The Tera-Era of Mega Projects: Digital transformation in construction

by Yugant Kapur

"Nothing is so painful to the human mind as a great and sudden change."

Mary Shelley's words from Frankenstein poignantly capture the tumultuous nature of progress we observe in today's monumental projects. Historically, mega projects were defined by million-dollar budgets, but the post-World War II era ushered in *'gigaprojects'* with billion-dollar price tags, exemplified by the Manhattan and Apollo programs. Despite this shift, the term *'megaproject'* has persisted.

We now stand on the threshold of what Bent Flyvbjerg has aptly called the *'Tera Era'*, where projects have escalated to trillion-dollar scales, now known as *'teraprojects.'* These ventures are no longer merely large; they rival the GDPs of entire nations, comparable to the economies of Australia or Canada. This relentless quest for ever-greater scales reshapes project management, introducing profound challenges and unprecedented opportunities. As we navigate this new era, the discomfort of transformation is inevitable, but the potential for revolutionary advancements is equally profound.

The break-fix model in megaproject management underscores this as a paradox: despite their growing scope and complexity, megaprojects often falter due to initial misinformation, unrealistic estimates, and flawed feasibility studies, resulting in costly interventions when projects inevitably struggle.

Survival of the Unfit

In contrast to Adam Smith's "invisible hand" in economics, Albert Hirschman's "Hiding Hand" principle posits that a lack of awareness about the true costs and challenges of large projects can sometimes be beneficial. This ignorance can drive individuals to undertake ambitious ventures they might otherwise avoid—a phenomenon Flyvbjerg describes as "survival of the unfit." Yet, despite technological advances that have improved our ability to estimate and manage costs more accurately throughout the construction phase, the sector still encounters significant hurdles. According to a McKinsey report, the construction industry lags behind other sectors in digital transformation, primarily due to persistent traditional practices and a lack of awareness about new technologies, particularly in regions like India. This digital adoption gap means that the advantages of modern cost-prediction tools are not fully leveraged. Given the increasing complexity of today's projects, it is crucial for business leaders to embrace these disruptive digital tools to ensure projects are completed on time, within budget, and with high standards of quality and safety.

Let us explore some tools that have begun to leave their mark in the construction sector and are seeing increasing adoption.

Building Information Modeling (BIM) is the process for creating and managing digital models of buildings and other physical assets. BIM's ability to generate 4D and 5D models, integrating project dimensions with schedules and costs, offers stakeholders enhanced visibility. Despite its benefits, BIM's effectiveness hinges on client-driven adoption, which is still developing in the Indian infrastructure sector. Projects where the government is the client seldom incorporate BIM capabilities as a contractual condition. However, positive changes are underway as some government clients increasingly demand BIM models, especially for Metro projects construction to facilitate better project monitoring. BIM also fosters collaboration among various stakeholders.

In megaprojects, numerous subcontractors often work independently, potentially causing interface clashes or conflicts. BIM's clash detection feature is invaluable in mitigating such issues and can cause potential savings in reduced reworks.

The **Internet of Things (IoT)** is also revolutionizing the construction sector. IoT devices track machinery and workers, collect data that improves machinery utilization, identify theft (such as diesel), and monitor worker activities at construction sites.

Artificial Intelligence (AI) and **Machine Learning (ML)** are also making significant impacts. Computer vision, for instance, enhances human-machine coordination, assesses bulk material stockpiles, and estimates quantities, among other applications.

Smart contracts facilitated by blockchain technology offer a promising future in contract management. These contracts enable automatic transactions upon fulfilling specific conditions, potentially boosting productivity.

3D printing is emerging as a transformative execution method. For example, L&T in Bangalore used 3D printing technology to construct a post office, demonstrating its potential to address temporary structure needs. It can also resolve supply chain issues associated with producing consumables, small tools, and tackles.

RFID tags for tracking precast members are becoming standard practice. Some advantages include tracking the real-time availability of components, streamlining the assembly of components, and reducing manual effort.

In conclusion, once seen as a laggard in digital transformation, the construction industry is now making remarkable strides. The increasing willingness of professionals to embrace new tools, growing investment from businesses, and the enhanced decision-making capabilities provided by these innovations signal a promising future.

As we embrace these technological advancements, the construction sector is poised to overcome its historical challenges and unlock unprecedented opportunities, ushering in an era of efficiency, collaboration, and groundbreaking progress.

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