

5 Technological Innovations Transforming E&C Sector

Precast construction techniques offer a high degree of modularity of designs and application of manufacturing principles for mass housing projects. The quality, safety, and speed of construction are greatly enhanced with precast.



In an atmosphere of increased competition, operational challenges and tighter margins, engineering and construction (E&C) companies are adopting new construction technologies in order to differentiate their services from their competitors, informs **P V Prasanth, Director, Operations and Technology, Shapoorji Pallonji Engineering & Construction**

The evolving landscape of new technologies in the E&C sector are transforming all stages of the project delivery process. These technologies are changing how companies design, plan, and execute projects. By adopting advanced software, construction-focused hardware, analytics capabilities and advanced construction technologies, companies are eliminating many of the problems that have dogged the E&C sector for decades. Such improvements could not have come at a better time, as construction projects are becoming increasingly complex and expensive, putting managers under greater pressure to improve costs, timelines, and efficiency.

Many E&C companies have begun incorporating new construction technologies into their projects, across all project phases (design, pre-construction, construction, operations and management). While some of their

efforts have focused on software tools for digital collaboration, companies are also looking at new ways to monitor and manage performance. Many new materials, building systems and innovative methods of construction are also being explored.

The major E&C companies use enterprise-resource-planning systems. In addition, new digital tools and solutions are being used for the design, preconstruction, or operations and management phases. In the construction phase, on-site execution, digital collaboration, and back-office integration are being reimagined with the use of such digital solutions.

Digital Tools that Support On-site Execution

During the execution phase, E&C companies typically encounter many difficulties, ranging from low productivity to delays in material shipments. The digital tools available currently allow the companies to mitigate some of the most

pressing problems and in the process enhancing field productivity, safety monitoring and quality control.

- Some field-productivity applications help companies to manage project staffing across skilled trades or to monitor on-site productivity at the trade or worker level.
- Many applications facilitate the tracking and reporting of safety incidents across job sites. In addition, they allow managers to distribute safety alerts and tips to the entire workforce.
- Some new applications help managers inspect remote sites by providing pictures and image tags, while others allow them to update and track their punch lists in real time. This, in turn, increases efficiency and accuracy during on-site execution.

While most tools in the on-site execution cluster fall into these areas, a few companies have also developed products to assist with many other onsite activities, including supply-chain logistics.

Digital Tools that Support Collaboration

E&C stakeholders—including architects, designers, and site engineers—are more numerous and widely dispersed than those in most other industries. They need to communicate and align frequently, since certain changes, such as a seemingly minor modification to a materials order, could significantly increase timelines or costs if made too late in the game. That explains why many E&C companies focused on tools that promote digital collaboration—the online exchange of information—throughout all E&C project phases. Some of the most compelling tools relate to the following use cases:

- Design management: E&C staff often need to update drawings and other project documents while on site. Rather than returning to the office to complete such tasks (as these engineers would have done previously), they can now make changes in the field.
- Contract management: These tools help staff with many critical tasks. For instance, workers can use them to update contract-compliance checklists

or collect information about client and contractor communications that occur as the execution proceeds.

- Performance management: With these tools, managers can update and immediately share information (including workforce data) in the field, particularly during the crucial preconstruction and construction phases. Some performance dashboards can automatically import field data, simplifying the process of collecting information.
- Document management: Many companies are adopting tools that let them upload documents, track changes, and record all decisions made about their content. In some cases, document-management tools can also serve as a permanent repository, giving E&C firms easy access to past records.

Digital Tools that Support Back Office Integration

Back-office integration, involving functions such as accounting, finance, and human resources, can help companies to access and exploit valuable project data on finances, costs, and schedules. All too often, however, analysts fail to mine this information because it is not easily accessible. E&C companies have developed solutions—mostly designed from an accounting perspective—that give managers immediate access to real-time back-office data. Many back-office-use cases focus on scheduling, managing equipment, and enterprise resource planning.

E&C companies are applying new hardware and software solutions to many use cases, sometimes by forming partnerships with large equipment manufacturers. A few examples:

- Predictive analytics: Every construction firm is a giant repository of data. E&C companies are now taking advantage of this information by creating new applications that can collect thousands to billions of records from all source systems. These solutions apply advanced analytics and machine learning to data -- both structured and unstructured—to optimize decision

making for multiple topics, including workloads, staffing levels, and strategies for minimizing inefficiencies.

- Project monitoring enabled by drones and IoT: Some companies are using these technologies to improve 5-D BIM—the process companies use to create digital representations of physical structures and then consider this information in combination with cost and scheduling data. Companies most frequently use drones to capture site images and aerial survey data, while the IoT primarily helps with monitoring equipment and preventive maintenance. Many E&C companies are also beginning to deploy these technologies to increase safety.

As the Indian economy transitions and its workforce expands, it will offer vast development and investment opportunities for the real estate sector. The growth of cities is going to further influence the country's built environment, while technology, demographics and environmental issues will become its new value drivers. The ideas, trends, and behaviours that will shape the real estate sector in the next decade are already perceptible today. Some are clearly evident while others are emerging quietly around us. By 2030, the real estate universe would have expanded tremendously as today's new asset classes will become mature segments.

As the operation dynamics of the real estate business in India are evolving and innovating at a pace much faster than envisioned, it is almost imperative that innovations be applied to the most basic as well as most important step in the value chain – construction techniques. It is expected that there will be wider use of technology in construction and construction management in the future as companies realise the long-term efficiency and cost savings of such techniques. Technology in construction space has coincided with growing demand for faster construction and world-class quality. Therefore, construction organisations would have to increasingly adopt newer construction techniques (and devise ways to mitigate/share the high costs associated with these new technologies) to meet the client's changing demands.

While clients are expecting more for less, the E&C companies are facing a few challenges in managing their construction operations:

- Reducing Availability of Skilled Workmen
- Higher expectations of Construction Safety Standards
- Higher expectations of Construction Quality Standards
- Increased regulatory, statutory and environmental compliances

Considering the current challenges in the operating environment and the need for growth and faster execution, different approaches to construction are being explored. The ideas and technologies that are becoming imperative for smooth project execution include:

- Modular Construction; Standardization
- Pre-engineered and site-assembled construction
- Mechanized Construction
- Faster construction methodologies
- Homogeneous Quality of Materials & Workmanship
- Cost-effective construction
- High-rise Construction

Monolithic Concrete Construction

Adoption of advanced technologies such as monolithic concrete construction (shear wall technology) using aluminium formwork or precast construction is slowly becoming the norm. These technologies reduce cycle times and the requirement of construction labour, reduce project duration vis-à-vis conventional construction, reduce material wastage, and improve construction quality and safety. These technologies also eliminate labour-intensive activities such as masonry and plastering, thus leading to time and cost savings.

A high degree of modularity of designs that ensures a higher repetition of formwork and higher productivity of mobilised resources is an added advantage.

The high-rise nature of residential structures for affordable housing naturally leads us to technologies such as monolithic concrete construction (shear wall technology) using aluminium formwork or precast construction, as mentioned above. Both these technologies are suitable for the Indian environment and to meet the unique challenges of urban housing development

we face. Alternatively, the usage of dry wall panel along with an RCC structural frame also leads to quicker and energy-efficient homes. Although there are many examples of successful group housing projects being delivered using these technologies in India, there is tremendous scope to use these technologies to meet the demands of affordable housing in India. Therefore, affordable housing projects need to be designed to suit the adoption of these technologies. This will lead to faster deliveries and project success.

The design-and-build project delivery system lends itself very well to the demands of the current-day construction projects. This system ensures that E&C companies adopt the latest construction technologies that improve cycle times, reduce manpower dependence, reduce material wastage, and eliminate wasteful activities. This automatically brings in time and cost advantages, which are then passed on by the E&C companies to their clients. The adoption of such technologies leads to many additional benefits to clients, such as improved safety and quality and greater chances of project success.

A lot of research and development efforts today are directed towards emerging technologies in precast construction that enable the manufacture of the whole dwelling unit as a monolithic module (with no joints) and complete with interior finishes. Similarly, 3D printing is set to revolutionize housing construction. It won't be long before these technologies become affordable especially for large volume constructions and become commonplace in India. And these technologies can then emerge as credible solutions to address India's affordable housing challenges.

The Indian E&C companies are now able to access these advanced technologies through global technology providers who are only too



Monolithic concrete construction using aluminium formwork allows faster cycle times and reduces the requirement of construction labour and material wastage. Mass housing projects can be completed faster with better quality and safety as compared to conventional construction methods.

keen to support this demand. Similarly, the plant and machinery associated with these technologies can be easily imported into India at competitive prices.

Pre-engineered Structural Steel Construction

The office buildings construction in India is also witnessing adoption of pre-engineered structural steel building systems in a big way to overcome the challenges posed by the RCC way of design and construction.

Pre-engineered Structural Steel provides many construction benefits of its own. The use of Steel results in an accelerated

schedule. Construction Quality is enhanced because of off-site fabrication, and that the productivity opportunities that exist in construction can be best addressed in off-site fabrication with a reduction of actual on-site time and on-site construction. 3-D interoperability and Building Information Modeling allows the close cooperation between designers and contractors in the design, fabrication and erection of steel structures.

Steel buildings enable a shorter construction period as compared to RCC buildings. Steel buildings enable (i) Earlier possession of the building for use

; (ii) Lower financing costs ; (iii) Better site utilization ; (iv) Earlier access for following trades (viz. MEP, Facade & Finishes)

The construction preparatory phase enables the steel structure to be planned and connections to be selected for speed of erection. Pre-engineered steel buildings can take advantage of Just-in-Time manufacturing techniques. The steel frame of the building is designed and manufactured from computer models directly linked to the CNC machines thus ensuring high dimensional accuracy and speed of erection. Quick drying fire-proof coatings technologies are available.

Conclusion

India has a huge economic opportunity in the coming years. With increasing per capita income and a population of about 1.25 billion, the Indian economy will continue to prosper aided by digitization, globalization, favorable demographics, and reforms. In addition, increased government spending on infrastructure and increasing urbanisation will provide plenty of opportunities for the construction sector.

E&C companies have adopted numerous tools for use across the project life cycle, ranging from design management to scheduling to safety monitoring. In the future, we will see even more tools emerge, particularly for use related to field management and performance management. With the role of construction technology growing so rapidly, and new use cases emerging constantly, E&C companies that do not invest in the right tools risk being left behind. The new materials, building systems and methods of construction along with emerging project management trends will change the way large projects will be delivered.

The companies that place the right bets now will probably be the industry leaders in the next ten to 15 years if they match their greater investment in technology with a company-wide commitment to change. Above all, they will need to alter fundamental aspects of their organizational structure, corporate culture, and IT systems, with the goal of seamlessly integrating new tools into daily work. With this support, their new tools will give them an edge that no amount of human effort can replicate. ●



Pre-engineered Structural Steel is increasingly being adopted for commercial buildings construction. As compared to conventional RCC construction, steel buildings enable earlier possession of the building for use, better site utilization, earlier access for following trades (viz. MEP, Facade & Finishes). Construction Quality is enhanced because of off-site fabrication.