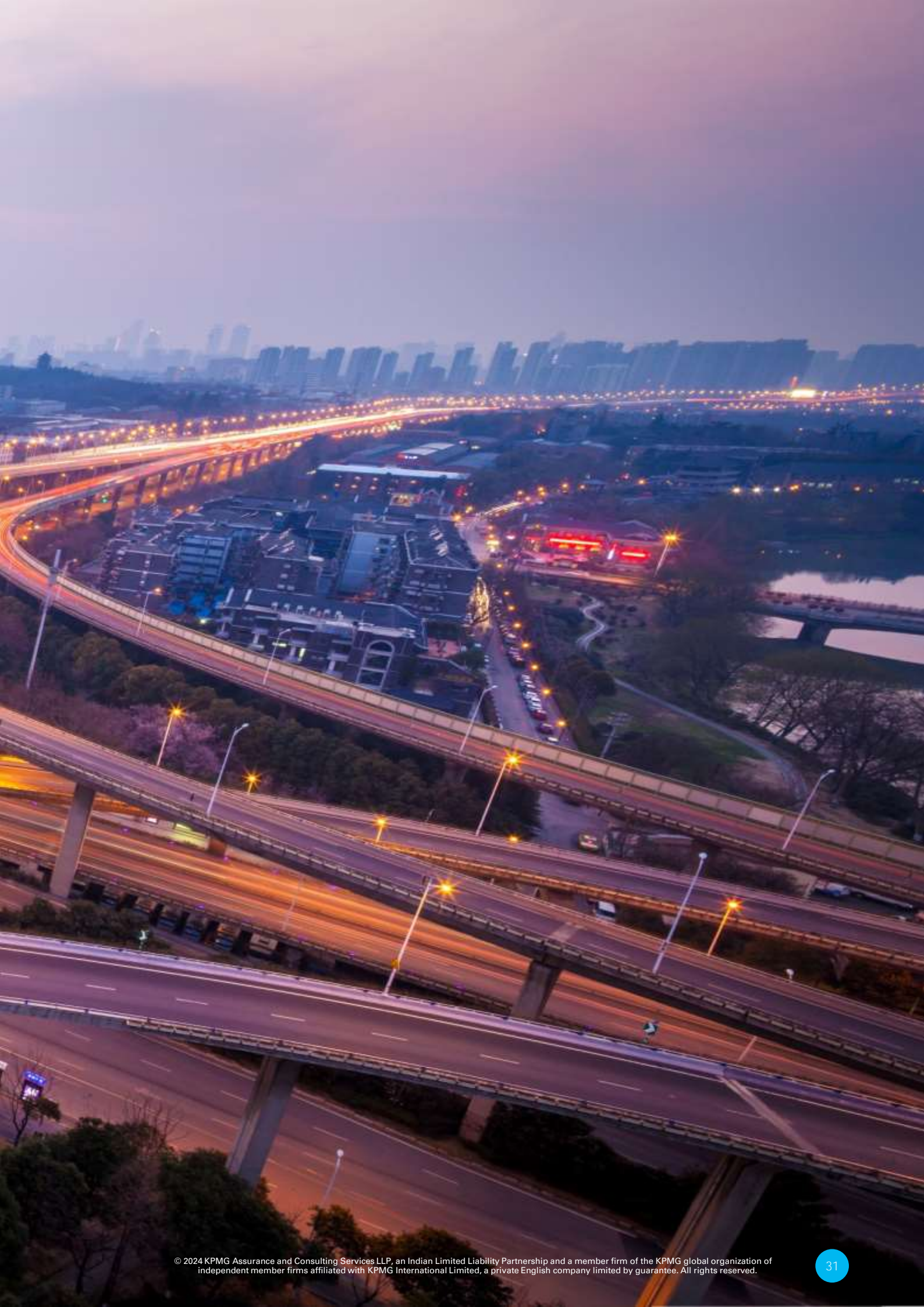


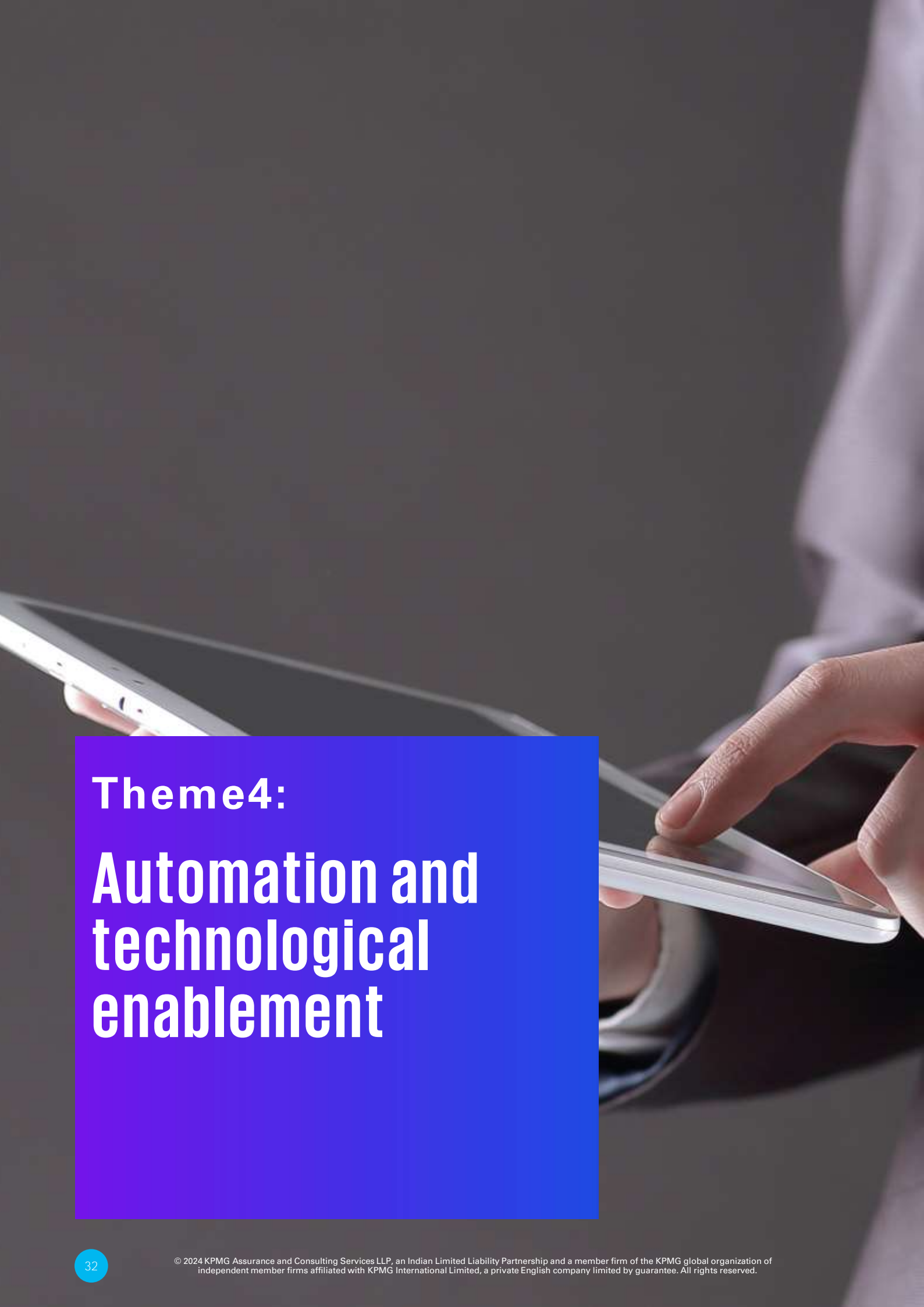
Steps to accelerate wider adoption of innovative construction practices

The key steps recommended by KPMG in India to accelerate the adoption of faster and smarter construction methods to meet the development aspirations are outlined below.

 Government	 Industry bodies	 Private sector
<ol style="list-style-type: none">1. Develop regulations and standards for innovative construction technologies including issuing permits and inspection like in Singapore and Australia.2. Set up incentives like tax holidays, subsidies and grants for capital investment in faster and smarter construction.3. Appoint suitable faculties and promote courses in Industrial Training Institutes (ITIs) and other vocational training institutes.4. Allocate funds and grants to institutions for advanced research on 3D printing and materials. Many countries including US, Australia, Germany have allocated dedicated funds.5. Promote innovation for faster and smarter construction in public procurement. Promote 3D printing for affordable housing schemes E.g., Dubai has committed to use 3D printing in 25 per cent of the city buildings under “Dubai 3D Printing Strategy”.	<ol style="list-style-type: none">1. Policy advocacy for standardisation and government support for subsidies and grants for improving market condition.2. Improve collaboration with architects, suppliers and government bodies.3. Collaboration with leading domestic and international universities.4. Develop platforms for sharing of data and good practices to improve mutual awareness5. Facilitate exhibitions and hackathons to bring innovation in faster and smarter construction.	<ol style="list-style-type: none">1. Leverage the startup ecosystem to train and equip workers with practical futuristic skills using immersive AR/VR tools etc.2. Take on pilot projects benefiting communities with live demonstrations. E.g., one of the leading companies in the US collaborated with a nonprofit organisation for mass housing.3. Develop experience centres to show success stories and provide performance guarantees to mitigate concerns on reliability.4. New business models like Environment as a Service (EaaS), where equipment can be available for pay-per-use basis - improves accessibility to medium and smaller players using open platforms ensuring improved utilisation and return of investment.

As we address the volume and complexity of construction for urban infrastructure development, embracing innovative construction technologies can improve the adoption of faster and smarter construction in the sector, ensuring efficient project delivery.



A person wearing a white lab coat is shown from the chest down, holding a tablet computer. The person's hands are visible, with one hand holding the tablet and the other hand touching the screen. The background is a dark, blurred grey.

Theme4: Automation and technological enablement

The agile sprinter

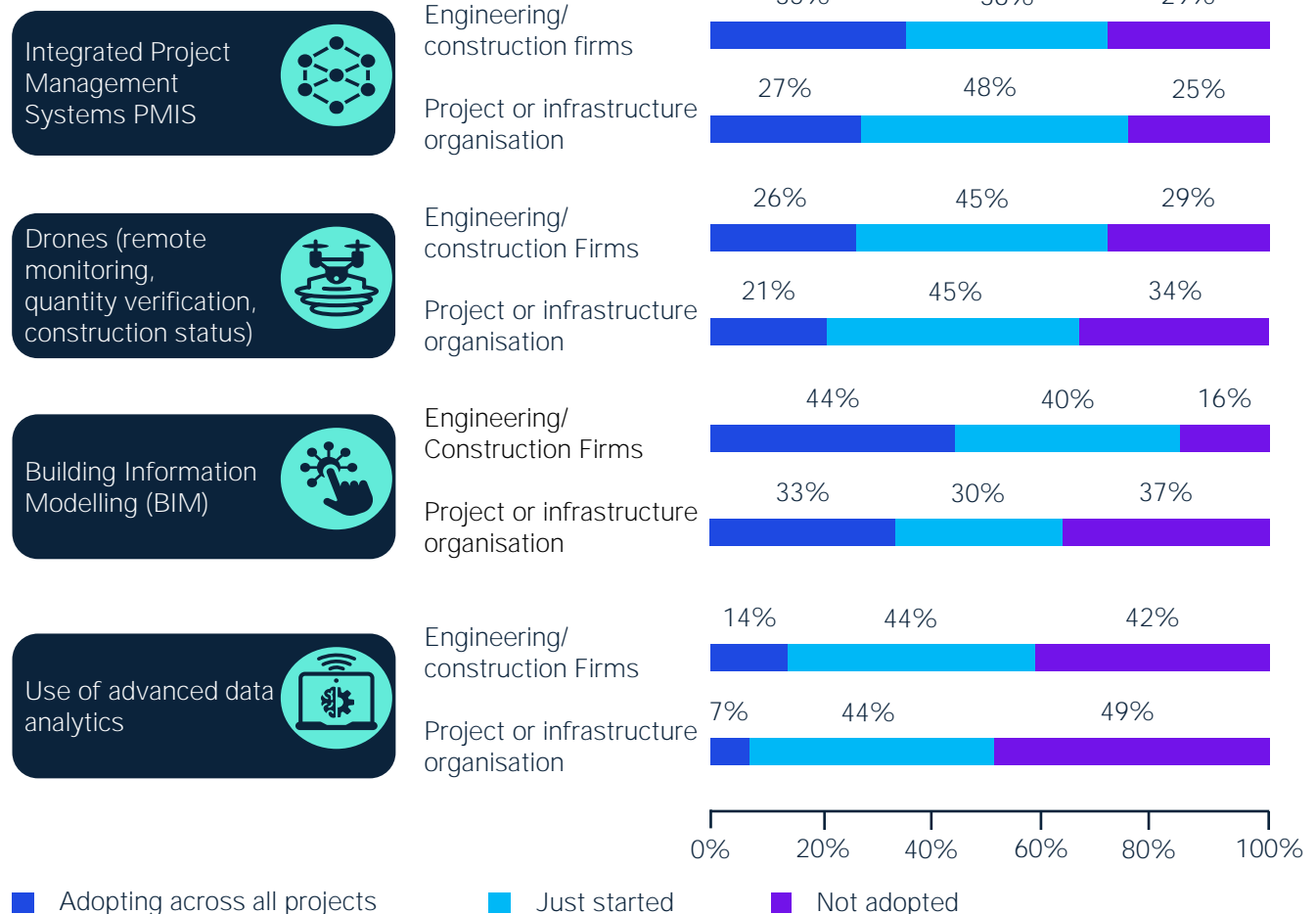


Construction management of large and complex infrastructure projects have evolved significantly. Implementation of Metro rail projects that used to take more than five years for example are targeted for completion in three years. This has been made possible due to widespread use of automation and technological solutions for monitoring, management and control of the projects.

The project managers of today have the ability to leverage real-time collaboration, data driven decision-making tools, integrated project management platforms, drone technology and sensors & IoT devices of not only improving control and predictability of delivery of projects but also reduce the risk of errors and delays. The technology solutions also have enormous potential to drive Govt's flagship infrastructure programmes, policy implementation and leverage its full potential more effectively for socio economic development.

The adoption of technology advancements in the project organisation is, however, not an easy one. Construction industry in India faces a digital adoption lag. According to Ministry of Statistics and Programme Implementation, Govt responsible for coverage and quality of statistics released on various govt. led programs, 504 projects have been rescheduled, resulting in cost increases of more than 19 per cent. The biggest barrier for this is the limited adoption of technology in construction, which is attributable to execution agencies' reticence to alter their established methods of operation¹.

Level of technology adoption



Source: KPMG Global Construction Survey, 2021

1. How India's construction companies are coming forward with digital transformation, Business World, Harsh Pareek, December 2022

The hurdles that slow down the pace of such technology adoption include:

- Skill gap in the workforce leading to challenge in integration of advanced technologies into existing systems.
- Securing both private and public sector investment for such adoption on projects.
- Regulatory and policy issues in the Indian construction sector.
- Resistance to change within the industry, stemming from a reliance on traditional methods and hesitancy to invest due to perceived risks and uncertainties.
- Effect on sector's competitiveness and its ability to support new technology implementation despite improvements in the quality and capacity of existing infrastructure, particularly in urban centres and manufacturing hubs.

Key technologies for enhancing project performance

Five innovative technologies which are expected to play a crucial role in improving project performance are outlined below.



1. Building Information Modeling (BIM)

BIM offers improved project visualisation, better cost estimation, and efficient project management, leading to 12 per cent cost savings in large projects². Many governments worldwide have already advocated BIM and in India too the

government can evaluate the benefits of digital construction and advocate its use for signature projects in the country. *In India, leading Metro and Airport Authorities have benefitted from implementing BIM.*



2. Project Management Information System (PMIS)

PMIS has helped by streamlining data management, enhancing real time monitoring, improving collaboration in complex infrastructure projects. By integrating real time data and analytics, PMIS enhances decision-making and streamlines workflows.

A leading Indian Metro Authority has implemented IPMS for integrated project controls to manage deliverables, resolve issues, collect field data, share submittals, drive project performance³.

2. How can BIM reduce time and cost of projects, ascendblr.org., last accessed on 11 January 2024

3. Delhi Metro Rail Corporation to implement Integrated Project Monitoring Software (IPMS), Express Computer.in, last accessed on 13 January 2024



3. Drones

- Used for monitoring, drones can increase data accuracy and reduce survey times by up to 90 per cent. Promotion of Drone-as-a Service (DaaS) in priority/flagship programmes can be an effective enabler.
- An authority of Government of India responsible for National Highways Development and Maintenance have been making use of drones in monitoring of project performance improving the visibility to take timely decisions and prompt action⁴.



4. Artificial intelligence (AI)/machine learning (ML)

- AI's predictive capabilities can foresee project delays, optimise resource allocation, and improve safety. The application of AI in Delhi Metro's construction has shown how it can streamline complex urban projects.



5. IoT

- IoT devices in construction sites can lead to better equipment management and worker safety, potentially reducing accident rates by up to 30-40 per cent.
- A leading Indian construction conglomerate in India is using IoT and AI to develop a connected equipment platform that offers real time visibility across project sites. This allows the construction conglomerate to monitor the status and progress of their projects in real time to supplement decision making and potentially increase efficiency.⁵

As per the KPMG Global Construction Survey, 2021, the majority of respondents comprising owners and engineering and construction companies believed that the top three technologies which have the greatest potential are integrated PMIS, Building Information Modeling (BIM) and advanced data & analytics. Drones and smart sensors were also technologies identified to have a significant impact. Both owners and

engineering and construction companies believe these innovations can give a healthy return on investments by increasing efficiency and improving decision making.

Embracing the above tools is not just a choice, it is a strategic necessity to propel the industry into a future defined by innovation and sustainable development.

4. NHAI makes video recordings through drones, The Economic Times, June 2021, last accessed on 12 January 2024

5. Microsoft Chairman and CEO Satya Nadella addresses industry leaders in Mumbai; encourages organizations to 'Do More with Less', news.microsoft.com, last accessed on 13 January 2024

Steps to accelerate wider adoption

The **integration** of automation and technology for construction management and control is increasingly becoming crucial for executing large and intricate infrastructure projects. With strategic planning, government support, and industry participation, India can establish itself as a leader in building smart infrastructure with consistent adoption of technology.



Government

1. Establish innovation labs where government, private sector, and academic institutions collaborate on developing new technologies. These labs could focus tailoring solutions to the Indian market like automated equipment, and AI models trained on local data.
2. Promote adoption of digital technology in flagship schemes, incentivise private sector for adoption. Also, roll out Information and Education campaigns (IEC) and programmes around ease of technology skill development.
3. Introduce low-interest loans or grants specifically for the adoption of new construction technologies.
4. Set up incubation centres that support startups focused on construction technology.
5. Policies are needed to facilitate technology adoption, such as tax incentives for using green technologies and revised building codes that accommodate new methods/technologies. The success of the National Digital Communications Policy by Government of India is a testament to how policy can drive technological change



Industry bodies

1. Encourage collaboration between the construction industry and other sectors like IT, manufacturing, and automotive. Such cross-industry partnerships can lead to the transfer of technologies (like automation and precision engineering) and innovative approaches to construction.
2. Create and standardise BIM, IoT, AI/ML practices specific to Indian projects for industry-wide efficiency.
3. Policy advocacy for grants, standardisation of practices with government.



Private sector

1. Allocate funds in Research and Development (R&D) for automation and technology enablement.
2. Develop virtual reality (VR) based training programmes for construction workers and managers. These programmes can simulate complex construction scenarios, providing hands-on experience with new technologies in a safe and controlled environment.
3. Use system generated data for predictive analytics to forecast trends to avail cost reduction, supply chain optimisation and prioritisation of investments.

The identified steps can expedite broader adoption of technology and automation and bring transformative change in implementation of infrastructure projects ushering an era of efficiency, precision and innovation.



An aerial photograph of a wind turbine standing in a rural landscape. The turbine is a tall, slender tower with three blades extending from the top. The landscape below is a patchwork of green and brown fields, with some buildings and roads visible in the distance. The sky is a mix of orange, pink, and blue, suggesting a sunset or sunrise. The overall scene is peaceful and scenic.

Theme 5: Decarbonisation in construction sector

The value-add mantra



Climate change is one of the formidable challenges being faced by humanity and our planet today. Interestingly, the construction sector accounts for approximately 40 per cent of the total greenhouse gas emissions. Out of this, more than 11 per cent of the emissions occur during the construction phase as embodied carbon, implying that a major portion of the emissions have occurred before the built space is operational.

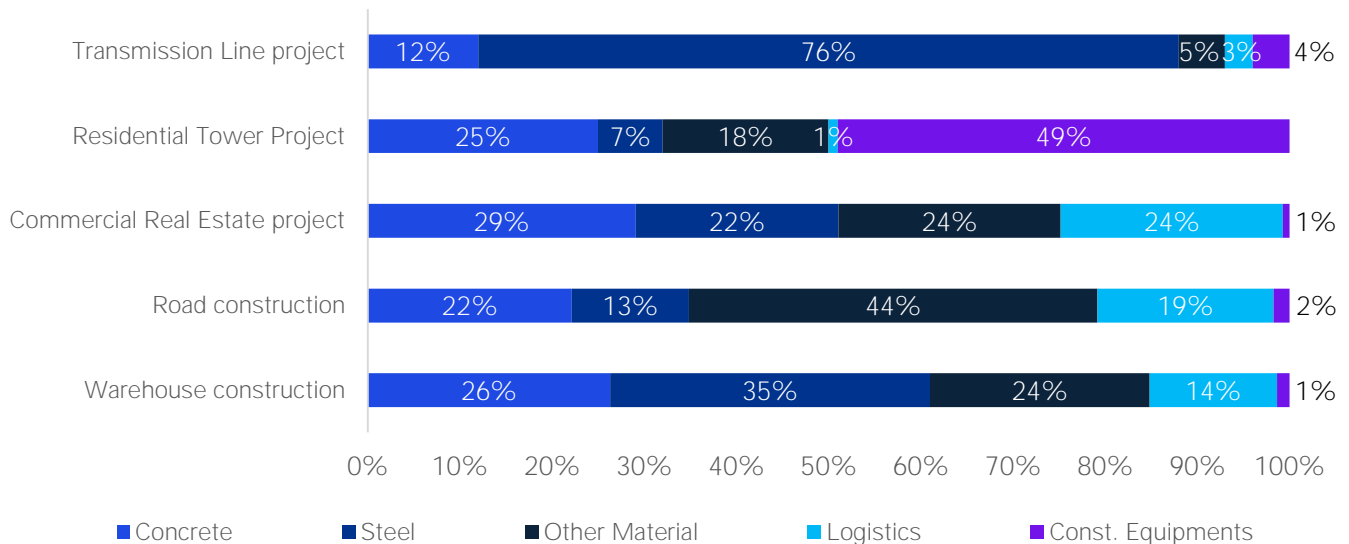
Embodied carbon refers to the emissions pertaining to the extraction, manufacturing, transportation, installation, maintenance and disposal of building materials. While operational carbon has been the focus and various measures combined with increasing efficiencies continue to reduce its intensity, embodied carbon has received limited attention.

Embodied carbon, thus remains an untapped area for carbon optimisation in the

construction industry and may become an equal contributor as operational carbon over the next 30 years, calling for an urgent action to address embodied carbon from stakeholders across the construction value chain.

According to United Nations Industrial Development Organization (UNIDO), to accommodate urban expansion driven by an increasing population across the globe, an equivalent of another New York City will have to be built every month for the next 40 years¹ increasing the demand of common construction material like cement, steel, insulation, etc. Cement, concrete and steel together account for more than 50 per cent of the industrial carbon generated². A KPMG in India's analysis shows concrete and steel used in common urban projects are responsible for approximately 25 per cent and 30 per cent of embodied carbon emitted respectively.

Embodied carbon contribution in some urban projects



Embodied carbon is best addressed in the early stages of construction, enabling stakeholders to reduce as much as 100 per cent of the emissions by either challenging the need or planning to offset their anticipated emissions through methods like carbon capture, carbon sequestration etc. As the construction cycle progresses, the opportunity to reduce embodied carbon decreases exponentially, with 50 per cent of the window closing by the time construction of the asset commences.

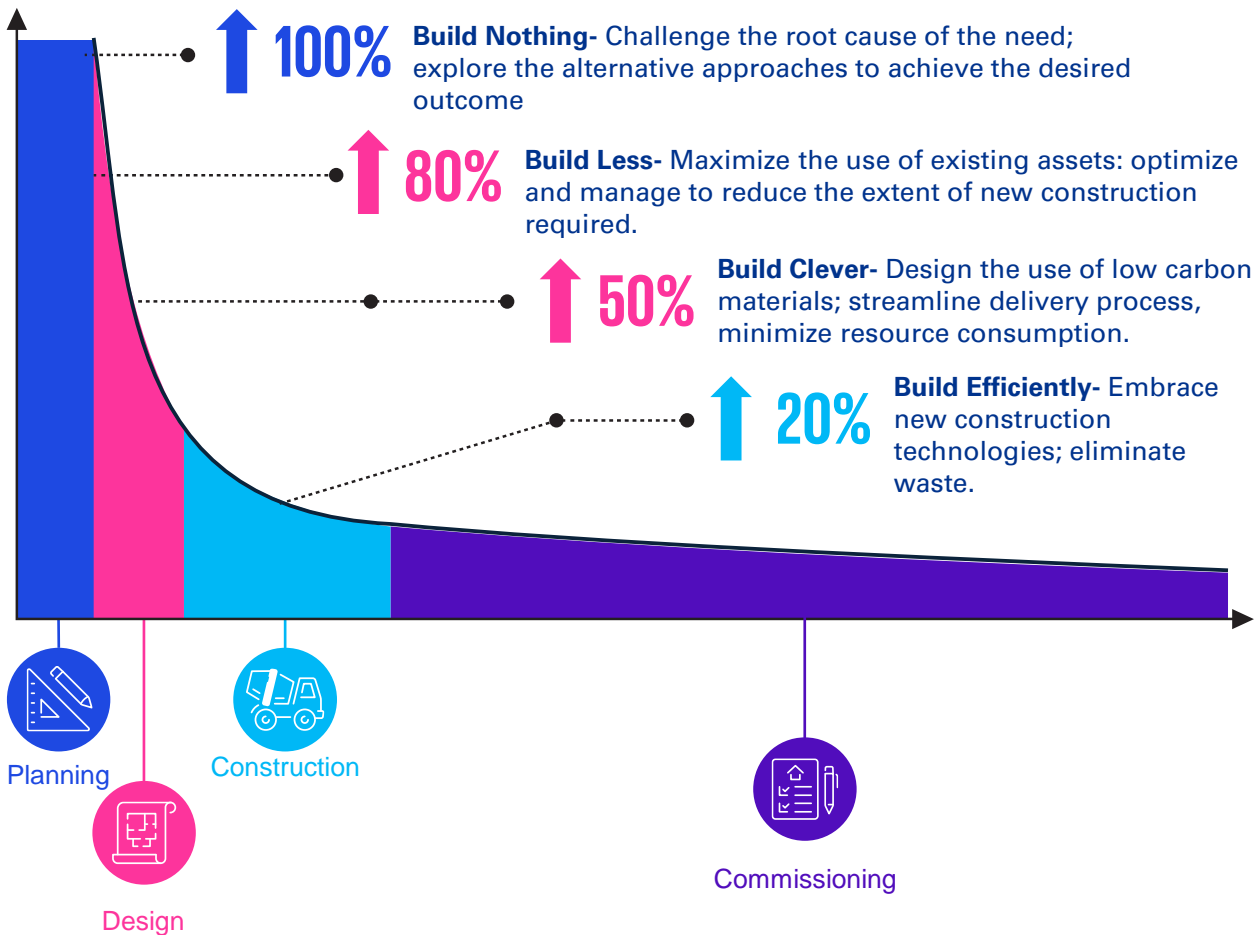
1. Steel and cement can drive the decade of action on climate change. This is how: UNIDO, Industrial Analytics Platform; Rana Ghoneim, Gökçe Mete and Anthony Hobley; May 2022

2. Why the build environment: architecture2030.org; Architecture 2030; last Accessed January 2024

Decarbonisation reduction potential across the project life cycle

Across the life cycle of a project, typically 50-70 per cent of total embodied carbon gets emitted till the physical completion stage. Out of this, 85-90 per cent of emissions are during the product/manufacturing stage, seven to ten per cent during the transportation, and three to five per cent during the construction stage. Both material selection and the respective processes adopted for extraction, manufacturing, transport, and, finally erection are chief contributors.

Four strategies to reduce carbon across the project life cycle



*Source: Bringing embodied carbon upfront, World Green Building Council, September 2019

Against a common misconception of increased cost for carbon reduction, up to 46 per cent of embodied carbon can be reduced with an additional spend of 1 per cent of capex.³, which according to a KPMG in India study can be increased up to 65 per cent with right decisions during the planning, design and procurement stages.⁴

Addressing the embodied carbon in the built environment, although is an urgent necessity and critical for countries to meet their net-zero commitments, however, it currently faces several challenges.

At an institutional level, standards and codes

should include embodied carbon measurement and sectoral benchmarking, setting limits for both new construction and refurbishments.

Incentivisation of low-carbon material production and usage in construction by governments can help achieve economies of scale of new technologies for addressing embodied carbon.





Leveraging technologies such as Building Information Modeling (BIM) and Digital Twins, which are already getting established for improved project management for carbon-conscious decisions.

3. Reducing embodied carbon in buildings; Rocky Mountain Institute; Rebecca Esau, Matt Junglaus, Victor Olgyay, Audrey Rempher; July 2021

4. Embodied carbon management for global infrastructure; KPMG in India; March 2023

Steps to accelerate switch to low carbon infrastructure

Some of the key steps that market players are advised to initiate to switch to low-carbon infrastructure are outlined below.

 Government	 Industry bodies	 Private sector
<ol style="list-style-type: none">1. Frame new policies / modify existing policies for embodied carbon.2. Impose tax liabilities on embodied carbon above allowable limits for new construction and refurbishments.3. Incentivise green material manufacturing and use in construction. 	<ol style="list-style-type: none">1. Set standards for embodied carbon assessments and reporting.2. Benchmark embodied carbon in construction across sectors.3. Catalyse transition to low carbon infrastructure by increasing awareness on low carbon material and setting guidelines for implementation of low carbon practices 	<ol style="list-style-type: none">1. Investor community: Increase investments in decarbonisation across low carbon material, low carbon transport etc.; Introduce and promote financial products encouraging low carbon infrastructure.2. Asset owners: Decarbonise existing assets and encourage low carbon infrastructure development and enable processes aligned to the net zero goals.3. Architects /engineers: Collaborate with the stakeholders to encourage and create sustainable low carbon infrastructure.

A collective approach towards whole lifecycle of decarbonisation is perceived to be way forward for built environment of our urban areas. It is imperative for all relevant stakeholders to assess, collaborate and seek a solution for address embodied carbon.





Theme 6: Innovative Finance



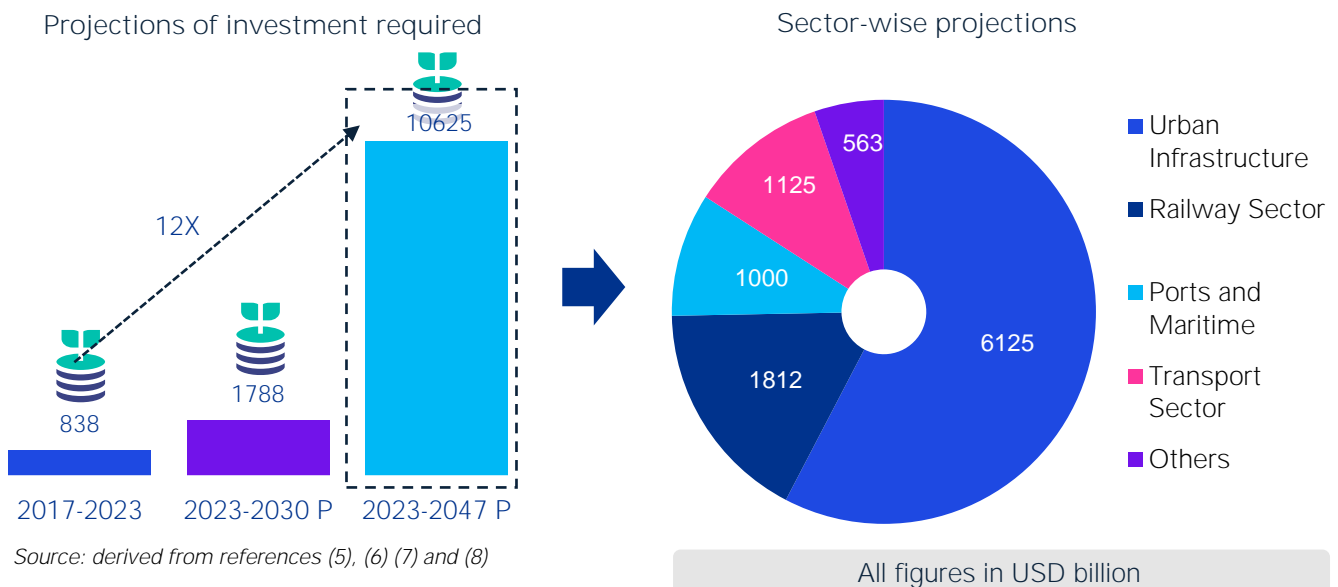
India has emerged as an economic powerhouse, consistently showcasing its meteoric rise and unwavering prowess on the global stage. It is currently the world's fifth-largest economy by nominal Gross Domestic Product (GDP) and the third largest by purchasing power parity, boasting of a young and growing population, a burgeoning middle class, and a rapidly evolving technological landscape.

The Indian economy has been set with an ambitious target of achieving a target of USD5 trillion by 2024³ and achieving

a tenfold increase from USD3.73 trillion¹ to USD20 trillion² by 2047.

India's infrastructure construction market, a behemoth valued at USD195 billion in 2021, is projected to nearly triple to USD535 billion by 2027, fueled by a robust 17.26 per cent annual growth rate⁴. An estimate suggests that to support such growth in infrastructure development and to match the economic growth of competing economies, a staggering investment of USD10,625 billion will be required between 2023 and 2047⁵, roughly 12 times the investments made between 2017 and 2023.

Projection of investment required in India with sector-wise break up



It can be observed from the above graph that urban infrastructure and rail transport are expected to need the maximum investments in the near future to effectively meet the needs of the fast-growing urban population and improve connectivity.

To meet the requirement of India's ambitious infrastructure dream, alternatives to the traditional source of finance will have to be

established as implementation of these transformative projects hinge on the ability to address the financing challenges

Fueled by the need to unlock new sources for infrastructure projects, Government of India (GoI) has pioneered a wave of innovative financing solutions through targeted regulatory changes. GoI is exploring different modes of finances to boost the country's infrastructure.

- GDP Of India: Current and Historical Growth Rate, India's Rank in The World, Forbes India, December 2023
- Envisioning Urban India @2047, KPMG in India, March 2022
- PM Modi's Aspirational Call for 5 trillion Dollar Economy in 5 Years, NM website, May 2020, last accessed on 5 January 2024
- Infrastructure Construction Market in India 2023, Netscribes, February 2023
- Govt estimates Rs 880 lakh crore investment in infra by 2047 for high growth, India News - Times of India, July 2023

- Revitalising Infrastructure Finance: Unlocking India's Growth Potential, ET BFSI, July 2023
- Renewable Energy in India: Investment Opportunities in the Power Sector, Invest India, last accessed on 7 January 2024
- India's infrastructure spending to double to Rs 143 lakh crore between fiscals 2024 and 2030, compared with 2017-2023, Crisil, October 2023

Innovative financing avenues to fund India's growth aspirations

Over the years, Gol has taken numerous initiatives to supplement the funding through innovative sources other than budgetary finance, traditional debt lending and sovereign backed development loans. Some of the key avenues which are being explored or have a potential for exploration are outlined below.



1. Strengthening of the bond market and long-term financing

- Reserve Bank of India (RBI) has issued guidelines “on Partial Credit Enhancement to Corporate Bonds” in 2015 to enable raising of resources via bonds. India’s corporate bond market is expected to double from USD580 billion in the Financial Year 2022-23 to USD1500 billion by FY 2030⁹. Infrastructure firms can enjoy a lower rate of interest by having higher credit ratings which attracts a wider range of investors. With a more attractive bond offering, infrastructure companies are more likely to successfully raise the capital they need for their projects.
- In a recent move to boost investment in India's crucial real sector, Gol has significantly revised its External Commercial Borrowings (ECB) policy.¹⁰ Infrastructure firms can score big using ECBs with cheaper loans, foreign currency for fancy imports, and longer repayment periods that match long-term projects. Plus, ECBs diversify funding, saving from the whims of local money markets.
- Creating an environment to encourage issuances of Municipal Bonds or 'Munis' by urban local bodies to finance public projects in their jurisdiction would help diversify the pool of fixed-income products available for institutional and retail investors in the market. To meet the debt obligations, the local bodies can exhibit increased accountability through greater efficiencies in levying and collecting of fees, innovative pricing for services, and monetising of services and assets.
- Traditional sources of funds have been revamped into Infrastructure Investment Trusts (InvITs), Real Estate Investment Trusts (REITs) for the development of India’s infrastructure and ensuring a balanced risk sharing between all the stakeholders.
- There has been underutilisation of permissible investments in infrastructure sector for Employees Provident Fund Organization (EPFO) AUM investments in InvITs¹¹ (current 0 per cent vs permissible 5 per cent) and insurance sector (current 8 per cent vs permissible 15 per cent)¹². Facilitation of EPFO and insurance investments in infrastructure will enhance the funding capacity.



9. Corporate bond market set to double by FY2030 at Rs. 100 trillion (US\$ 1.19 trillion), Report by CRISIL, IBEF, December 2023
10. External Commercial Borrowings Policy (revised), Ministry of Finance, June 2005

11. Employees' Provident Fund Organisation, Annual Report 2021, Ministry of Labour and Employment, Government of India
12. Insurance Regulatory and Development Authority of India (IRDAI), Annual Report 2021, February 2022



2. Acceleration in sustainable development

- As it has happened across the world, climate-proof infrastructure has taken centre stage in India's upcoming growth story, too. From United Nations Framework Convention on Climate Change (UNFCCC) or Conference of the Parties (CoP) 26's net-zero target to CoP 28's call for equitable climate action, India has prioritised resilience and emission reduction. The rise of ESG-focused financial products like green bonds, blue finance and sustainability-linked loans reflects growing investor demand for eco-conscious options. Diverse tools such as renewable energy equities to green mortgages are empowering companies to embrace sustainable practices.
- The increasing appeal of green finance is showcased by over USD20 billion

accounted by Green Social Sustainability and Sustainability linked (GSSS) debt bonds in India's market in January 2023¹³. Securities and Exchange Board of India's (SEBI) launch of ESG mutual funds in 2023 further signifies burgeoning investor interest in sustainable investments¹⁴. As India builds for the future, climate-resilient infrastructure and green finance is expected to forge a path towards a sustainable and prosperous nation. Before COVID-19, the ocean economy was poised for a doubling act, booming from USD1.5 trillion in 2010 to USD3 trillion by 2030, creating 40 million ocean-powered jobs. Now, the tide is turning as the financial world starts embracing the treasure trove of opportunity a thriving ocean presents¹⁵.



3. Private sector participation

- Private participation in funding for development of infrastructure remains modest, standing at approximately 20 per cent of total infrastructure investment in the country. Streamlining Public Private Partnership (PPP) transactions and institutionalisation of Infrastructure PPP Adjudication Tribunal or a similar mechanism for mediation and conciliation will be required to reinvigorate private sector participation in the sector
- Utilisation of intrinsic land value through

Land Value Capture (LVC) and Transit Oriented Development (ToD) is emerging as a key solution for financing of public transport systems like metro rail projects across India. Few cities such as Chennai, Bengaluru, Gurugram, etc. have recently rolled out strategic plans for implementation in this aspect. Oregon Metro in the US leverages ToD and LVC to fuel metro expansion¹⁶. Countries such as China, Hong Kong, Indonesia, Philippines, Thailand, Japan, and Singapore too are leveraging LVC for their infrastructure¹⁷.



13. India's green bond issuances just 3.8 pc of overall domestic corporate bond market, Economic Times- Energy World, last accessed on 7 January 2024
14. New category of Mutual Fund schemes for Environmental, Social and Governance ("ESG") Investing and related disclosures by Mutual Funds, SEBI, July 2023
15. Blue finance: What is it and how could it save the ocean?, World Economic

Forum, February 2022
16. Transit – Oriented Development 2020 Annual Report, Oregonmetro, December 2020
17. Assessing Co-benefits from Metro Rail in India, Observer Research Foundation, Promit Mookherjee and Dhaval Desai, January 2023

Actions to facilitate innovative financing mechanism

Though Government of India has taken several initiatives to bridge the funding gap in infrastructure development, it will be vital to continue in this direction. Some of the steps required to facilitate inclusion of innovative financing are outlined below.

 Government	 Industry bodies	 Private sector
<ol style="list-style-type: none">1. Encourage participation by statutory authorities managing pension and insurance funds in new infrastructure financing instrument such as InvITs.2. Develop a comprehensive policy and framework to improve depth and liquidity in bond market (including municipal bonds, ESG bonds, green bonds, etc.)3. Create regulatory mechanism and market ecosystem to promote innovative financing instruments such as land value capture financing.	<ol style="list-style-type: none">1. Advocate need to bring reforms in policies and processes similar to the bankruptcy resolution process, dispute resolution mechanism, etc.2. Partner with the government to develop new financing avenues and facilitate availability of long term, low-risk, low-interest rate financing.3. Highlight contradictions in government contracts and regulations to the authorities.	<ol style="list-style-type: none">1. Actively participate in financing the nation's infrastructure and reduce the burden on government finances.2. Actively pursue emerging options to secure financing through emerging instruments such as InvITs, bonds, equity crowdfunding, and others.

As the landscape for infrastructure financing evolves in India, we anticipate an increasing number of organisations and companies leveraging these advancements to actively contribute to the country's infrastructure development.









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Shubham Agarwal

Sreerathan C

Vibhor Mishra

Vijay Kumar

Vishak Sridharan

Yash Singh

Venkatesh R

Avanti Premkumar



KPMG in India contacts

Akhilesh Tuteja

Head - Clients & Markets

T: +91 124 254 9191

E: atuteja@kpmg.com

Vinodkumar Ramachandran

Partner and Head, Business Consulting

Global Head - Industry 4.0

T: +91 22 3090 1930

E: vinodkumarr@kpmg.com

Nilachal Mishra

Partner and Head, Government and Public Services

T: +91 124 669 1000

E: nilachalmishra@kpmg.com

Suneel Vora

Partner, Business Consulting

Lead - Major Projects Advisory,

Co-lead Industrial Automation Intelligence and Digitalisation

T: +91 22 3989 6000

E: suneelvora@kpmg.com

Karun Raj Sareen

Partner, Business Consulting

Major Projects Advisory

T: +91 406 111 6000

E: karunsareen@kpmg.com

kpmg.com/in

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KPMG Assurance and Consulting Services LLP, Lodha Excelus, Apollo Mills Compound, NM Joshi Marg, Mahalaxmi, Mumbai - 400 011
Phone: +91 22 3989 6000, Fax: +91 22 3983 6000.

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