



## PREFAB CONSTRUCTION

# How Prefab is Changing the Construction Industry and How You Can Keep Up

As the construction industry continues to evolve, new trends in construction, including prefabrication, are beginning to take a foothold. Prefabrication is poised to influence many aspects of the industry, including:

- Designing
- Productivity
- Planning
- Technology
- Safety
- And collaboration

Since contractors want to double their labor hours invested in prefab within the next five years – according to the 2017 *FMI/BIMForum Prefabrication Survey* – the industry will need to quickly adapt its culture and technology to see the rich benefits from these methods.

“The future of construction includes the normalization of prefab and off-site manufacturing. The extremely high global demand for construction that we are currently seeing will help to force the industry’s hand to do more with less.”

- Nancy Novak  
Senior Vice President of Construction  
Compass Datacenters

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Even though most agree that there are advantages to prefab, the process is still wrought with frustration. Of the trade and general contractors surveyed, the *FMI/BIMForum Survey* found that **90% said their prefab processes need improvement**. This is in part due to the challenge of getting everyone on board with a deep shift in the processes of construction.

“ Prefabrication is a major factor in the future of sustainable, lean and repeatable construction. Advancing construction technology workflows allows companies to more easily achieve this repeatability which results in enhanced product quality, reduces costly material waste and helps to close the gap on skilled labor shortages. Companies not adapting their business models will be left in the dust.”

- Scott Diaz  
Director of Business  
Development  
FARO® Technologies

As the survey noted, “One of the biggest barriers to change and transformation as it relates to prefabrication is not technology; it’s people and culture.”

**Tech can help ease these prefab growing pains.** The *FMI/BIMForum Survey* discovered that improved technologies have been driving an increased use of prefabrication, which has more than doubled from 2010 to late 2016. *Construction Dive* argued that, “Having a comprehensive, digital picture of a [prefab] project can help the players involved understand what resources are needed and when, and minimize the risk of over – or under – estimating the time and money the project will require.” Some of the most efficient methods of creating this digital picture are through 3D technology, such as 3D laser scanning, which enable detailed and streamlined methods of planning, communication and coordination necessary to succeed with prefab.

## Changes in the Construction Industry

**Prefabrication has grown out of its low-cost residential roots** into luxury hotels, sprawling hospitals and everything in between due to changing expectations.

# 2X

more prefabrication used between 2010 and late 2016





Prefab now comes in all sizes, including custom high-end fabricated pieces, bathroom modules and precast concrete. “Any facility that has large universal spaces like classrooms, hotel rooms, hospital rooms, office space, etc., naturally fits for an off-site manufacturing effort because of the repeatable design,” Novak said.

Most contractors are incorporating it in some way, as owners demand shorter time frames, more accountability and more focus on safety and risk management. So, contractors and subcontractors have had to innovate to keep up.

### Multi-Trade Collaboration

Multi-trade collaboration is becoming an expectation with more requests for off-site MEP panels, headwalls and skids, and is likely to change subcontractor business structures in the future to meet these growing prefab needs. Trades will require heavy collaboration and partnership in the design, bidding, fabrication and installation phases or may find the necessity to form new, multi-trade businesses.

Instead of planning a sequence of different subcontractors on the jobsite, contractors must coordinate many subcontractors on- and off-site simultaneously in a prefab setting. This requires different planning and partnership approaches.

“A large subcontractor base is embracing prefab. As they are threatened with losing work to true manufacturers, they must learn to compete. Subcontractors discover they’re more productive in a factory environment and make more money with prefab.”

- Amy Marks  
CEO, XSite Modular

# PRE

is the most important part of prefab

### Early Cooperation

The “pre” may be the most important part of prefab. Pre-planning is a critical step in all forms of construction, and prefab is no exception.

And this is pre-planning in a way the construction industry isn’t used to, bringing all parties to the table in the design process, including trades, to think through the ramifications of the choices made. “The challenge is leveraging the MEP trades (where most of the manhours are spent) by planning the design around being able to fabricate large interdisciplinary modules off-site,” Novak said.

From *Building Design + Construction*: “Certain aspects of prefabrication can have significant impact on the design, such as how walls are to be framed, the routing of mechanical and electrical systems, layout of interstitial spaces, and openings for components like headwalls.”

**It’s a must for everyone (contractors, subs, prefab manufacturers, architects and owners)** to come to firm agreements about design, often even including agreements with owners about materials and finishes. The design must be finalized, allowing for little flexibility during building. The success of the project depends on it.

The current construction process isn’t set up to handle this degree of pre-planning. The prefab planning process demands adherence to a new set of expectations.



## Leading-Edge Technology

The adoption of more sophisticated technologies is becoming the norm in construction, and prefab is contributing significantly to this shift. Highly accurate as-built data is needed to keep contractors, subs and manufacturers clear on actual measurements and tolerances and to plan move-in paths.

“Just like in manufacturing, companies need techniques to build and verify what’s being constructed. This tech tends to involve 3D reality capture hardware using laser scanning and software that registers a detailed point cloud where extraordinarily accurate measurements can be taken,” Scott Diaz, director of business development at FARO, said.

“ [Construction companies] need to trust that what they are building will work in the field; otherwise the entire purpose of prefab is wasted. Continued improvements in construction technology is providing this piece of mind.”

- Scott Diaz  
Director of Business Development  
FARO Technologies

## Building Productivity & Safety

Prefab enables sharp labor productivity increases through the adoption of manufacturing techniques, estimated at a hike of five to 10 times by a McKinsey Global Institute Report on construction productivity. This is massive, considering the report’s findings about how much construction productivity growth (1%) currently lags behind the labor production growth of the economy as a whole (2.8%) and manufacturing (3.6%).

While an effort that improves productivity may often threaten safety, that’s not the case with prefabrication. “The best way to increase safety on the jobsite is to reduce the number of people on the jobsite. If safety is really your number one priority, you’re doing prefab,” said Marks.

Safer environments, early stage collaboration, multi-trade businesses and advances in technology — considering these factors, the future of construction is taking a different shape. But there are challenges.

## Difficulty Adapting to Prefab

While the construction industry is clearly seeking to rapidly innovate, there are growing pains. As *Building Design + Construction* headlined their

# 5-10X

more construction productivity with prefab manufacturing techniques



## Benefits of Prefab:

- Worker safety
- Shortened timelines
- Cost savings
- Increased productivity
- Less waste
- And more



article, “Prefabrication’s predicament: It’s much harder than it looks.” They went on to argue that prefab is still in its “R&D phase” for most firms.

## The Knowledge Gap

While the desire to move to prefabrication is clearly there, it takes dramatic cultural change and years of investment. All parties must be invested in adapting processes. “There’s a massive knowledge gap in the industry. It’s not easy to learn prefabrication and there are few places you can turn to learn,” Marks said. Marks’ firm, XSite Modular, is one of those few places.

For those first years of experimentation with prefab, contractors likely won’t see many of the benefits. However, good 3D technology can help speed up ROI by providing accurate as-built data, enhancing planning, reducing errors and keeping all the teams on track.

Currently, **only 21% of trade and general contractors are planning for prefabricated assemblies** during the design stage (*FMI/ BIMForum Survey*). This means a lot of failed opportunities and worksite frustration.

## Design Changes

It can be a challenge for owners to commit to the design as early as prefab requires, allowing for little flexibility once construction begins.

While this is a concern for many with the adaption of prefab, technology solutions such as augmented reality (AR) and virtual reality (VR) can help by allowing owners to virtually walk through the building and make more informed design choices.

## Few Prefab Partners

Contractors may also struggle with few prefab manufacturing partners to choose from. Simultaneously, Jobsite pointed out in an article that those existing partners are facing underutilization, which in turn hinders growth in the area. As Marks stated, “If we don’t do prefab

# 21%

of trade and general contractors are planning for prefabricated assemblies

“Virtual and augmented reality programs will help to normalize prefab in our industry because clients really like seeing what they are paying for in 3D, and it helps tradespeople see things more clearly to work through conflicts prior to having manhours in the field.”

- Nancy Novak  
Senior Vice President of Construction  
Compass Datacenters

because there are only, say, three partners, there will never be six partners to choose from.”

As a result, traditional construction companies are developing their own prefab businesses to compete with the true manufacturers.

## Bidding Process

Even the standard construction project bidding process requires development. While traditionally each subcontractor bids his or her portion of the job, prefabrication bids tend to be on completed, multi-trade modules or units.

It’s difficult to compare these numbers. In order to bid these jobs, it forces trade collaboration and a potential increase of integration in the construction industry.





## Tips as You Take on Prefab:

1. Invite all your stakeholders to the table early in the process to figure out where prefab could add the most value to the project.



2. Adopt 3D scanning equipment, such as the FARO Focus Laser Scanner, to help plan move-in paths for prefab elements and where you'll put your lifting equipment.

3. Think about your connections. Make sure there is enough space for a human to get in there and connect them.

4. For your own sanity, take a page from manufacturing. Institute a design freeze – the point at which no design changes can take place.

5. Employ software that gives all vendors access to the same data and measurements without having to download anything, like FARO SCENE WebShare Cloud.



6. Use the digital 3D templates of the FARO Tracer Laser Projector to speed up assembly and aid in accuracy. The Tracer<sup>SI</sup> can also scan assembled parts and notify you of errors against the CAD model through the BuildIT Projector software.

7. VR and AR programs help owners envision the completed project and thus make design decisions earlier in the process. They also help train subcontractors in the assembly need. SCENE and SCENE WebShare Cloud provide VR walkthroughs of 3D scanned environments, and FARO Visual Inspect™ AR provides augmented reality to inspect and assemble parts.



## Advanced BIM Forging the Way

**Complex BIM is fundamental for managing prefab projects.** BIM has been evolving with the industry from blocky, inaccurate 2D models to now 3D point clouds that eliminate the need for hand measurement and are used to coordinate production.

To succeed, contractors first and foremost need a thorough, 3D BIM that is updated with as-built conditions in order to have real and precise calculations for subs and manufacturers to abide by. Without this, prefab can be a mess of poorly fit pieces and rework.

FARO Technologies is a leader in 3D hardware and software solutions for inspection, project management and quality assurance/quality control (QA/QC) in the manufacturing and construction industries, making the company particularly suited to help with inspection and assembly in prefab manufacturing environments, as well as on-site reality capture and installation.

According to Scott Diaz, “Construction is moving towards what manufacturing does so well: build and verify. As a higher and higher percent of work is going to prefab, FARO can help lead the way by building Laser Scanners, Trackers and Tracers into prefab workflows to provide full visibility and risk mitigation of the entire process.”

**Laser scanning with advanced BIM software is often an entryway into prefab,** and it’s not complicated to use. 93% of construction customers stated that FARO’s technology gives them a competitive edge over competitors who are not investing in 3D capture technology, according to a *FARO 2017 Construction BIM Survey*, third-party verified by TechValidate.

The best BIM solutions are user-friendly, allowing anyone to pick it up with a little training. FARO includes training and support in the purchase of Laser Scanners, making it as easy as ever for teams to implement this tech.

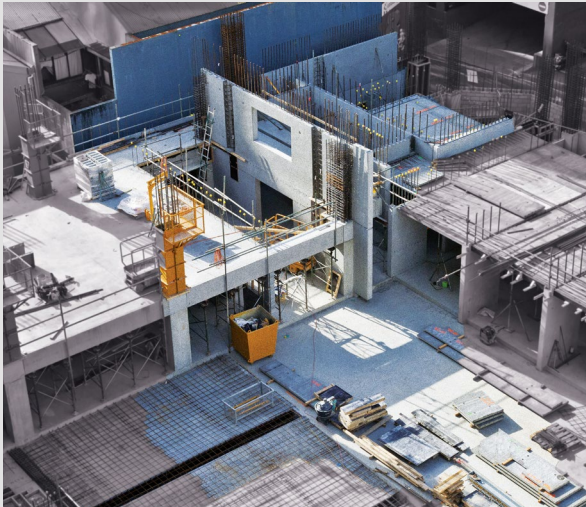
# 93%

of customers say FARO's technology gives them a competitive edge



“This technology has opened the door to new clients and new projects that would have previously been out of reach. We can now take detailed measurements of large sites and industrial facilities and be confident in this data as the starting point for our design. Clients and contractors have noticed a huge benefit in a major reduction in rework and field fitting prefabricated items.” ”

FARO 2017  
Construction BIM Survey Respondent



## Custom Prefab Example with Serious ROI

CW Keller creates beautiful [custom fabrication](#) pieces with very tight tolerances. Due to this, they've struggled with the differences between BIM and as-built, needing a better way to determine precise measurements during the construction process.

CW Keller turned to using FARO 3D Laser Scanners to scan the initial as-built conditions, often providing the scan as a service to clients who don't have such technology. They design their custom pieces to fit based on the scan and create custom [3D laser templates](#) with the FARO Tracer to aid in the speed and accuracy of assembly off-site and during installation of their prefab pieces at the construction site.

"When it snaps into place with the template, we know we have it installed correctly," Pittenger said.

## A Vision for the Future

Noni Pittenger, design engineer at CW Keller + Associates, is building a new reality in construction. She imagines a time when as-built conditions at the construction site are automatically scanned with 3D laser technology,

“The FARO team has been great! They always understand exactly what I'm trying to do when I ask questions. They're always there to help and collaborate.”

- Noni Pittenger  
Design Engineer, CW Keller + Associates

and the BIM updates with the worksite scan in real-time. That model then automatically generates 3D laser projections that can be used as templates for assembly, inspection and installation of prefab pieces. And she says that with the help of FARO, they are aren't far from the automation of the scans.

**Imagine the transformative possibilities this could have for construction businesses.**

Currently, according to a *McKinsey Global Institute Study*, construction is the second least digitized industry in the United States. While many firms are innovating in the industry like CW Keller, there's still a lot of room for digital adoption throughout the construction lifecycle, and FARO's here to make that process as easy as possible.

**The future of prefabrication is through 3D laser capture technology.**

Advances in safety, risk management, timeline and project management, collaboration and more will also impact the construction industry. And, as more companies begin to innovate and adapt, FARO will be there to provide lasting solutions that work.





### For More Information:

Website: [www.FARO.com](http://www.FARO.com)

Toll Free: 1-800-736-0234

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