



NAVIGATING THE SHIFTS IN THE ENGINEERING, PROCUREMENT, AND CONSTRUCTION INDUSTRY

Executive summary

In the engineering, procurement and construction (EPC) industry, a significant part of the work involves information exchange between various partners via engineering drawings and building information modelling (BIM), to deliver long-term and high-cost projects. BIM allows stakeholders and suppliers to plan, design, construct, and manage a building and infrastructure more efficiently.

A KPMG study reveals that in the past three years, only 31% of projects were completed within 10% variance of the allocated budget. Lack of efficient information exchange, coordination of activities, and real-time collaboration are the key reasons for projects exceeding budget and schedule.

As technology becomes more pervasive and integrated with all businesses (including, manufacturing and aerospace industries), it is imperative for the EPC industry to innovate and make a lasting impact by leveraging technology.

The fragmented nature of the construction industry has traditionally made it resistant to the adoption of new technologies. Notable technologies that EPC companies are adopting to achieve operational efficiencies, fulfill legal or compliance obligations, and adopt sustainability in designs are:

- Knowledge-based engineering
- AR / VR for designing
- BIM monitoring (project management and collaboration)
- AI for field services
- Mobility and adaptive learning
- Connected systems to support sustainability
- Back-office standardization and optimization

Increasing cost of construction

Since January 2011, the United States national construction cost index (CCI) has increased by an annual average of 2.3%, resulting in a cumulative 11.8% increase in cost during that period. According to the Bureau of Labor Statistics, 985,000 or 15.8% of US construction workers quit the industry between 2005 and 2015, causing an increase in labor cost as well.

Most specialized contractor companies are small businesses. After the COVID-19 pandemic, depending on how long it takes for the economy to recover, specialized contractor companies that have sustained themselves with funding provided by the CARE Act may not return to work at all.

Technological advancement and digital transformation

The diverse nature of skills involved and large variations in the maturity of participating stakeholders have diluted the focus on technology. Due to lack of digitization, it has been difficult to facilitate knowledge sharing across current or past projects.

The construction industry is similar to the manufacturing and aerospace industries, and technological advancements in these industries can be replicated in the EPC industry. Moreover, technologies such as 5G and IoT are becoming more cost-effective, which should boost the EPC sector.

Sustainability

55% of the world's population lives in urban areas. This figure is projected to grow to 68% by 2050.

According to the United Nations Environment Program (UNEP), "increased construction activities and urbanization will increase waste, which will eventually destroy natural resources and wildlife habitats over 70% of land surface from now up to 2032".

The escalating cost of construction and higher construction demand due to increasing urbanization and federal funding for disaster management and focus on sustainability to reduce carbon footprint will make adoption of new technologies imperative to sustain this industry.

Increasing cost of construction

Despite the decline in global commodity prices, labor shortages are still driving up construction costs in the US.

While the US Producer Price Index (PPI) has witnessed dramatic price drops for many key construction materials including asphalt, diesel, and iron and steel products, the overall price of construction material has not fallen. The decline in prices of some materials has been offset by an increase in prices of other construction products (glass, cement, construction sand, gravel, and stone). In addition, local materials prices tend to be sticky - supply-chain issues, contract requirements, project timelines, and other factors cause price changes to lag broader trends.

The Chinese economy now accounts for about 17% of global GDP and the most dependent stands to be most affected. The US imported about 10% of intermediate goods from Chinese factories. Finding alternative sources will be difficult for products in which China is a dominant global supplier.

Technological advancement and digital transformation

EPC companies are entrusted with building futuristic infrastructure for cities, designed to last for a lifetime, and support the emerging needs of society. Ironically, these companies themselves

are slow to adopt the latest technology compared to other industries.

If we can overcome the hurdles of successful implementation of digital technologies and upskilling the workforce

to absorb new technologies, it should alleviate industry and infrastructure issues.

Some of the challenges faced by the EPC industry are represented below :



Several platforms and technology solutions can help overcome these challenges, but it is impossible to transform the complete landscape at the same time. Each enterprise operating in its specialty domain in the EPC value chain must adopt new technologies progressively.

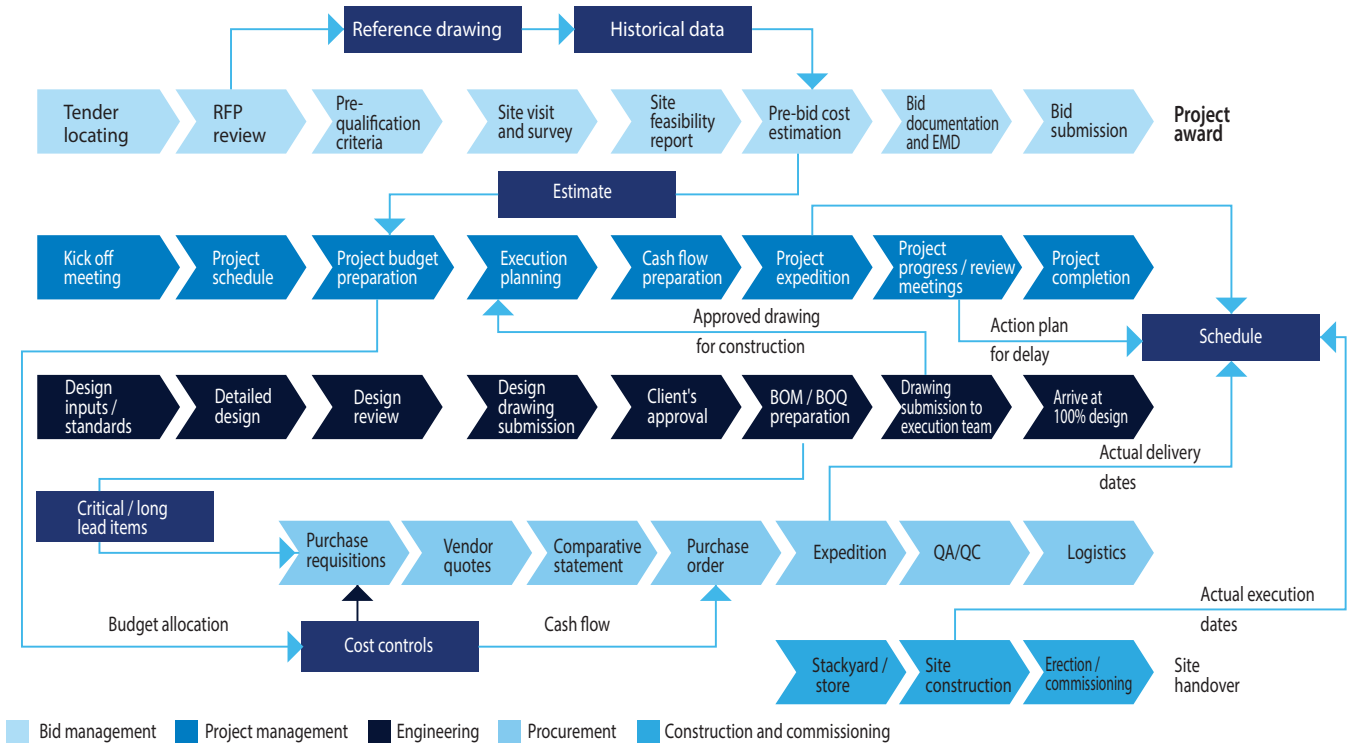


Figure 1: EPC value chain



The average age of a construction worker is 42 years. A **digital learning management** system retains tribal knowledge and shares the learnings from past projects with the next generation. At the same time, training is more effective and engaging with learning platforms that can provide personalized and relevant content. Learning management systems help EPC companies streamline onboarding of new employees into the organization's specialty business, become compliant with certification and safety standards, and reduce chances of accidents at the work site.

Some of the key challenges the EPC Industry faces are **project management, communication, and coordination** among numerous stakeholders. Along with applying standardization of platforms in a fragmented and diverse industry, it is imperative to have a connected ecosystem and data flowing between individual platforms. Connecting applications using robotics process automation (RPA), orchestration platforms, and microservices enables **smart dashboards** for dynamic **cost and schedule controls and project management through real-time tracking**. A digital ecosystem that provides superior user experience with an open architecture, adapts quickly to changes and provides a holistic (instead of linear transactions) view. This is the foundation of a **Live Enterprise**. An **enterprise data platform**, when built along with a connected ecosystem of applications, offers insights from past projects, deploys AI / ML to support decision making, and ensures a predictable outcome. Better collaboration tools enable participants to work on the latest design specifications as the design is modified during the construction process.

90% of data and information exchanged during the construction process is created during the design and engineering phase. Enabling standardization and re-use at the design phase is most effective in controlling costs in the construction

lifecycle. **Design automation and standardization** can save up to 30% of the cost of engineering and design, and also reduce errors.

The construction site is handed over to the asset owners for operations after completion of construction. New technologies such as **digital twins, AR / VR and drones (for inspections)** can help reduce the cost of operations by cutting down the cost of inspections and enabling preventive and on-demand maintenance instead of scheduled maintenance. VR also improves the construction experience for clients as well as EPC professionals. The increasing usage of drones is helping with surveying / tracking, modeling, documentation, and incident prevention. AI can operate in tandem with drones and scanning technology to capture 3D images of the construction site through the building process, and track progress. AI can then use this data to analyze progress and alert management of potential delays or errors as they happen before they result in major slowdowns.

Due to mergers and acquisitions, shared services usually become very fragmented over time. **Standardization and automation of processes in the areas of finance and accounting, sourcing and procurement, contract management, HR, payroll, legal, sales and fulfillment** have been achieved in many industries. As enterprises embark on their digital journey, cost savings from standardization in **areas of shared services** can boost **technology transformation** initiatives.

Construction activity requires mobilization of the workforce and heavy equipment to construction sites. Having human labor and equipment available at the right time and place are very important for the construction process. The EPC industry needs advanced **fleet management workflows** based on AI / ML to auto-assign work, incidents, equipment to support construction and maintenance processes. Digital solutions can provide the workforce with **user manuals on hand-held devices** along with troubleshooting steps and visibility into inventory of parts and materials. These technology solutions can help assign the right technician without human intervention, predict and mitigate risks during the repair process, and ensure successful repair on the first attempt. AI plays a significant role in improving functions such as cost estimates, building design, project tracking, data management, and risk management. AI systems can filter requests for information, open issues, and change orders while alerting project managers about any critical data, and sorting the rest.

The construction process is highly dependent on suppliers and the procurement process. The ability to standardize parts and material, supplier consolidation, digitization in areas of contract management, purchase order and invoice processing can deliver up to 25% cost savings.



Sustainability

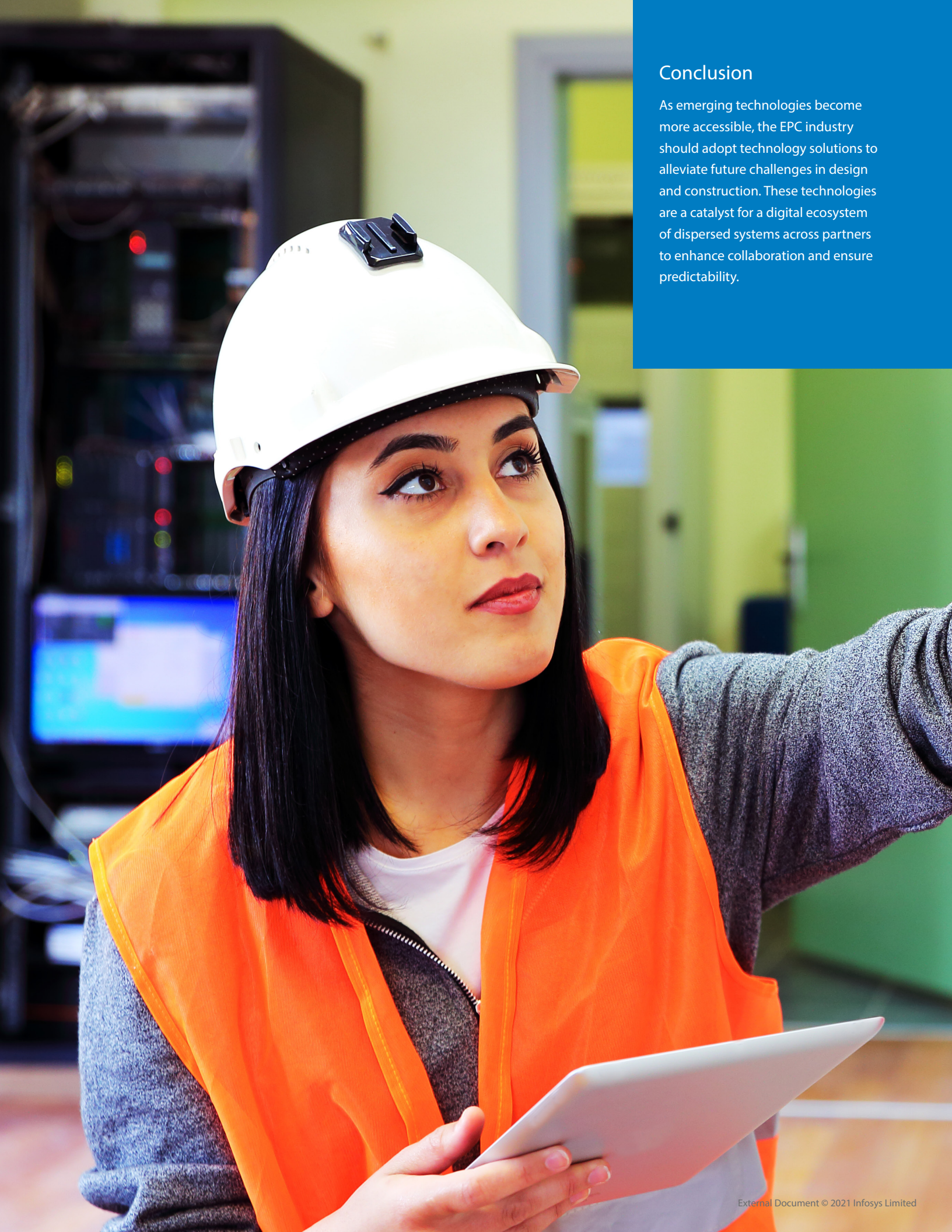
In 1961, about 34% of the world's population lived in urban areas. By 2030, it will rise to over 60% as cities and towns become home to 1.4 billion+ more inhabitants.

The average household spends at least US\$ 2,000 a year on energy bills — over half of which goes toward heating and cooling. In an average household, space heating accounts for 50% of the energy consumption, appliances account for 27%, water heating accounts for 19%, and air conditioning accounts for 4%.

Smart cities serve as engines of economic activity, innovation, and progress. The economy is transitioning toward decarbonization in every sector, including construction. Every building, new or existing, is challenged to meet decarbonization targets, which are expected to become more stringent. The competition between contractors, due to the promotion of sustainability in the industry, would encourage the application of sustainable construction technologies, ultimately decreasing construction costs. Meanwhile, there are technology-driven smart spaces solutions that can minimize waste and meet higher usage of utilities and lower costs at the same time.

This sophistication in scheduling helps contractors eliminate last-minute on-site design coordination and rework, simultaneously reducing waste and compressing project timelines. Construction professionals attributed costly rework to poor project information, including incorrect and inaccessible project data. The survey estimated that the US construction industry loses US\$ 14.3 billion a year due to inadequate project information alone.





Conclusion

As emerging technologies become more accessible, the EPC industry should adopt technology solutions to alleviate future challenges in design and construction. These technologies are a catalyst for a digital ecosystem of dispersed systems across partners to enhance collaboration and ensure predictability.

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