

Knowledge@Wharton – Wipro

**Future of Industry: Engineering and Construction**

# Engineering and Construction Companies Get More Networked



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The global engineering and construction (E&C) industry is rapidly resetting how it executes projects. Most projects are larger than ever and increasingly face difficult physical or political environments. More owners, meantime, are demanding that contractors not only build but also operate projects to speed the return on investment. Arjun Ramaraju, head of Wipro's E&C business, and Rahul Mangharam, an engineering professor at the University of Pennsylvania, discuss these key emerging trends in this white paper produced by Knowledge@Wharton and sponsored by Wipro Technologies.

The global engineering and construction (E&C) industry is witnessing dramatic changes in its business environment. Project involvement no longer ends by handing over the keys to the owner of a new structure. Increasingly, the contractor's involvement now extends throughout the lifecycle of an asset and beyond — to social and economic impacts such as quality of life and citizen participation.

In this paper, Arjun Ramaraju, a Wipro vice president and global head for engineering and construction business, identifies the major disruptive forces E&C companies face and how they are responding. [Rahul Mangharam](#), a professor of electrical and systems engineering at the University of Pennsylvania, explains how technology is helping address those challenges with more efficient utilities and transportation infrastructure.

### Better Technology

According to Ramaraju, E&C companies have been laggards in using technology, but that is now changing. They are discovering the benefits of mobility, sensors and platforms for collaboration, analytics and business intelligence.

He cites a prominent multinational construction company that has used mobility effectively. The company found that using tablet computing at construction sites allowed it to resolve challenges faster, reduce rework, lift crew productivity overall and ensure quality standards. Many E&C projects today also use the so-called "building information modeling" (BIM) technology, which simulates building processes.

In order to succeed in their new business environment, Ramaraju advises E&C companies to become "digital enterprises."

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A digital enterprise uses new technology in all stages from project planning to execution, and with project sites, where data on activities is digitized.

## Smart Cities and Energy Efficiency

“Smart cities” are also developing — in Seattle, Brussels, Munich, Hamburg, Singapore and elsewhere — and have emerged as new business opportunities for E&C companies, says Ramaraju. They address the demands posed by the growing trend of migration to urban areas that puts new pressure on infrastructure.

Smart cities have been defined as those that combine physical infrastructure — like transportation networks and utilities with “knowledge and social capital” to achieve a superior quality of life and sustainable development. “It implies a new kind of governance, genuine citizen involvement in public policy, voluntary organizations, soft infrastructure like knowledge networks, the after-dark entertainment economy, etc.,” says Mangharam. Cities want to do all that, not simply to improve operational efficiency, but also to enhance their appeal as a location for businesses.

Energy efficiency is an integral part of smart cities, for example, and that challenge often flows to E&C companies. Mangharam estimates that urban buildings have an average life of 70 years, and existing buildings — versus new, more energy-efficient construction — make up 98% of the inventory in major cities. Thus, E&C companies must focus more on retrofits to improve efficiency, and that means a unique solution for each building.

As noted in a recent Knowledge@Wharton special report — “Sustainability in the Age of Big Data” — existing buildings can be wired with sensors that can lead to huge gains in energy efficiency. One notable example: Microsoft, which took three years to organize 30,000 existing sensors at the company’s Redmond, Wash., headquarters into a single energy-efficiency system. That network produces billions of data points each week regarding the amount of energy used by air-conditioning, heaters, lights and fans. The resulting analysis found many savings, such as a garage exhaust fan that had been left running unnecessarily for a year at an annual cost of \$66,000. More generally, the system avoided some \$60 million in capital investment in energy-efficiency technology by running existing facilities more efficiently with the help of smart systems.

## More Embedded Sensors

As E&C companies nibble around the edges of new technologies in RFID (radio frequency identification), sensors and mobility, they come to grips with the untapped potential. “It is the tip of the iceberg of what companies can do with technology,” says Ramaraju.

Mangharam offers a few examples of how E&C companies building urban infrastructure have used sensors and embedded software to help better manage utilities and transportation services. Sensors in garbage cans, for instance, send signals when they are 75% full, helping trash trucks map their route to pick the fullest bins first. Enevo Oy, a Finnish company, has 5,000 sensors fitted on garbage bins in U.S. and European cities, notes [Fast Company](#).

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In the U.K., power companies start panicking as the credits start to roll after each episode of the popular BBC television soap opera *EastEnders*, says Mangharam. That is because millions of viewers turn on their electric kettles to make tea, causing a demand spike of up to 3,000 megawatts for between two and six minutes. To meet that demand spike of a few minutes and avoid brownouts, the power companies increase supply by turning on dams in Northern Ireland or source power from France, he adds.

Similarly, in the U.S., power companies have to plan for breaks in the Super Bowl football championships each February. At half-time, millions of viewers open their refrigerators to grab a drink, says Mangharam, and power companies synchronize their supply accordingly. Those breaks also mean millions of toilets are flushed in a synchronized fashion, causing stress on sanitation systems.

Mangharam sees those as examples of the next level of pressures smart cities will confront, in areas like energy, sanitation, a sports event or TV shows. “You can see how systems are responding or not responding today,” he says, adding that E&C companies will need to invest in new technologies to respond to those challenges.

## Changing Business Environment

E&C companies also have to confront other major changes in their business landscape. Many civic infrastructure projects like airports or power plants today are much bigger than in earlier years, says Ramaraju. They also are more often located in developing countries that lack the expertise

to implement them, or at times face risks like war or other political conflicts.

The E&C industry’s business practices are also changing. In many government-owned projects, E&C companies are expected to arrange project financing and recover their investments by operating the facility they build (say, a toll expressway) over a specified period. That makes E&C companies today more selective in picking projects that suit their expertise and resources, says Ramaraju. In earlier years, they would indiscriminately bid for projects and later figure out how to implement them.

To respond effectively to all those changes, E&C companies need a global mindset and delivery network of offices or partnerships, standardized operating practices and technology platforms, and superior risk management skills to factor in the new geopolitical, competition and business-model risks. “One bad project can wipe out the entire bottom line of a company,” says Ramaraju.

## All Hands on Deck

To make technology yield the best results, collaboration across a project’s ecosystem is also a must for E&C companies, says Mangharam. In smart cities, for example, the “smartness” is no longer just about building the right infrastructure and throwing in technology like sensors or smart meters. It has to do more with being “smart” in intangible ways, combining technology and human judgment collaboratively to solve problems.

“It requires a team that is exposed to the variety of perspectives — some of which

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*“One bad project can wipe out the entire bottom line of a company.”*

— Arjun Ramaraju

maybe conflicting perspectives of what it means to be smart — and then work together as a team,” says Mangharam. “The technology is already there, and it is about making it work seamlessly with coordination between humans.”

He offers an example of how the Southeastern Pennsylvania Transportation Authority (Septa) uses technology and collaboration to respond to commuter needs. Septa’s cameras installed in all its train stations track commuter traffic patterns, allowing it to respond in real time by deploying more trains or buses if required. Septa tracks those demand patterns across the tri-state region (Pennsylvania, New Jersey and Delaware) it operates in, factoring in traffic density

on Amtrak, the Port Authority Transit Corp. (Patco) and other transportation networks in the Philadelphia region, he says.

“Humans are still making the decisions at a higher level than technology, which makes decisions at lower levels,” says Mangharam. “For example, [in the Septa example], to change a route’s schedule would be a lower level decision. But to deploy three more buses on a certain route, or to invest in a new bus technology, would be a higher level decision.” Such processes work best with technology unifying “the entire ecosystem of customers, partners and industry experts.” Early adopters to such new technology among E&C companies will have an edge over rivals that are slow to act, he adds.

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*“Technology is unifying the entire ecosystem of customers, partners and industry experts.”*

— Rahul Mangharam

This article was produced by Knowledge@Wharton, the online business journal of The Wharton School of the University of Pennsylvania. The project was sponsored by Wipro Technologies.

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