Construction sector transformation

The productivity drivers: off-site construction

Engaging with better process: part two
Off-site construction

Throughout the series on the transformation of engineering and construction, we have discussed transformational leaders – specifically the importance of a strong change leader, the impact of integrated building information modeling (BIM), optimization through methodologies such as lean construction (Lean) and how digital now touches everything we do. Like BIM and Lean, off-site construction – encompassing prefabrication (prefab) and modular construction (modular) – has been around for decades but is reentering the spotlight as a viable means to addressing the central issues: time, budget, productivity, quality and safety. Changing societal norms are the second reason for the continued rise of off-site construction. Like BIM and lean construction, indicators are showing that the greatest impact of off-site construction will occur during the current phase of the sector.

Why is off-site construction transformational? And why now?

Of course, off-site construction has been well-established for some time in some construction processes, such as with high-rise facades, which are being manufactured off-site and delivered flat-packed, ready for installation. Much more is yet to be achieved.

"As an analogy, the automotive industry used to build cars on-site and suppliers provided spark plugs and cables. Today, cars are assembled and suppliers provide the entire ignition system. Automobile manufacture has moved from ‘construction from parts’ to ‘assembly of components.’ The change needed in construction is a move from delivering concrete and materials to delivering walls, floors, rooms for on-site assembly.”

— Christian Birck, Head of Customer Excellence & Innovation, LafargeHolcim

Off-site construction materially impacts each of the key performance indicators of construction: productivity, quality, safety, time and budget.

- The quality, productivity and safety that can be achieved in an automated, controlled environment are likely to exceed those possible on-site.
- Any “critical path” construction activity that can be moved to “off-site construction” enables a reduction in overall construction time. This ranges from using pre-cast concrete to reduce curing times to installing completed modules.

“The true current day value of prefabrication is its ability to ‘crunch the schedule’ and deliver projects with greater speed and populate the building with paying tenants.”

— Stacy Scopano, Innovation, Development & Construction, Skanska USA

“We’re focused on automation. In our experience, a digital building process with a multi trade prefab has the biggest potential to reduce the duration of the project.”

— Atul Khanzode, Ph.D Technology and Innovation, DPR Construction

This applies to all forms of construction, including residential, with modularized bathrooms; commercial, with precast flooring; or civil, where bridge sections are pre-cast and lifted into place.

Time can be further optimized by integrating off-site construction with lean construction processes.

When safety, productivity, quality and time are improved, it will have a positive impact on meeting budget and margin targets.

Future trends will further increase the transformational impact of off-site construction. BIM files will connect directly with robotized prefabrication plants producing modules. Modules can be fitted with electronic “chips” costing less than a dollar and connected to BIM via the IoT. This allows these components to be delivered and installed correctly (alerting site managers when being installed incorrectly), increasing efficiency and reducing costly rectification rates and building maintenance costs.

To link back to the automotive sector analogy, the trend from “construction from parts” to “assembly of components” has enabled local parts manufacturers to develop into global component producers. Global building materials producers or local module producers may respond to the construction opportunity by developing highly sophisticated, automated production facilities, which will further increase quality while reducing cost, and enable them to balance supply and demand by shipping goods to “boom time” geographies. And while perhaps further out into the future, driverless transportation will reduce the cost of off-site construction further again.
Changing societal norms are the second driver of off-site construction. The call for sustainability will continue to gain strength as the world grinds toward a more circular economy and carbon neutrality. Off-site construction results in a net reduction in waste, noise and dust. Local governments, responding to environmental concerns and looking to reduce the physical impact of construction waste, noise, dust and traffic congestion, will continue to place stricter regulation on “on-site” construction in favor of “off-site” construction. Beyond government regulation, the trend of organizations needing to demonstrate responsible business practices and a sense of social responsibility by reducing waste and impact on the environment is likely to increase supporting the adoption of off-site construction.

**Conclusion**

As with the other quadrants covered in this series, successfully implementing off-site construction requires buy-in from all stakeholders, from the top down and bottom up, including trade subcontractors. Published examples demonstrate that organizations with underdeveloped lean construction capability and limited experience with off-site modular construction produce disappointing results.

Switching from traditional processes requires a shift in mindset, as well as method, but the payoff can be material in all areas. To be truly transformational, “off-site construction” requires development in tandem of the digital, BIM and lean quadrants.

**Getting started**

1. **Readiness**: gauge where your organization stands with regard to transformation.
2. **Pilot**: run a pilot and gradually adopt off-site construction.
3. **Critical path**: consider local trials where it affects the critical path and off-shore only once stable.
4. **Quality**: not all off-site manufacturers are created equal; verify that their quality standards are aligned with yours.
5. **“In-source” option**: should you elect to “in-source” your “off site construction,” manufacturing expertise and leadership are essential.
6. **Buy-in**: manage your constituents; not everyone’s views will be aligned to yours.

**EY point of view**

Despite the hurdles, the trajectory is set. Off-site construction reduces the impact of construction and demolition on communities. As construction companies increase the use of prefabrication and modular to reap the combined benefits of safety (controlled environment), time (“crunching the schedule”), quality (assembly line precision) and cost (automation and, over time, the advent of driverless transport), the economics and societal expectations will drive their more widespread use.

**Barriers to adoption**

The project-based nature and the fragmented value chain can impede progress. The project procurement KPIs are often oriented towards cost of materials. The economics of prefabricated or modularized solutions can include completing construction in shorter time frames, less waste removal costs and when done well should reduce re-work, costs of which may be hidden in subcontractor accounts and warranty costs which are likely to occur post project completion. None of this may factor into procurement KPIs. Creating innovation and efficiencies requires looking at costs from different perspectives and a future state strategy.

**The adoption spectrum**

The spectrum ranges from construction companies that have invested in prefab manufacturing capacity to others that are using external, independent prefab and modular producers. Some organizations maximize off-site, while others have not adopted prefab or modular in a meaningful way.

Construction companies that develop manufacturing capability and capacity in-house may develop a competitive advantage. Conversely, large-scale multinational prefab and modular companies in the years ahead may offer unbeatable economics and price-quality ratio.
## Contacts

<table>
<thead>
<tr>
<th>Name</th>
<th>Role</th>
<th>Email Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mark Grinis</td>
<td>EY Global Real Estate, Hospitality &amp; Construction Sector Leader</td>
<td><a href="mailto:mark.grinis@ey.com">mark.grinis@ey.com</a></td>
</tr>
<tr>
<td>Ad Buisman</td>
<td>EY Global Engineering and Construction Leader</td>
<td><a href="mailto:ad.buisman@nl.ey.com">ad.buisman@nl.ey.com</a></td>
</tr>
<tr>
<td>Erin Roberts</td>
<td>EY Americas Engineering and Construction Leader</td>
<td><a href="mailto:erin.roberts@ey.com">erin.roberts@ey.com</a></td>
</tr>
<tr>
<td>Viktor Andrade</td>
<td>Brazil Engineering and Construction Leader</td>
<td><a href="mailto:viktor.andrade@br.ey.com">viktor.andrade@br.ey.com</a></td>
</tr>
<tr>
<td>Linda Shen</td>
<td>China Engineering and Construction Leader</td>
<td><a href="mailto:linda.shen@cn.ey.com">linda.shen@cn.ey.com</a></td>
</tr>
<tr>
<td>Paul Gerber</td>
<td>France Engineering and Construction Co-leader</td>
<td><a href="mailto:paul.gerber@fr.ey.com">paul.gerber@fr.ey.com</a></td>
</tr>
<tr>
<td>Sylvain Perdriau</td>
<td>France Engineering and Construction Co-leader</td>
<td><a href="mailto:sylvain.perdriau@fr.ey.com">sylvain.perdriau@fr.ey.com</a></td>
</tr>
<tr>
<td>Martin Cecon</td>
<td>Germany, Switzerland, Austria (GSA) Digital Leader, Associate Partner, Strategy</td>
<td><a href="mailto:martin.cecon@parthenon.ey.com">martin.cecon@parthenon.ey.com</a></td>
</tr>
<tr>
<td>Axel Schäfer</td>
<td>GSA Partner, Strategy</td>
<td><a href="mailto:axel.schaefer@parthenon.ey.com">axel.schaefer@parthenon.ey.com</a></td>
</tr>
<tr>
<td>Volkmar Schott</td>
<td>GSA Partner, Strategy</td>
<td><a href="mailto:volkmar.schott@parthenon.ey.com">volkmar.schott@parthenon.ey.com</a></td>
</tr>
<tr>
<td>Satoshi Abe</td>
<td>EY Japan Engineering and Construction Leader</td>
<td><a href="mailto:satoshi.abe@jp.ey.com">satoshi.abe@jp.ey.com</a></td>
</tr>
<tr>
<td>Han Shin Nae</td>
<td>Korea Engineering and Construction Leader</td>
<td><a href="mailto:hanshin.nae@kr.ey.com">hanshin.nae@kr.ey.com</a></td>
</tr>
<tr>
<td>Jonas Svensson</td>
<td>EY Nordics Engineering and Construction Leader</td>
<td><a href="mailto:jonas.svensson@se.ey.com">jonas.svensson@se.ey.com</a></td>
</tr>
<tr>
<td>Bert Bardoel</td>
<td>EY Oceania Engineering and Construction Leader</td>
<td><a href="mailto:bert.bardoel@au.ey.com">bert.bardoel@au.ey.com</a></td>
</tr>
<tr>
<td>Francisco Fernandez Romero</td>
<td>Spain Engineering and Construction Leader</td>
<td><a href="mailto:francesco.fernandezromero@es.ey.com">francesco.fernandezromero@es.ey.com</a></td>
</tr>
<tr>
<td>Adrian Mulea</td>
<td>EY UK &amp; Ireland Engineering and Construction Leader</td>
<td><a href="mailto:amulea@uk.ey.com">amulea@uk.ey.com</a></td>
</tr>
<tr>
<td>Heather DaSilva</td>
<td>EY Real Estate, Hospitality &amp; Construction Analyst and Contributor</td>
<td><a href="mailto:heather.dasilva@ey.com">heather.dasilva@ey.com</a></td>
</tr>
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