



PwC's Construction Industry Vision 2025: Towards a digital future

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Table of contents

Executive summary	03
Survey methodology	04
Introduction	05
Challenges in the construction industry	06
Analysis and insights	07
Conclusion	16



Executive summary

Technology-driven construction methodology and digital practices in engineering, planning, procurement, monitoring and information exchange are being increasingly deployed to achieve the project targets of time and cost. Sharing of information in the form of digital data among project owners, authorities, consultants, suppliers and contractors through all the stages of the project execution process integrates all the participants in a project. This integration enables a 'single version of the truth' and improves execution through parallel actions, thus eliminating the challenges related to legacy systems such as lack of coordination and information gaps. Having the right data at the right time ensures data-driven decision making, and thereby reduces human errors and enables a focus on the key aspects of a project.

The objective of the report is to identify key digital and technological interventions that will shape the Indian construction industry in the future. We approached a large number of professionals in the engineering and construction (E&C) industry for this survey. Our findings are based on an analysis of their responses and the perspectives of various stakeholders in the industry across the value chain. These include owners, engineering and project management consultants, large engineering, procurement and construction (EPC) players and Government officials.

This report analyses and addresses the following questions industry professionals are eager to understand in order to shape their organisations' strategies while implementing digital technologies:



What has been the impact of disruptions in the construction industry?

What are the digital solutions that have been implemented in the sector over the last few years and do the results meet expectations?

What are the digital solutions being planned for implementation at present?

What are the emerging technologies that are expected to be implemented in the long term?

What are the issues faced by the industry in implementing digital solutions?

From participants' responses to the survey and our interaction with important industry players, it is evident to us that the pandemic has significantly changed the landscape of the construction industry and increased its focus on digital and technological interventions in nearly all the spheres of project execution.

Although implementation of digital solutions has picked up pace in the past few years, with document management solutions, procurement and bid process management tools, building information modelling (BIM) 3D and UAV-based solutions being the top solutions implemented, the satisfaction level with regard to these solutions achieving their business objectives has been varied.

With the widespread disruption witnessed in the construction industry and its entire value chain, we observe a significant increase in interest in standard digital solutions along with key emerging technologies such as artificial intelligence, machine learning, internet of things (IoT) and LiDAR scanning. This trend indicates that organisations are looking at long-term solutions to improve the efficiency of project implementation.

The survey has provided insights into the need for digital and IT-based solutions in the E&C industry. We have elaborated on this aspect in the 'Analysis and insights' and 'Conclusion' sections of this report. The main digital solutions the industry is planning to implement in the short term include:

- digital workflow-based communication and collaboration tools for effective communication management to improve the workflow in a multi-location environment
- UAVs/drones for project monitoring and high-definition surveying
- digital project reporting tools with data analytics features
- common data environment (CDE) for collaborations on effective designing and planning across project owners, designers, planners, contractors, suppliers and other consultants
- schedule analytics tools to improve predictability and forecasting.

It is important to note that many organisations are now seeking external support to streamline their implementation of digital solutions, and ensure maximum adoption and benefits in order to achieve the desired results. Change management, which includes training of employees, integration of various digital solutions and obtaining a buy-in from key stakeholders, constitutes their main concern.

We have seen that all organisations across the private and public sector (whether EPC, project management consultancies [PMC] or owner-driven) have increased their focus on implementing digital solutions. They are looking for solutions in the areas of scheduling, monitoring and reporting, as well as in designing, procurement and construction. The unanimous view of all the stakeholders is that digital solutions will be the future of the industry and effective implementation and usage of these solutions will bring about long-term benefits for their organisations.

Survey methodology

We shared the survey with project organisations in India in the last quarter of 2020 and received an overwhelmingly positive response from various sections of the E&C industry value chain. The organisations were split into different categories to conduct a detailed analysis of various groups.

Categorisation of respondents

The respondent organisations were categorised according to:

- area in which a respondent's organisation conducts most of its business – digital solution providers, engineering consultants, EPC contractors, owner companies, project management consultancies (PMC) and industry bodies
- type of organisation – Government, public sector undertaking (PSU) or private.

Top management professionals comprised 40% of the respondents (chief executive officers, managing directors, executive directors, project directors and team or group leaders).

Mid-management professionals (project managers or those with equivalent designations) accounted for around 39% of the respondents. Those in junior management positions comprised 21% of the respondents and mainly included project professionals working on technology tools with project managers and discipline leads.





Introduction

The Government's construction activities and private investments in the infrastructure and industrial sector generated around 8% of India's GDP in FY2019.¹ This has been constant since the last five years (excluding the pandemic period).

The sector employed around 50 million people in FY 2019. According to projections, the construction sector is expected to contribute around 14% of India's GDP and employ more than 66 million people by FY 2040.²

India's macroeconomic scenario is characterised by a high level of expenditure on infrastructure. The key aspect to note is the flat trajectory of productivity and efficiency throughout the engineering, procurement and construction (EPC – execution, planning and monitoring) value chains.

Unlike other traditional industries such as manufacturing, logistics and transportation, the project industry has lagged behind in comprehensively embracing technological advancements which would enable integration across the entire project value chain to improve overall efficiency.

The global pandemic has given rise to an unprecedented situation and resulted in a substantial reduction in physical deployment of human resources. The industry has already adopted various virtual means to work cohesively in these times. The new normal in the working environment has made the engineering and construction (E&C) ecosystem more open towards understanding and implementing technological interventions which can replace many old practices.

1 <https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG?locations=IN>

2 <https://www.constructionweekonline.in/people/16931-indian-construction-sector-time-to-regroup-and-rejoice>

Challenges in the construction industry

The construction industry has been facing multiple challenges even without the impact of the COVID-19 pandemic. Data from the Ministry of Statistics and Programme Implementation (MOSPI),³ which monitors infrastructure projects worth INR 150 crore and above, indicates that as on December 2020, out of 1,671 such projects, 442 reported cost overruns and 536 faced time escalation.

Delays in processing of regulatory clearances, the slow decision-making process for tenders and contract administration, lack of adequate skilled manpower, low manpower productivity and inadequate integration between different project participants have been cited as the main reasons for this departure from target, time and cost projections. Another area of concern is that productivity

levels in the E&C industry have remained stagnant over the past couple of decades, while it has increased significantly in other traditional industries such as manufacturing and operations.

The major contributor to the productivity witnessed in other industries has been their adoption of technology and digital methods in production planning, monitoring, data analytics and plant operations. The current technology landscape offers multiple solutions that are applicable at various stages of the project lifecycle. In this study, we aim to understand and elaborate on the major trends and success factors in the adoption of digital technology in the E&C industry which will significantly improve overall project performance.



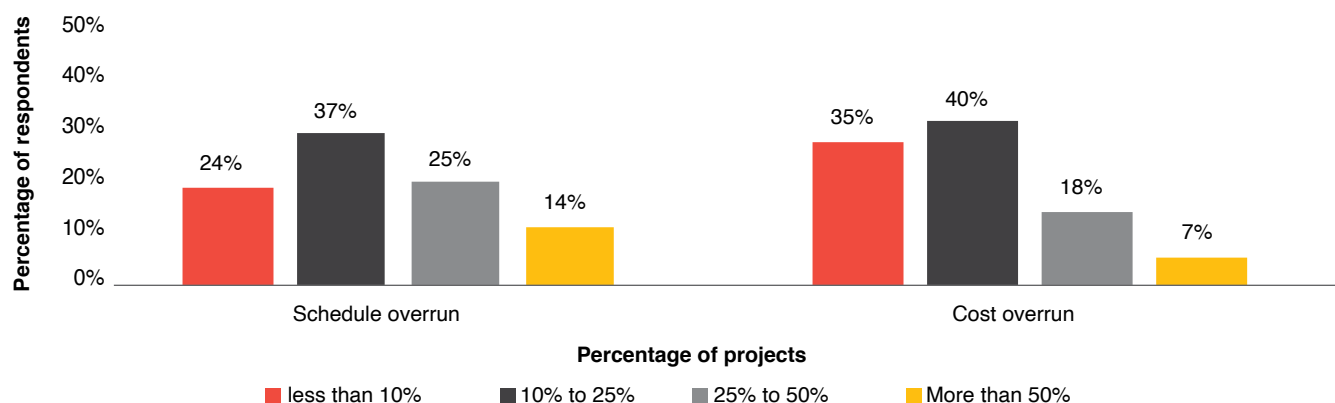
³ <https://mospi.gov.in/web/mospi/infrastructure-and-project-monitoring-division-ipmd-> (MOSPI Website)

Analysis and insights

Expected delays and cost overruns in a project – normal scenario vs disruptive events

Prior to the pandemic, 14% of the respondents expected more than 50% of projects to be delayed and 7% expected cost overruns in over 50% of their projects.

Figure 1: Project performance – normal conditions

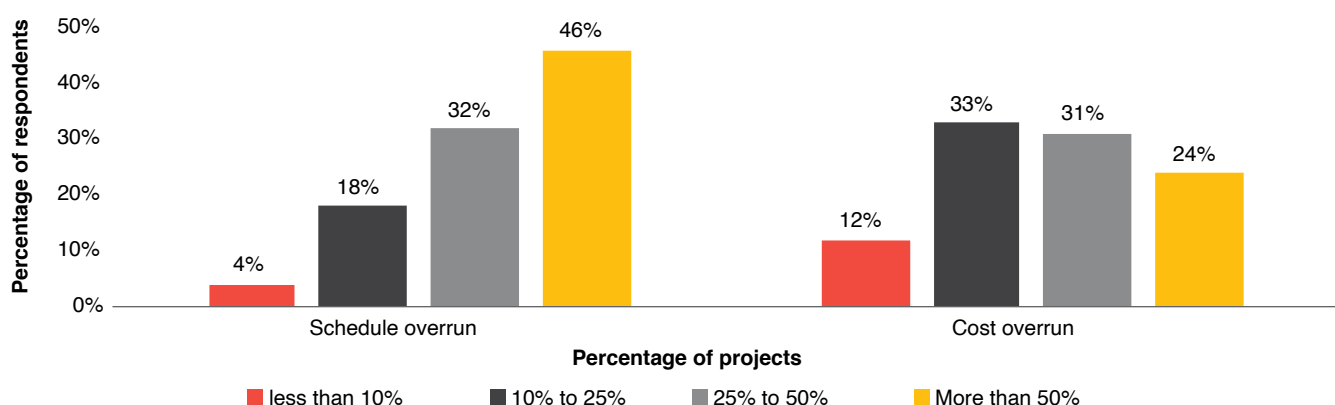


In normal times, only 14% respondents said that time overruns would occur for more than 50% of their projects, while 24% believed that less than 10% of their projects would encounter schedule overruns (Figure 1).

Further, 40% expected that 10% to 25% of their projects would face cost overruns during normal conditions and 35%, that less than 10% of their projects would experience cost overruns.

In today's changed scenario, 46% of the respondents expected that more than 50% of their projects would be delayed and 24%, that more than 50% of their projects would face cost overruns.

Figure 2: Project performance – disruption scenario (unforeseeable events)



In the disruption scenario, 46% of the respondents expected a schedule overrun for more than 50% of their projects, while only 4% believed that less than 10% of their projects would be impacted (Figure 2).

Further, 33% felt that cost overruns would occur in 10% to 25% of their projects, while 31% expected that 25% to 50% of their projects would exceed their budgets.

The survey responses clearly indicate that during the disruption scenario, schedule and cost overruns would increase significantly and the construction industry was not adequately prepared to counter the impact of such disruptions.

Key execution-related challenges faced by the industry

Identifying key challenges that are causing delays and cost overruns

Based on the survey results, we have tried to identify key execution-related challenges. Industry respondents have said that the following challenges would be critical during the disruption scenario (Table 1).

Table 1: Execution-related challenges faced by respondents

Rank	Execution-related challenges (in descending order of priority)	Percentage of respondents
1	Regulatory challenges during disruptive event – reduced manpower, social distancing norms, etc.	78%
2	Delay due to disruption in logistics for material supply at site	70%
3	Cashflow issues arising out of delay in payments	67%
4	Inadequate availability of skilled/unskilled labour	66%
5	Inadequate risk mitigation preparedness	58%
6	Contractual issues arising due to disruptions/delays	56%

Based on the survey responses, these challenges have been further categorised into high and medium risks and provide us a clear understanding of the industry's views on the issues faced

Figure 3: High risk category – execution-related challenges

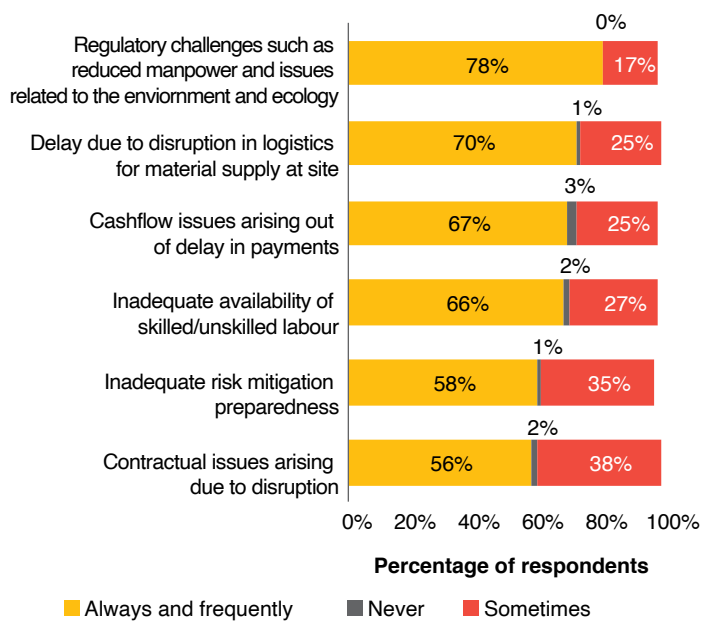
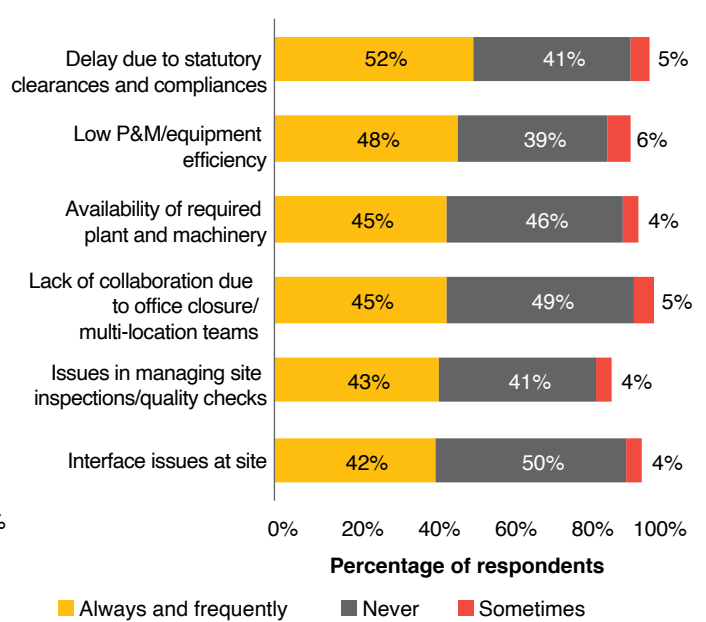


Figure 4: Medium risk category – execution-related challenges



We delved deeper to understand the challenges faced by respondents engaged in different projects, i.e. EPC and construction companies vis-à-vis those of project owners (private or Government; see Tables 2 and 3). We found that project owners and EPC and construction companies faced different challenges.

Table 2: Execution-related challenges faced by project owners

Rank	Execution-related challenges (in descending order of priority)	Percentage of respondents
1	Regulatory challenges owing to disruption – reduced manpower, social distancing norms, etc.	84%
2	Cashflow issues arising out of delay in payments	64%
3	Lack of collaboration during to office closure owing to disruption	64%
4	Delay due to disruption in logistics for material supply at site	60%
5	Inadequate availability of skilled/unskilled labour	56%
6	Delay due to statutory clearances and compliances	56%

Table 3: Execution-related challenges faced by EPC and construction contractors

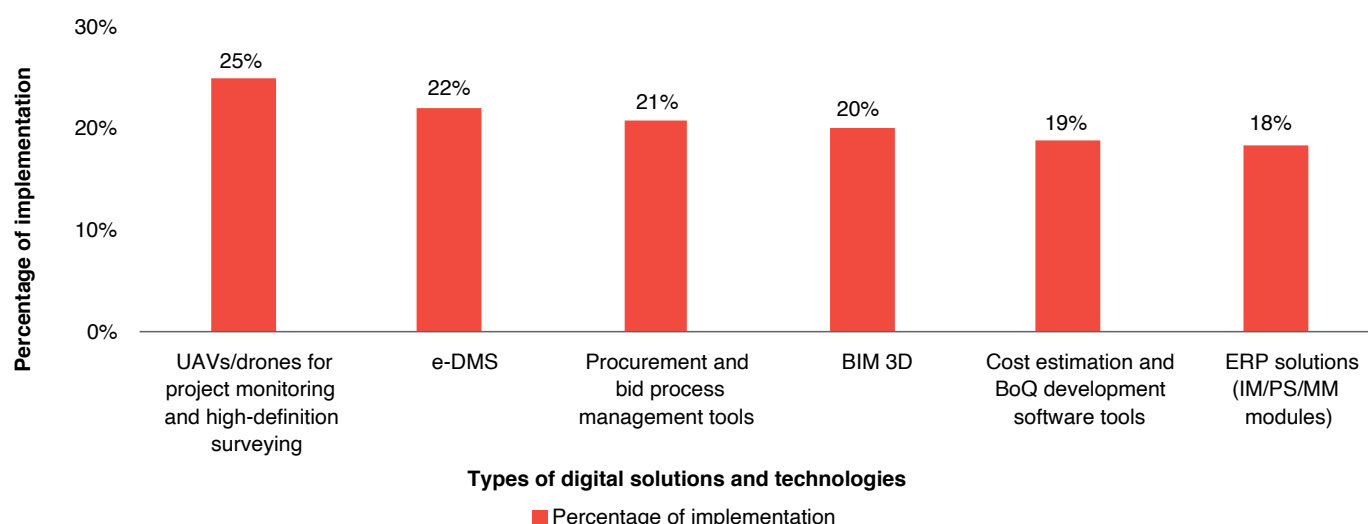
Rank	Execution-related challenges (in descending order of priority)	Percentage of respondents
1	Cashflow issues arising out of delay in payments	81%
2	Delay due to disruption in logistics for material supply at site	81%
3	Regulatory challenges due to disruption – reduced manpower, social distancing norms, etc.	79%
4	Inadequate availability of skilled/unskilled labour	73%
5	Inadequate risk mitigation preparedness	65%
6	Contractual issues arising due to disruptions	60%
7	Delay due to statutory clearances and compliances	59%

Digital and technology solutions currently being implemented in the industry

Understanding currently deployed digital technology solutions

The construction sector has seen increased acceptance of digital initiatives. Based on the survey responses, we have identified the key solutions which are currently being implemented by various organisations (Figure 5).

Figure 5: Top digital solutions currently being implemented



The key insights gathered from the above results are as follows:

- **Around 25% of the respondents are using UAVs and drones for project monitoring and high-definition surveying.** This solution has been rated as the most important one implemented in the construction industry. In addition, CCTV cameras are being installed at project sites by organisations to monitor real-time progress.
- **Of the respondents, 22% have implemented e-document management systems (e-DMS)** for effective documentation and control and access for their projects.
- Further, various **digital tools associated with procurement and bid process management** have seen significant traction in the construction sector, and 21% of the respondents have implemented related solutions.
- **Around 20% of the respondents** have implemented the BIM 3D modelling solution in large residential, commercial and industrial projects, which require clash checks for complex networks of piping, ducting and other associated mechanical, electrical and plumbing (MEP) and structural solutions.
- **19% of the respondents have implemented cost estimation and bill of quantity (BoQ) development software tools**, and 18% have enterprise resource planning (ERP) systems for cost management.
- According to the survey results, BIM 5D and BIM 6D solutions have seen low implementation. This is in contrast to our global insights, which reveal that these solutions are used widely in developed countries.



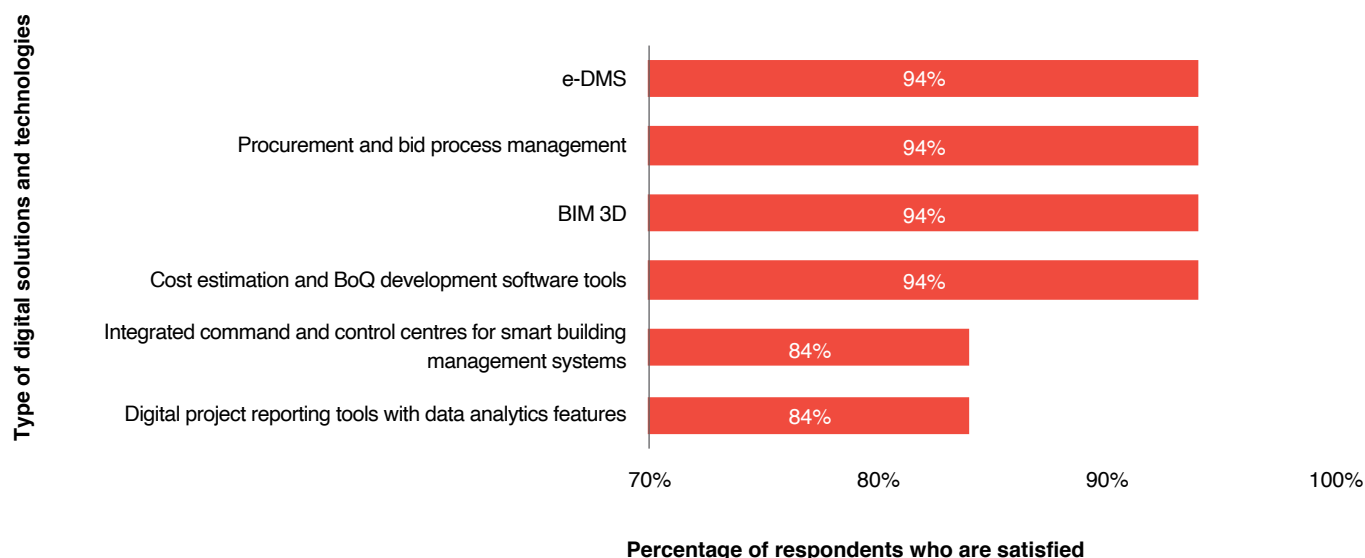
Satisfaction score of various solutions that have been implemented by some companies

Digital technology solutions with high success rates

Among the different digital solutions being used in the industry, satisfaction levels varied, based on realisation of expectations. This section provides insights into the relative impact and efficacy of these solutions (Figure 6). We analysed the survey responses to

understand the gaps between expectations and actual outcomes. We found that satisfaction levels in operations and benefit realisation are 94% for e-DMS, procurement tools, BIM 3D and cost estimation tools.

Figure 6: Satisfaction score with solutions*



*Only takes into account companies that have implemented these solutions

We then conducted further analysis based on the types of organisations and the areas in which they work. This is detailed below.

Top digital solutions implemented by Government/owner agencies and EPC players and percentage of satisfaction

We observed that although there is greater penetration of digital and technological solutions in Government agencies, their satisfaction levels are lower than those of private project owners. This may indicate that Government agencies need additional assistance in implementation, change management and user training to ensure that solutions are implemented and used correctly. We also noted that the adoption rate of owner organisations is almost the same as that of Government enterprises, although the former have a higher satisfaction rate on benefit realisation (Figures 7 and 8).

In the case of EPC companies (Figure 9), we found that engineering, procurement and cost-estimation tools have seen the highest implementation and these organisations reported high satisfaction rates with digital adoption.

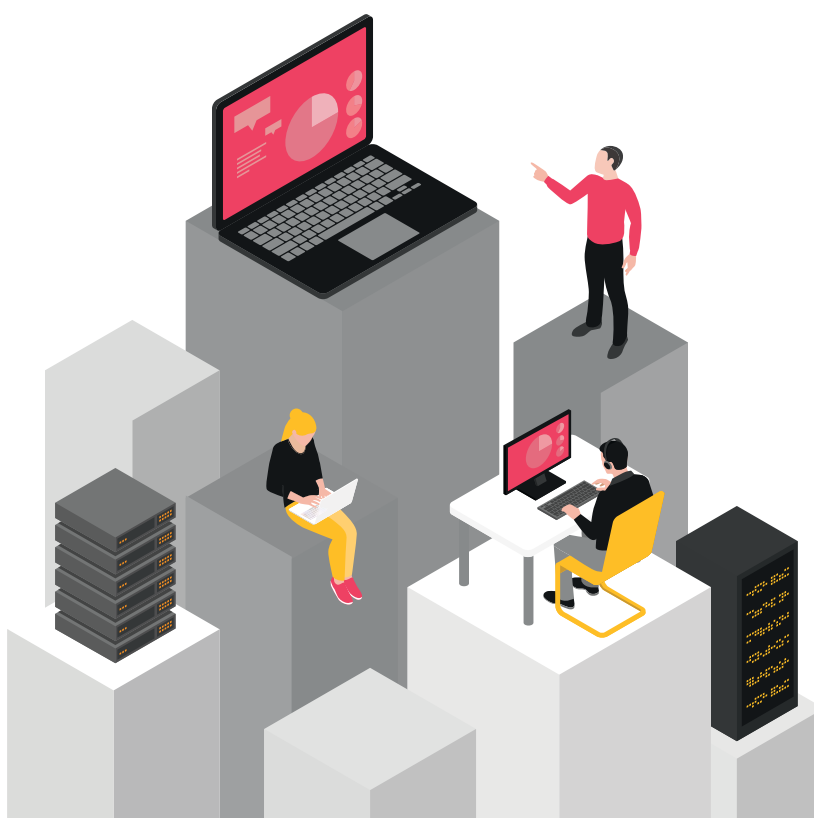
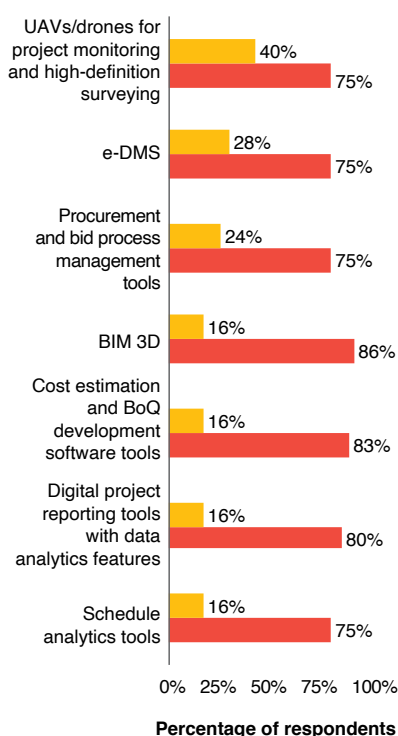
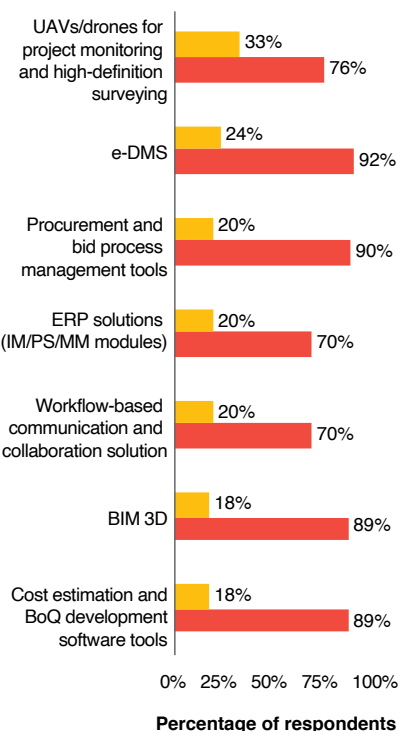


Figure 7: Top digital solutions implemented by Government agencies



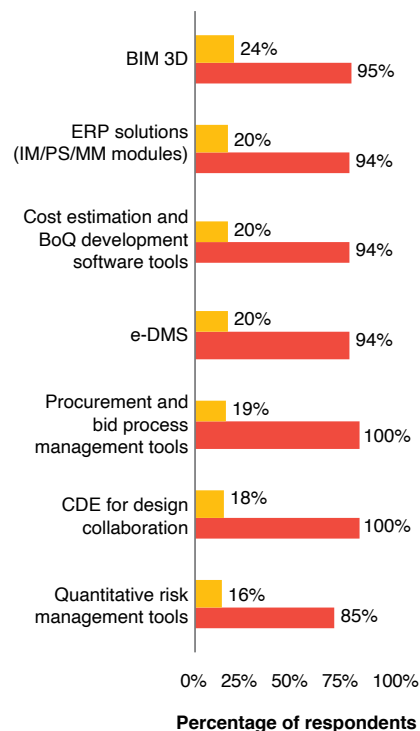
■ What percentage of Government officials have implemented digital solutions?
 ■ What percentage of Government officials find the results to be satisfactory?

Figure 8: Top digital solutions implemented by owner organisations



■ What percentage of owner respondents have implemented digital solutions?
 ■ What percentage of owner respondents find the results to be satisfactory?

Figure 9: Top digital solutions implemented by EPC players



■ What percentage of EPC respondents have implemented digital solutions?
 ■ What percentage of EPC respondents find the results to be satisfactory?

Top digital solutions the construction industry is planning to implement

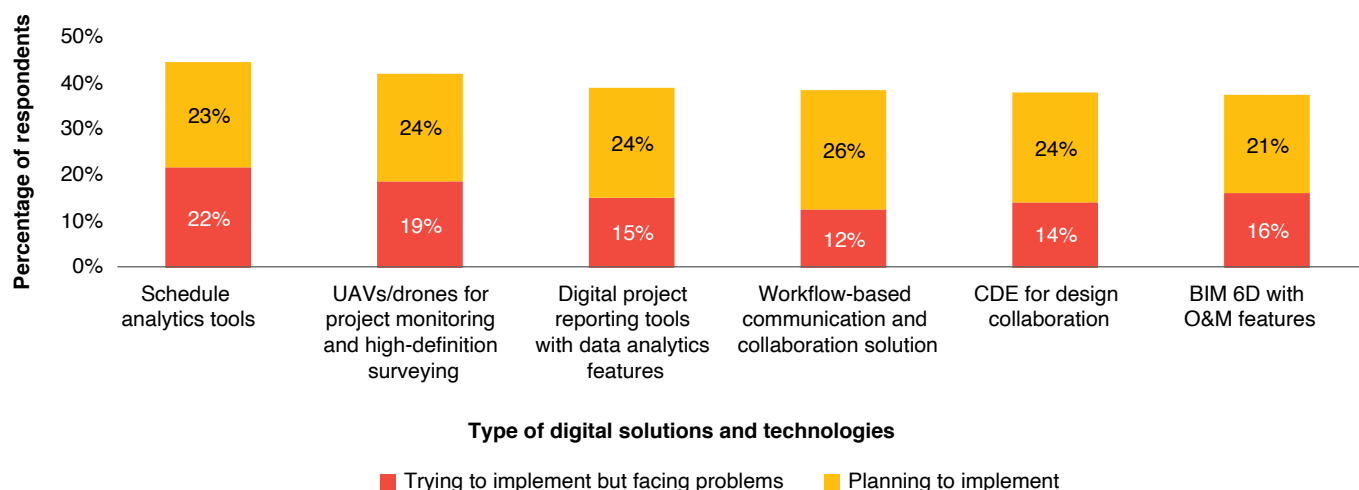
Leveraging technology solutions to improve project performance

In addition to the various solutions that have already been implemented, we have tried to identify the solutions the E&C industry seeks to implement in the near future, to improve productivity, save time, reduce manual errors and reduce costs. We have divided these solutions into two categories:

- solutions the industry has already identified and is planning to implement in the near future
- solutions that are already being implemented but are facing problems.

Top digital solutions planned for implementation in the near future

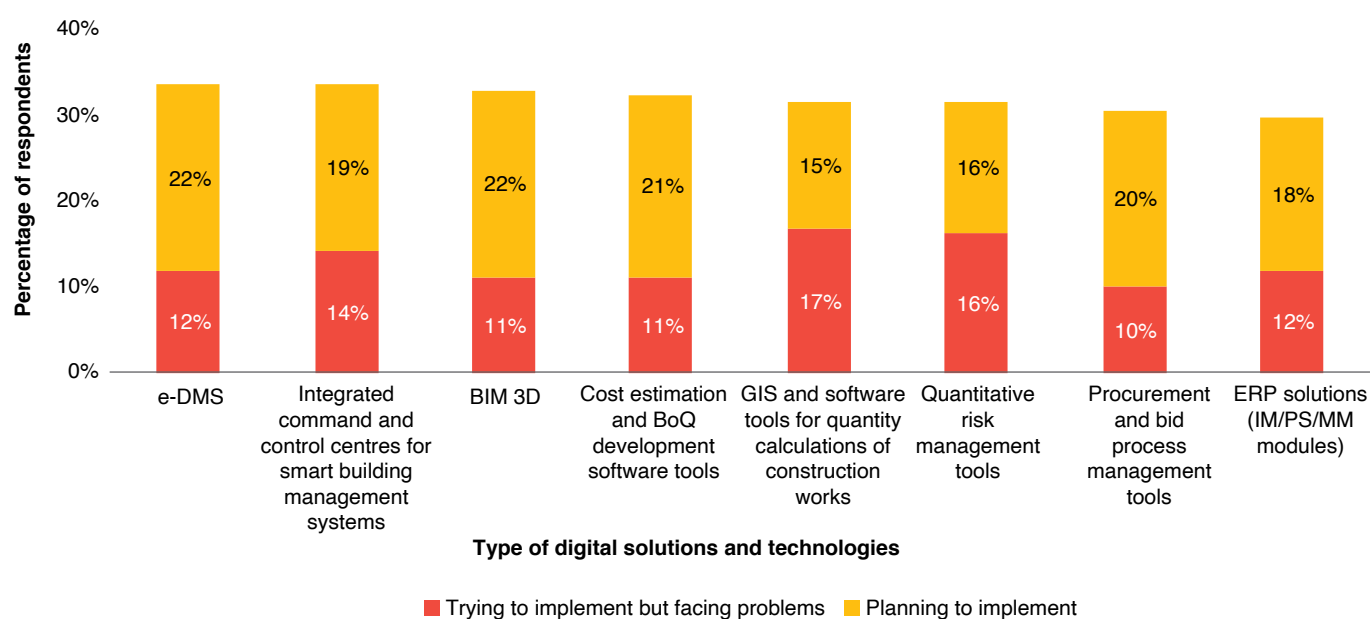
Figure 10: Top digital solutions the construction industry is planning to implement in the near future



1. **Workflow-based communication and collaboration solutions:** 26% of the respondents have selected workflow-based digital solutions as the most desirable digital solution under the first category.
2. 24% of the respondents are planning to implement the following three digital solutions:
 - **UAVs/drones for project monitoring/high-definition surveying**
 - **digital project reporting tools with data analytics features**
 - **CDE for design collaboration.**
3. **Schedule analytics tools:** Around 23% of the respondents have selected schedule analytics tools.

Some of the other digital solutions that the respondents are planning to implement in the near future are shown:

Figure 11: Other digital solutions the construction Industry is planning to implement in the near future

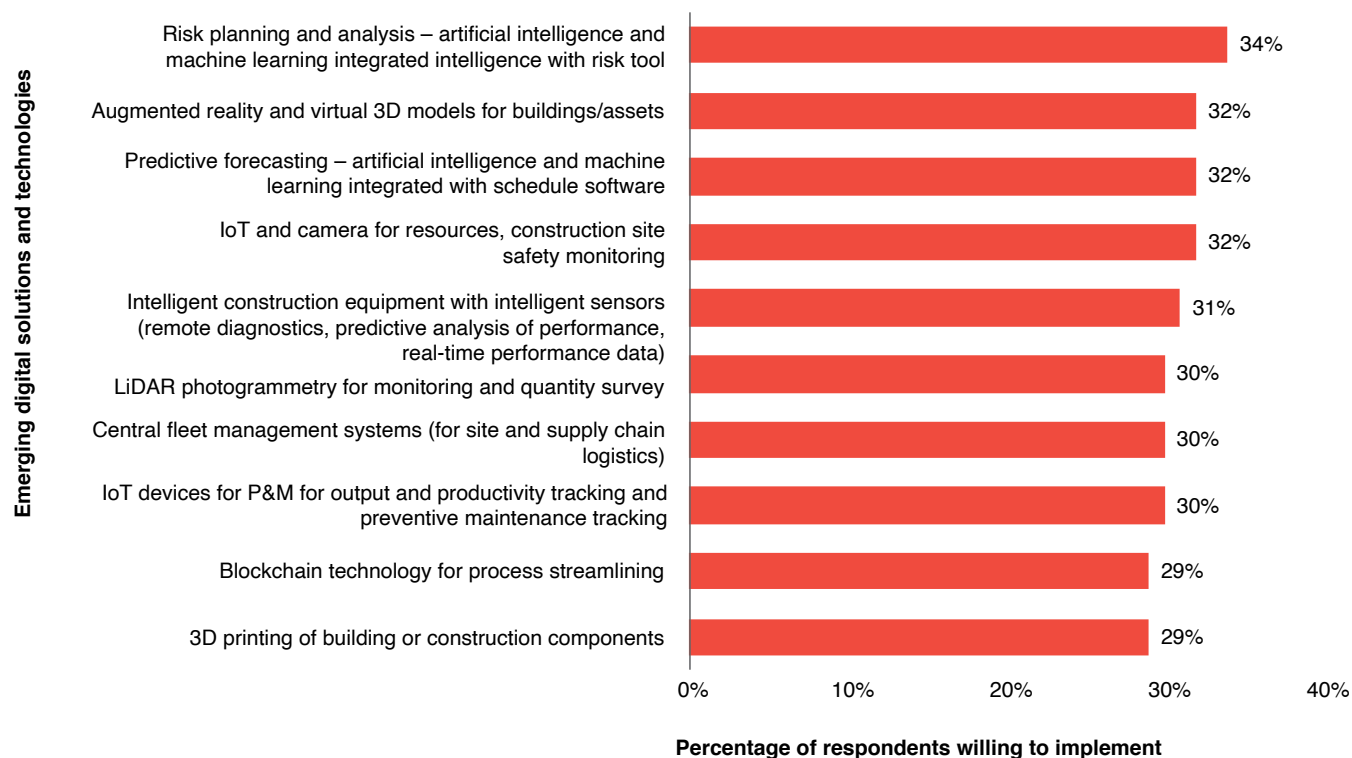


Emerging digital solutions in the E&C industry

Taking advantage of emerging technologies in the long term

Organisations are now also taking a long-term view for their digital solution portfolios. Figure 12 shows the top emerging digital solutions (in descending order of priority) that the industry plans to implement after two or more years.

Figure 12: Emerging digital solutions in the construction industry – percentage of respondents willing to implement

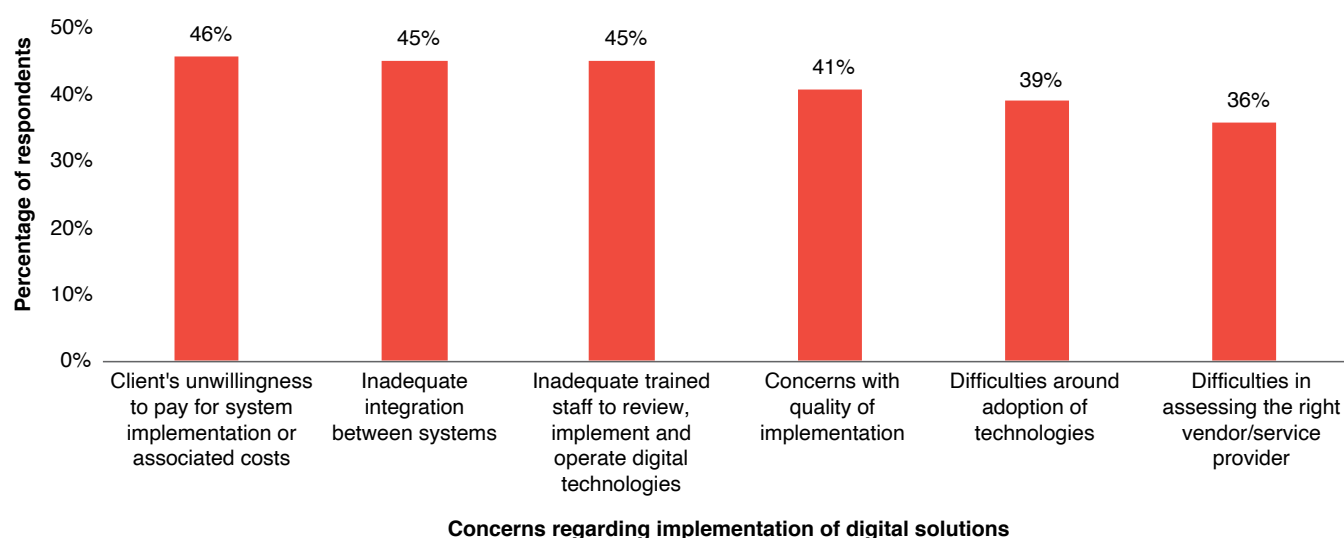


Our survey revealed that 65% of the respondents in the construction industry are not aware of the emerging technologies that can be effectively adopted during various stages of a project. This indicates that there is a great need for such organisations to increase their awareness and adoption of the digital solutions available for their industry.

Major concerns related to implementation of digital solutions

The main concerns expressed by industry respondents include lack of a precise understanding of return on investment, the complexity involved in integrating these solutions with their existing systems and inadequately trained staff (Figure 13).

Figure 13: Top concerns related to implementation of digital solutions





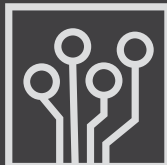
Conclusion



The top digital solutions already implemented or in the process of being operationalised across the E&C industry are as follows:

25% of the respondents use UAVs or drones to monitor projects. This makes these one of the most extensively used digital solutions in the capital projects sector.

22% of the respondents use e-DMS; **21%** use procurement and bid process management tools; and 20% have adopted BIM 3D.



The satisfaction score (percentage of respondents with satisfactory results) for digital solutions that have been currently implemented was as follows:

94% of the respondents reported satisfactory outcomes with e-DMS, procurement and bid process management tools, BIM 3D, and cost estimation and BoQ development software tools.

While UAV and drones are among the top implemented digital solutions, the satisfaction level is only at **78%**, which is lower than that for other solutions.



The top digital solutions that the industry is planning to implement in the short term include:

26% of the respondents plan to implement workflow-based communication and collaboration tools in view of the new way of working during the pandemic, often across multiple locations.

Around **24%** of the respondents plan to implement:

- UAVs and drones for project monitoring and high-definition surveying
- digital project reporting tools with data analytics
- common data environment (CDE) solutions

23% of the respondents wish to implement schedule analytics tools because they feel these will improve predictability and forecasting in their operations.





The main emerging digital tools being planned for implementation by the industry in the long term (two years or more) include:



Major concerns related to implementation of digital solutions

34% of the respondents are seriously considering the option of implementing a risk management tool with artificial intelligence and machine learning.

The solutions below are being planned for implementation by 32% of the respondents:

- schedule management tools for predictive forecasting with artificial intelligence and machine learning
- IoT and cameras to monitor safety of resources and construction sites
- augmented reality and virtual 3D models for buildings and assets.

- client's unwillingness to pay for system implementation or associated costs
- inadequate integration between systems
- inadequate trained staff to review, implement and operate digital technologies
- concerns with quality of implementation
- difficulties around adoption of technologies
- difficulties in assessing the right vendor/service provider

- The survey results provide insights into construction practices and tools that are increasingly being deployed to achieve project targets on time and within budgets through adoption of technology solutions, integration of engineering with construction scheduling and cost estimation, and most importantly, in the manner that construction is being visualised through remote monitoring.
- Project collaboration through sharing of digital data among promoters, authorities, consultants, suppliers and contractors at every stage of the construction process – from conceptualisation to completion – appears to be the direction in which the industry is heading. Further advancements in artificial intelligence, specifically in machine learning and augmented reality, are the emerging technologies that would take the E&C industry to the next level in the coming years.
- E&C industry players from the Government, corporate sector, contractors and engineering consultants all understand the importance of technology adoption. It is the right time for consultants and solution providers in E&C technology to demonstrate the benefits in terms of faster, better and cost-effective project execution. Government policies should also support the fast-track adoption of digital technologies. Such policies will not only provide the best end product on current projects, but also ease the transition into a more connected and automated future in the industry.





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