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Whitepaper

Impact of Digital on Construction Project Planning

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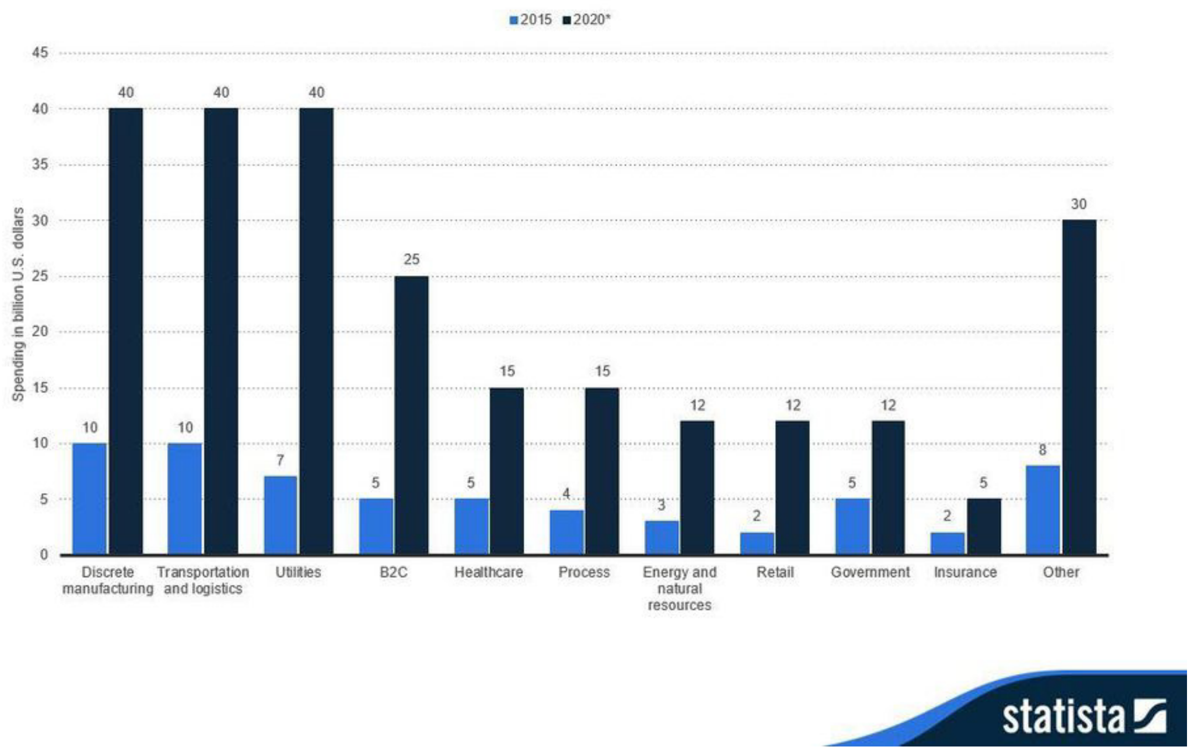
A Larsen & Toubro Group Company

Digitization to Improve Project Planning in the Construction Industry

The Engineering & Construction (E&C) industry has been consistently behind the curve, when it comes to using digital solutions to revamp existing systems and processes. A quick glance at vertical-wise spend on the Internet of Things (IoT) worldwide, shows that the construction industry does not feature among the top 10 verticals. With construction being a key contributor to the overall GDP of some of the major economies worldwide (~8% in India), it stands to achieve significant gains with wider digitization of its value chain.

Internet of Things spending worldwide by vertical 2015 and 2020

Spending on Internet of Things worldwide by vertical in 2015 and 2020 (in billion U.S. dollars)



Planning is one area where digital processes can create groundbreaking impact, in construction projects. Estimates suggest that a delay in a month in the completion from planned timelines in the construction industry could result in annualized cost overruns of 10-15% of the project value. Therefore, efficient planning is an uncompromisable need for successful completion of projects. This paper elucidates the avenues that digital systems can improve in terms of project planning in the construction industry, and the potential challenges that could come up from the context of railway construction projects.

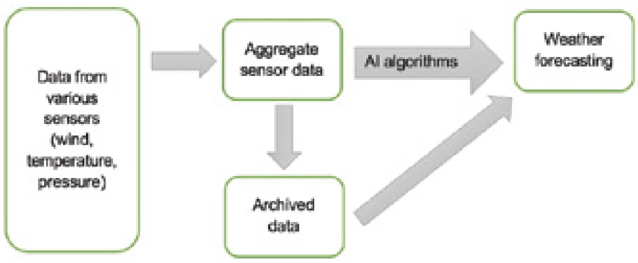
Although it doesn't enjoy an immediate recall, railway construction forms a critical part of the construction domain, especially in terms of transportation infrastructure. Several ambitious rail projects are in the offing across the world, including the Mumbai-Ahmedabad speed rail corridor (the first bullet train project in India), the Singapore-Kuala Lumpur High Speed Line (touted to drastically reduce journey time between the two cities by 70%) and the bullet train project connecting Los Angeles and San Francisco (which is expected to halve the travel time between the two cities.) Railway networks, as is evident, do not exhibit any sign of fading away as one of the most used modes of transport. This gives a definite opportunity to use digital applications for improved project management in railway construction, especially considering the number of big-ticket projects that are already underway, or are expected to kick off in the coming years.

Applications

A key factor that sets railway projects apart from its more well known peers in construction is the sheer linearity of the project's scope in Track Kilometers (TKM) — ranging from as low as 30 TKM to almost 700 TKM, or even higher in some cases. With an average project life cycle of 3-5 years to complement the linear scope, planning across man, material and machine domains is where digitized tools can look to aid, for quicker and profitable turnaround of projects.

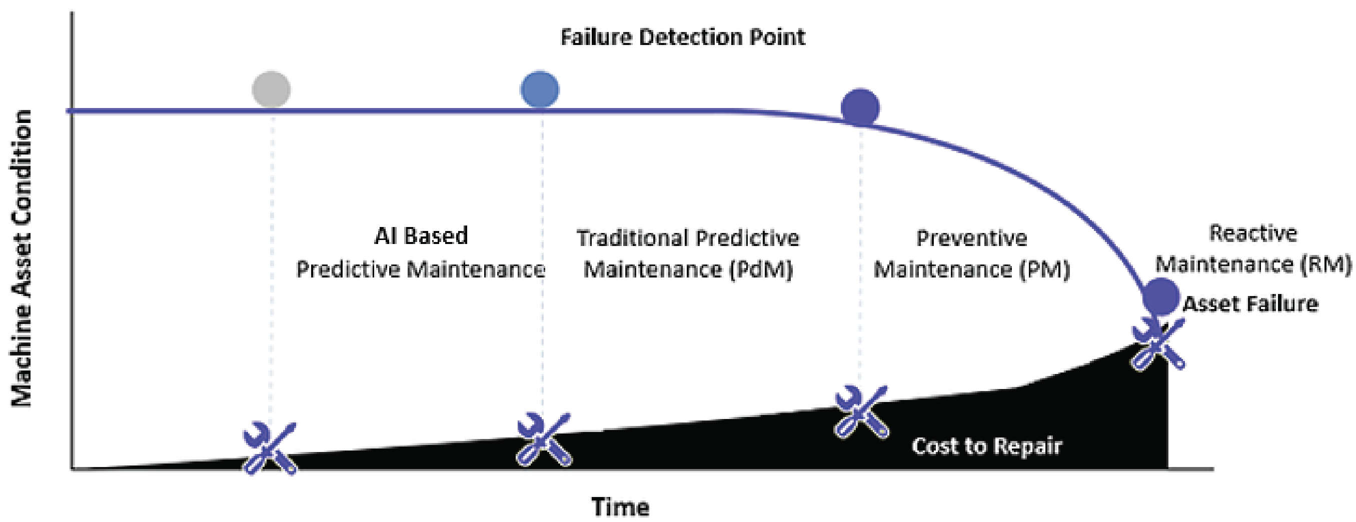
Predicting Weather Patterns

One area which is almost always a spot of bother for such projects, and hampers overall productivity, is weather conditions across the route identified for track laying. Monsoon periods can be a tormenting time, posing severe challenges in procurement of key materials such as ballast, which are laid on the track. This leads to an overall slowdown, as different sources of ballast procurement across the project scope could face adverse impact of varying degrees due to the monsoons, leading to a reduction in ballast availability. Predicting the cyclical nature of such weather patterns by crunching historical data and using advanced analytics can help in proactive intervention from the management of the organization in planning for such conditions. Not only would it help create better visibility on the target output in terms of TKM that can be achieved during climatic periods which are expected to be non-conducive, but it would also result in effective planning with respect to deployment of resources, and stocking up of material in inventory.



Asset Maintenance

As is characteristic of any construction project, railway projects employ several types of heavy machinery, with the purchase cost of equipment associated with track-laying spanning from USD 1.5 to 3.5 Million. Apart from the high purchase costs, what makes matters even more complicated for organizations is the non-availability of backups in terms of the overall rail equipment and related parts — in the event of a breakdown, due to the specific nature of the output derived from such machinery. In such cases, the equipment is forced to remain idle, leading to a delay in all subsequent activities. This mandates the undeniable need to maintain such equipment in perfect condition. Sensorizing such equipment with IoT devices, which transmit real-time data on various health indicators such as temperature, pressure, fuel efficiency etc., can help in better prediction of any maintenance needs, and enable live monitoring. This data can be benchmarked against boundary conditions set by Original Equipment Manufacturers (OEMs) on the aforementioned indicators, for better assessment of maintenance requirements. Predictive maintenance of equipment can eliminate from planning a factor of uncertainty and delay due to equipment breakdown.



Coordination Across Business Entities

What also makes rail projects stand out is the nature of collaboration that such projects need to have with other construction domains, which do not fall under the purview of rail construction management. This could include construction of bridges along the path, or the completion of earthworks — both of which come before rail laying, in the sequence of activities. Such activities are either taken up by different business entities within the same organization, or are handled by independent construction companies, under contract.

To illustrate this further, one of our clients — a leading conglomerate with a significant market presence in the construction industry — has separate business units that handle activities related to roadworks, structures, and rail works. All rail projects that this company takes up, necessarily involve construction activities that belong to these two domains other than rail works. In order to stick to planned timelines, continuous availability of approaches or front, as is the industry parlance, is critical which necessitates constant engagement with the entities involved in the allied construction activities. Considering the vast project scope, the lack of coordinated planning across these entities results in the machinery being moved around to areas across the track length, where patches of front are made available. This leads to a fire-fighting approach to the planning, and the machinery remains underutilized.

What could help here are Artificial Intelligence (AI)-driven predictive models, using historical data of such construction activities. This may help in deriving prospective timelines for project completion, creating a better line of sight on-the-front availability. This aids in the development of a concrete and realistic plan, which can then help the management involved in the railway construction project decide with more conviction on the allocation of their resources.

In the case of an operating model, where independent companies are involved, it would need collaboration in terms of seamless sharing of data, which calls for an alignment between the companies at the preliminary stages of the project. Given the linear scope of the project for rail specific works, organizations segregate work into several sites, or work packages, across the project span. It goes without saying that each work package should always be up to speed on the progress of work in every other package, so as to maintain cohesion. This would go a long way in effective planning.

Surveying Using Geospatial

Yet another critical activity associated with front availability is the surveying done at the initial phase of the project. Taking the case of conventional civil track projects, the rail tracks would often have to pass through rural areas, with some of their key transportation routes getting obstructed during the project construction phase. In some cases, rail construction companies have been at the receiving end of backlashes from localites, due to their everyday commute getting compromised — forcing companies to pause construction activities in such areas.

An application of AI that is becoming increasingly popular as a surveying technique, is geospatial AI. By using geospatial AI at the time of surveying, the geographical data captured can be fed into an AI model, which would help predict with better accuracy the potential areas across the span of the project where the construction project could face heightened challenges in terms of topography, or areas where the project interferes with important transportation junctions. This is principally similar to the way traffic congestion is predicted by factoring real-time data from smartphones. Organizations would find it more beneficial to revisit these geospatial surveys at periodic intervals, in different stages of the project — and not restrict it to the initial phases.

An extended application of geospatial AI in surveying, which would help in proactive planning, is to embed socio-political factors into the predictive model — which may cause work impediments along the rail laying course. This, for example, could include the upcoming elections, or the presence of labor unions along areas where the track laying is planned. Both of these could have negative repercussions in sourcing labor. Therefore, inclusion of these factors would enable the creation of a holistic view at the time of surveying, which can help the organization in identifying interventions that can be done at the preliminary phases of the project.

Challenges

Assuming digital solutions to be a one-stop solution for all challenges in this domain would be a gross misconception, or an oversimplification of these challenges.

The inherent, linear nature of rail projects is indeed one of its major pain points. In the case of building projects, where construction activities are restricted to confined spaces, organizations would have a better grip on project monitoring. This not only enables relatively quicker implementation of digital interventions, but also lead to deeper penetration of structural changes to usher in the digital culture.

However, the same cannot be said about rail projects. With temporary site offices spread across the scope of rail projects, monitoring and checking for effective implementation of digital initiatives from a central location is a challenge. Even if workshops and training sessions are conducted for the site-level employees to highlight the benefits of using digital initiatives, bringing about structural changes to revolutionize their way of working would be a tough task. Given that most of these projects are crunched on timelines, there is a general reluctance from employees to change their way of working and make it more "digitally driven", despite its glaring and obvious benefits. This is primarily because of a gestation period involved in getting used to the new systems.

A key driver to circumvent this would be a relentless top-down push by the senior management, which could motivate employees to start adopting digital methods. Identifying digital points of contact in every site office, along with associated employee KPIs in using digital initiatives, are other areas that can be possibly explored.

Apart from the challenge of bringing in systemic changes in an organization's culture, there are other infrastructure challenges that pose problems for wider AI implementation in rail construction projects.

One of the underlying principles behind rolling out civil track works is to improve transportation access to all possible parts of a country. This, in essence, would mean that the projects would find themselves venturing into distant areas, where continuous network connectivity is not guaranteed. In some cases, the areas are completely off the grid. Interruption of continuous data transmission, which is important for real-time alerts and prompt decision-making, becomes common. This mandates a necessary enhancement of robust offline versions, that has the capability to store large volumes of data and transmit back to a central server when the system comes back online, for every digital initiative.

A lot of digital's success in this domain is also dependent on the maturity and depth in the data already maintained by the organization. However, the data maintained is often unstructured and not in a user-friendly format. This precludes AI tools from deriving any fruitful insights from the historical data. Although tedious, organizations should consider deploying dedicated resources to transform these data lakes into usable and consistent formats to reap benefits in the long run.

About the Author

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Anand Ganapathy is an associate consultant working with the strategy and value realization vertical of the consulting and thought partnership (CSTG) BU of LTI. He has worked on projects in the construction industry helping clients realize sustainable business impact through digital initiatives. Anand completed his master's in business administration from IIM Bangalore.