

Data-Driven Connected Technologies for Quality and Productive Construction Processes in Highways and Airports in India

OVERVIEW

India's transport infrastructure, recognized as the 'lifeline' of the nation, continues to grow significantly in the new millennium as the government enhances its investment and spending to develop and expand transport projects to cater to the needs of the ever-growing population. India has a diversified and extended transport network with 5.89 million kilometers [\[1\]](#) of road, 68,442 kilometers [\[2\]](#) of rail route, 12 major ports, nearly 200 non-major ports[\[3\]](#), and 125 operational airports (including 29 international and 86 domestic airport). The nation is overflowing with seminal infrastructure projects – the Golden Quadrilateral National highway network, Bharatmala Pariyojana national highway project, the Dedicated Freight Corridor, and the UDAAN scheme which have revolutionized not only the capacity but also the quality of India's transport infrastructure.

With the transport sector in India expected to grow at a CAGR of 5.9 per cent; under the National Infrastructure Pipeline (NIP), the government has planned a total investment of INR 103 lakh crore over the next five years.

ROADS & HIGHWAYS

India has the second-largest road network globally, with the Ministry of Road, Transport and Highway (MoRTH) set to develop approximately 60,000 km of roads in the next five years (from FY 2019). India has gradually become the fastest highway developer globally with 27 km per day highway constructed in FY 2019, 35km per day in FY 2021 to increase this target to 40 km each day.

In this context, in addition to the funds allocated to the National Infrastructure Pipeline (NIP), the government has allocated INR 1.70 lakh crore for transport infrastructure to accelerate highway construction in the country. As part of the pipeline, the project will include:

- Accelerated development of highways, including 2,500 km access control highways.
- 9000-km of economic corridors.
- 2000-km of coastal and land port roads.
- 2,000 km of strategic highways.

The goal is to complete the Delhi-Mumbai expressway and two other packages completed by 2023 and begin working on Chennai- Bengaluru expressway.

AIRPORTS

On the Airport side, India aims to become the third-largest aviation market globally by 2024. India has 464 airports and airstrips, of which 125 airports are owned by the Airport Authority of India (AAI). These 125 AAI airports account for 78% of domestic and 22% of international passenger traffic. Government agencies have projected requirements for nearly 250 brownfield and green-field airports by FY 2020. The Government has allocated approximately INR 3,224 crores to the aviation sector, of which airports were allocated INR 600 crores for the revival of 50 airports under the regional connectivity scheme (UDAAN).

CHALLENGES IN DEVELOPMENT OF HIGHWAY AND AIRPORT PROJECTS IN INDIA

Quality and productive construction has been a consistent challenge in Indian construction projects. Both vertical and horizontal construction projects often face numerous challenges from project conceptualization to the operations and maintenance (O&M) stage. Despite the prominent stake in the economy and society, the sector's performance lags tremendously behind other industrial sectors in terms of digitalization. There are varying levels of complexities from plan, design, engineering to the build and maintenance stage in both highways and airport construction.

As per the Infrastructure Quality parameter of the Global Competitiveness Index, and Kearney's analysis, India lacks in efficiency, productiveness, and quality of transport infrastructure – in the road, rail, air and port infrastructure; highlighting an urgent need for the country to focus on improving the quality and efficiency of transport infrastructure projects in the country. Challenges of project funding, land acquisition delays, environment concerns, low productivity, ageing assets, increasing level of reworks, on-site wastage, etc., have necessitated stakeholders to leverage technology to enhance quality, efficiency, productivity, and durability of public infrastructure projects such as highways and airports.

CHALLENGES SPECIFIC TO PROJECT WORKFLOWS

Specific challenges are foreseen in project workflow in the development and expansion of both highways and airport projects; for instance, in the design and engineering phase of airport expansion or construction, stakeholders witness major challenges in the form of improper quantification of construction materials and constructability errors. These project shortcomings lead to inflated costs, rework, and delays. In highways, prominent challenges faced during engineering design include delay in engineering approvals, improper baseline and planning, and cost based on real-time market scenarios that ultimately affect the efficiency of the design processes.

Similarly, highway construction has traditionally been plagued by shortcomings in inter-departmental collaborations, adverse environmental conditions, contractor's non-performance, skilled manpower, equipment breakdown and idle time. While in airport construction, challenges are largely related to change in design/scope and planning in-silos.

Thus, with large-scale investments, design complexities, and lasting impact on future infrastructure assets, these projects are prone to significant project execution risk and massive cost overruns. These challenges are often a result of project data gaps, leading to significant material wastage, cost & time overruns, and continuous reworks, resulting in massive delays and loss of capital.

OVERCOMING THE CHALLENGES

One of the biggest challenges in construction arises from disconnected workflows and lack of connectedness in off-site & on-site activities. Activities ranging from take-off and site modelling to project scheduling and managing the jobsite are proven complex due to disconnected construction workflows. With the Government of India investing significantly in highway construction and airport expansion projects, the need for adopting data-driven connected technologies (or connected construction technologies) is strongly evident – particularly to maintain quality and enhance productivity. Advancements in the design industry, from 2D CAD drawings to 3D digital models, have specifically linked design processes.

On the other hand, in the construction stage, the advent of GNSS machine control systems, site positioning, fleet and asset management, remote site monitoring, use of big data and cloud solutions have enabled increased productivity & higher Return on Investments (ROIs). Using the right-data-driven connected construction technology, project stakeholders have witnessed tertiary benefits like document

sharing, issue tracking & punch lists, jobsite reports, collaboration & approvals, offline working capability, RFI tools, and reduced duplicate data entries.

Application of content-enabled (multi-disciplinary on-site data), connected (near real-time off-site to field collaboration), and constructible workflow (using as-built data), has proven successful in the reduction of disjointed design-to-execution workflows. A connected construction ecosystem changes the future of transport infrastructure projects by structuring the available datasets and streamlining the information for an efficient workflow benefitting each stakeholder.

Connected construction solutions provide a collaborative approach to integrating lifecycle data, resulting in increased ROIs and project time and cost compliance. An integrated 3D data-driven design model provides project transparency, data interoperability among multi-disciplinary stakeholders, planning, sequencing & scheduling for enhanced productivity.

WAY FORWARD

Data-driven connected technologies or connected construction solutions encompass a dynamically connected environment of construction software(s) 3D Machine Control systems and field solutions to fast-track the design-to-execution tasks in highways and airport projects. Connected technologies are a catalyst for data-driven decision making on the job site by extracting on-site data using connected technologies. This reduces the silos in project execution whilst increasing productivity, bringing effective collaboration among stakeholders, and reducing errors & reworks. Thus, connected technologies are set to mark a beginning of an integrated ecosystem to enable seamless data-driven productivity; whilst ensuring delivery of quality construction projects.

DISCUSSION POINTS

Data-driven connected technologies or connected construction solutions are key to resolving many challenges faced by stakeholders during airports and highway construction. While the Indian highway and airport ecosystem is aware of the value proposition of this technology architecture, they have been unable to leverage the appropriate benefits of these solutions. Thus, in this context, there is a pertinent need to initiate a discussion and deliberate on the how, what and why to establish the relevance, and importance of data-driven connected technologies in highway and airport projects.

Key Discussion Points:

- What is the need and relevance of data-driven connected technologies in highways and airport construction projects?
- What is the current level of awareness of data-driven connected technologies in highways and airport construction projects?
- How can the current level of awareness about these technologies be translated to actual implementation?
- What are the gap areas and the challenges which project owners, designers, contractors, and sub-contractors face in implementing these technologies? How can these gap areas and challenges be resolved?
- What could be the necessary policy interventions (or mandates) required to facilitate the adoption and implementation of such technologies in highway and airport projects?
- How are the short term and the long-term market for these technologies evolve, and what factors would drive these market directions?