MODULAR BUILDING INSTITUTE'S

Key Findings and Best Practices for Successful Modular Projects

2022 PERMANENT MODULAR CONSTRUCTION REPORT

MODULAR BUILDING INSTITUTE

About the Modular Building Institute – The Voice of Commercial Modular Construction

The Modular Building Institute (MBI) is the international nonprofit trade association serving the commercial modular construction industry for nearly 40 years. MBI promotes the advantages of modular construction while advocating for the removal of barriers that limit growth opportunities.

Through its long-standing relationships with member companies, policy makers, developers, architects, and contractors, MBI has become the industry's best resource for information for the commercial modular construction industry.

History

Founded in 1983, the Modular Building Institute (MBI) is the international non-profit trade association serving the global modular construction industry. Members are manufacturers, contractors, relocatable building fleet owners, architects, developers, and material and service providers.

Mission

As the Voice of Commercial Modular Construction™, it is MBI's mission to expand the use of offsite and modular construction through innovative construction practices, outreach and education to the construction community and customers, and recognition of high-quality modular designs and facilities.

Cover:
Cubix Othello (exterior)
Built by Jackson|Main Architecture & Metric Modular
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BROAD Garden A1 (exterior)
Built by BROAD U.S.A. Inc.
First Place, Permanent Modular Multifamily over 25,000 Sq. Ft.

PERMANENT MODULAR CONSTRUCTION

2022 ANNUAL REPORT

EXECUTIVE Summary

Bridging the Gap Between Construction and Manufacturing

Throughout this report there are several references to "permanent modular construction," as one might expect. In many factories across North America, the modular prefabrication process closely resembles construction activity occurring at an offsite location. But increasingly, modular prefabrication is becoming more closely aligned with manufacturing principles and practices.

This is becoming more evident as traditional construction labor shortages continue and factories implement a more streamlined and efficient way to build. Lean manufacturing techniques, investments in technology and automation, and component assemblies more closely align with modern manufacturing than with anything on a common construction site.

The modular industry exists somewhere along the continuum of labor-intensive on-site tradespeople and automated, factory-controlled manufacturing. In countries like Japan, the modular industry grew out of other manufacturing sectors such as the auto industry. In fact, Toyota is one of the largest modular home builders in that country. However, in the U.S., the industry evolved more from its construction roots with construction site trailers among some of the earliest examples of buildings using this process.

This industry is truly global in nature and represents an evolution of the way we build. As such, it is challenging to obtain industry data, and often more difficult to make "apples to apples" comparisons with the traditional labor sector in North America.

QUBE Pilot & Technology Demonstration (exterior)
Built by QUBE Projects Inc.
First Place, Permanent Modular Multifamily Under 25,000 Sq. Ft.

So, is the modular industry construction-based or manufacturing centric? It is neither, and it is both.

The modular industry market share has grown to 5.52 percent—doubling in size over past five years—with an estimated annual value of projects put in place topping $10 billion in North America. The multifamily market grew to become the largest for modular manufacturers, fueled in part by the Canadian Rapid Housing Initiative.

Tight labor markets, quicker return on investment, and low housing supply continue to be the main drivers for growth. Going forward, new industry standards and an increased demand for more sustainable construction building practices will continue fuel growth for this industry.

OVERVIEW

SECTION 1

of the Modular Construction Industry

The modular construction industry is primarily regulated at the state and local levels by building code administrators and authorities having jurisdictions. As with site-built structures, a building constructed using the modular process must meet the local codes where the building will be placed. Unlike federal manufactured housing products, built in accordance with the Housing and Urban Development (HUD) standard, there is no specific "modular building code" or exceptions for a building constructed utilizing the modular construction process. It is simply a more efficient process to construct building components at an offsite facility, and then transport and assemble components of a building at the final building site.

Modular construction can be utilized for a variety of uses including residential, commercial, or industrial applications. MBI represents the commercial sector of the industry.

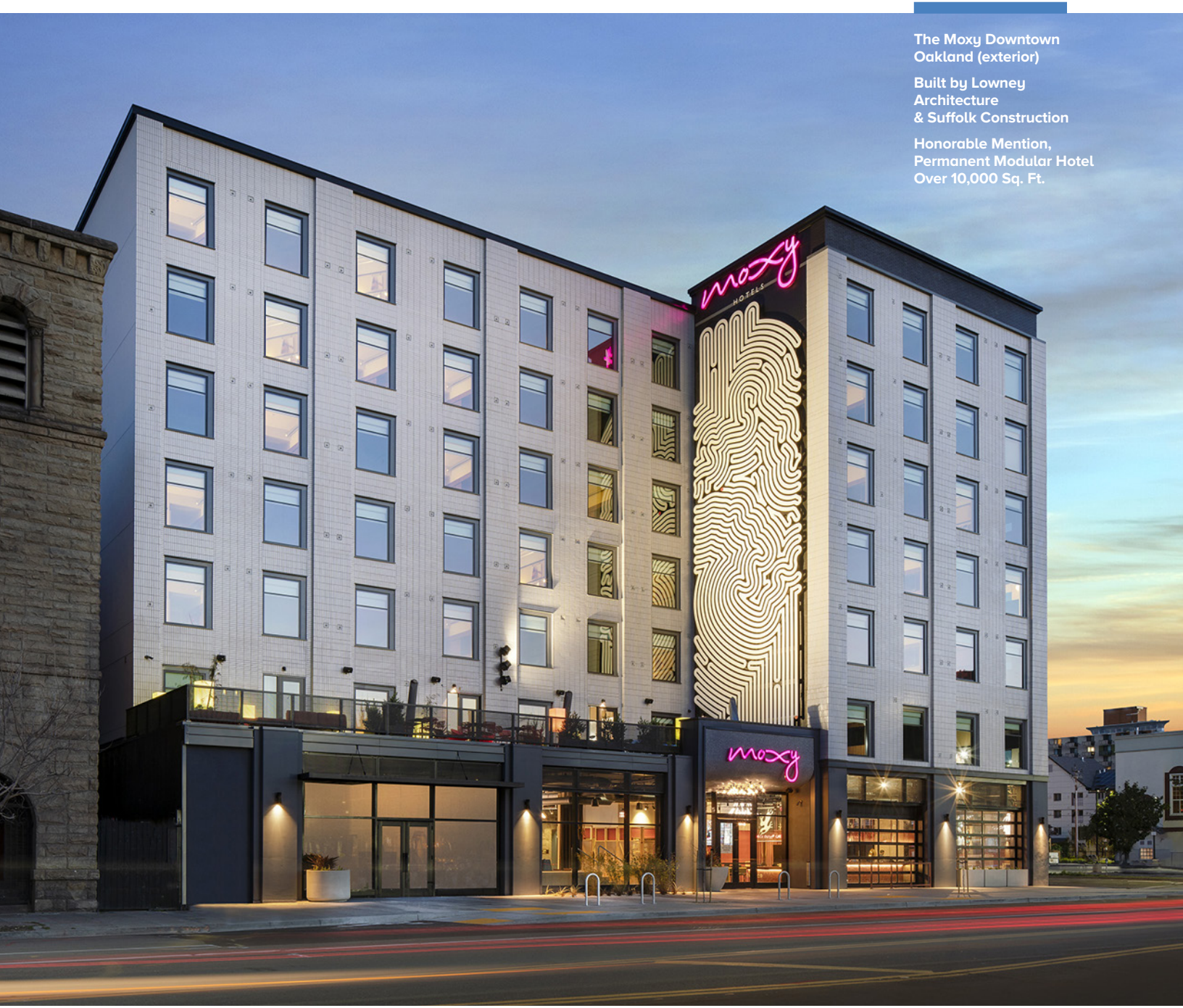
Commercial Modular Buildings are non-residential factory-built building components and structures designed to meet all applicable building codes. Commonly, these buildings are constructed in accordance with the International Building Code (IBC) in the United States, the National Building Code (NBC) in Canada, or a local version modeled after these codes. In this context prefabricated, mechanical, electrical, or plumbing (MEP) systems are not included for industry revenue and production figures.

The commercial modular building industry is comprised of two distinct divisions, both represented by MBI.

Relocatable Buildings (RB) – Relocatable buildings, as defined in the International Building Code, are partially or completely assembled buildings constructed and designed to be reused multiple times and transported to different building sites. This segment of the industry maintains fleets of relocatable buildings offered for sale or lease to customers.

Permanent Modular Construction (PMC) – PMC is an innovative, sustainable delivery method utilizing off-site, lean manufacturing techniques to prefabricate single or multi-story whole building solutions in deliverable volumetric module sections. PMC buildings are manufactured in a safe, controlled setting and can be constructed of wood, steel, or concrete. PMC modules can be integrated into site-built projects or stand alone as a turnkey solution, and can be delivered with MEP, fixtures, and interior finishes in less time, with less waste, and higher quality control compared to projects utilizing only traditional site construction.

PMC buildings are subject to the same building codes and requirements as site-built structures, depreciate in much the same manner, and are classified as real property. This segment of the industry provides construction-related services for the successful design, manufacturing,



The Moxy Downtown Oakland (exterior)

Built by Lowney Architecture & Suffolk Construction

Honorable Mention, Permanent Modular Hotel Over 10,000 Sq. Ft.

The Moxy Downtown Oakland (exterior)
Lowney Architecture & Suffolk Construction
Honorable Mention, Permanent Modular Hotel Over 10,000 Sq. Ft.

delivery, installation and finish-out of commercial and multi-family buildings.

This report focuses on permanent modular construction (PMC). Unlike other over-priced "prefabrication" reports, which rely almost exclusively on publicly available data and often include a mix of construction processes under the off-site construction umbrella, MBI obtains industry information for this report from multiple sources including:

The Moxy Downtown Oakland (interior)
Lowney Architecture &
Suffolk Construction
Honorable Mention, Permanent
Modular Hotel Over 10,000 Sq. Ft.

MBI member surveys – Each year, MBI asks all members for data regarding their annual revenues, sources of revenue, markets served, production, capacity, and total employees.

MBI's project database – Through the annual Awards of Distinction contest, MBI gathers specific project data to calculate average square footage of buildings by market type, average days to complete by market type, modular project cost, and total project costs.

Construct Connect Insight – MBI uses this database to determine the baseline for new construction starts in key markets and to measure overall industry market share.

Publicly available data such as news stories, public filings (U.S and Canada), and corporate websites.

Every effort has been made to ensure the accuracy and reliability of this data. In some cases, MBI's best estimates and member experience are used. Given that no one, sole source for this information exists regarding production, revenue, and market share for the entire commercial modular industry in North America, MBI is confident that this report represents the most comprehensive and accurate information available on the commercial modular construction industry in North America.

About Permanent Modular Construction

Many industries regularly use permanent modular construction, including schools, banks, restaurants, hospitals, hotels, medical clinics, and housing developers. The industries that utilize our services are numerous (as measured by the North American Industry Classification System, or NAICS), but the most common categories include:

236116 New Multi-family Housing Construction
236220 Commercial and Institutional Building Construction

Modular construction helps owners and contractors address:

Quicker occupancy – Streamlined construction process, in many cases 30-50 percent faster than with conventional construction.

The Intersection (exterior)
Built by Lowney Architecture & Holliday Development
First Place, Permanent Modular Multifamily Over 10,000 Sq. Ft.

Labor shortages – More efficient use of skilled labor with a safer work environment
Predictability – Due to the shortened construction schedule, up-front materials purchases and reliable labor, modular projects provide a hedge against construction market uncertainty.
Reduction of waste – Utilizing modular construction methods can reduce the amount of waste that ends up in landfills by more than 50 percent compared to a comparable site-built project.

The term "modular" describes a construction method or process where individual modules stand alone or are assembled to make up larger structures. Unlike relocatable buildings, these structures are intended to remain in one location for the duration of their useful life; thus, they are permanent. Permanent modular buildings may be wood-frame, steel, or concrete and can have as many stories as building codes allow.

Industry Standards

The North American modular industry is currently made up of over 250 regional manufacturers building everything from construction site offices to single-family homes and hotels. The industry is regulated primarily at the state level through administrative agencies that implement and enforce the rules for building in that state.

However, only thirty-five states (and one Canadian province) have such a program This means the remaining jurisdictions rely on local code officials to determine compliance and safety. Additionally, the programs lack a degree of uniformity in requirements and even terminology. For example, the program in Massachusetts is referred to as the "manufactured buildings program," while in other states the industry is referred to as "industrialized buildings," or "factory-built housing."

MBI worked with the International Code Council to develop two new industry standards for various aspects of modular and offsite construction, including standard definitions.
These ANSI standards – ICC/MBI 1200 & 1205 - address how modular buildings get approved, among other aspects of construction. Currently, the various state program requirements make it extremely challenging and costly for regional manufacturers shipping into multiple states. Helping to develop and implement more consistent administrative rules will improve efficiency and lower costs.

MBI also worked with the Canada Standards Agency towards the development of a new standard for multi-story modular buildings including transportation, installation, and module-to-module connections. Preceding this work, MBI helped CSA with standards research which led to the development of a June 2020 publication titled: *High-Rise Modular Construction: A Review of the Regulatory Landscape and Considerations for Growth.*

Stages of Modular Building

Primarily, four stages make up a modular building project:

UNION FLATS IN SAN FRANCISCO CA | FROM DAVID BAKER ARCHITECTS | GUERDON MODULAR BUILDINGS | DCI ENGINEERS

01.

Design approval by the end-user and any regulating authorities

02.

Assembly of module components in a controlled environment

03.

Transportation of modules to a final destination

04.

Erection of modular units to form a finished building

Approval Process

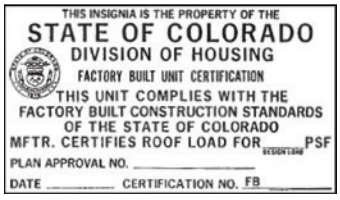
Most states in the U.S. as well as one Canadian province (Alberta) have an administrative agency that oversees and regulates the modular construction industry. While the terminology sometimes differs (see section on industry standards), the general procedures for building inspection and approval are similar. In the states where no agency exists, the local Authority Having Jurisdiction (or AHJ) is responsible for the inspection and approval process.

The administrative rules of each agency provide for safety standards and inspection procedures for industrialized building construction, design, and manufacture. Buildings and building components are either inspected and approved directly by the agency staff or by a third-party inspection agency (TPIA) or engineering firm acting on behalf of the agency.

Cubix Othello (side)
Built by Jackson|Main Architecture & Metric Modular
Honorable Mention, Permanent Modular Multifamily Over 25,000 Sq. Ft.

Buildings constructed using the modular process must comply with all applicable building code requirements including wind, snow, and seismic conditions. Because most elements of the building - including electrical and plumbing - are completed and "closed" off-site at the modular manufacturing facility, the inspection protocols must be clear and concise. Local code officials must be assured that the building has been inspected and will meet all requirements so that destructive inspections do not need to occur once the building is on site.

Once inspected and approved, modular/industrialized building components are deemed to have met all the applicable code requirements and a modular program label or insignia will be affixed to the module (see image below of sample state insignia).



Example of state modular code label.

Once the modules are delivered to the final site, other requirements are subject to approval at the local level. These requirements may include land use and zoning, local fire zones, site development, building setback, side, and rear yard requirements. Other requirements could be property line requirements, subdivision regulations, subdivision control, review and regulation of architectural and aesthetic requirements, foundation design, utility, and module connections.

SECTION 2

INDUSTRY Accelerators

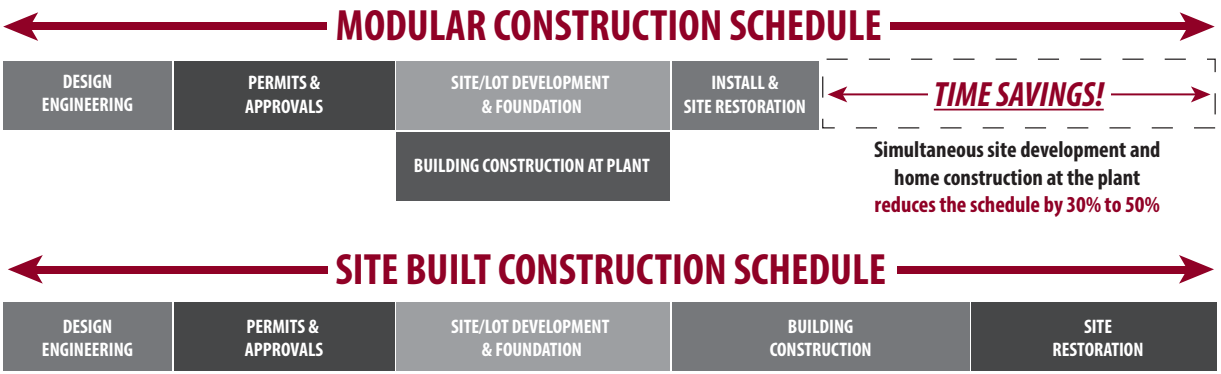
Labor Shortages Continue

According to a September 2021 survey conducted by the Associated General Contractors (AGC) and completed by over 2,100 construction firms, 89 percent of survey participants indicated they were having a hard time filling vacancies and had current openings. Additionally, about 41 percent of the current US construction workforce is expected to retire by 2031, and current construction wage trends far exceed recent rates. Severe capacity constraints are preventing many assets from being built on schedule. (McKinsey & Company, March 2022). The modular industry is not immune to these same labor challenges and labor is still needed to staff factories. But the modular industry is well positioned to tap non-traditional sources that the construction industry has yet to fully take advantage of, such as minorities, women, and the disabled.

One area where the modular industry can help with labor shortages is when the manufacturer acts in the capacity of a subcontractor, or "super-sub." In the same manner that a computer scientist is not required to build computers and an auto mechanic is not required on the Toyota assembly line, semi-skilled workers are utilized on the factory floor at various stations of the building assembly with strict control measures to ensure code compliance and

BROAD Garden A1 (exterior)
Built by BROAD U.S.A. Inc.
First Place, Permanent Modular Multifamily over 25,000 Sq. Ft.

Shorter Schedules / Quicker Return-on-Investment



quality. A general contractor can "sub out" a significant portion of a building to one company, rather than tracking down multiple trades.

High Housing Demands Continue

Housing supply continues to remain low while demand is rising. According to a February 2022 report by the National Association of Realtors (NAR) titled "The Double Trouble" of the Housing Market from February 2022, the problem may not be going away anytime soon.

Two in three renters cannot afford to buy a home; one in two renters pay more than 30 percent of their income for rent due to rising rental costs. And it is getting worse. Home prices continue to rise to record highs, eroding affordability even further. Since 2019, home prices rose nearly 30 percent. As a result, a typical home is about $80,000 more expensive than pre-pandemic. Wages may have also increased but not anywhere near the pace of the home prices. This means that potential buyers need to spend more of their budget on housing in order to buy the typical home now compared to 2019.

Meanwhile, inventory of homes for sale dropped significantly in the last couple of years, reaching record lows in 2021. In fact, there was a housing shortage even before the pandemic hit in 2020. There are currently only around one million units available for sale compared to near four million homes available for sale in 2007. This translates to fewer options for homebuyers leading to multiple offers and competition in the housing market.

It should come as no surprise that the multifamily market is now the fastest growing and largest market for the modular industry in 2021.

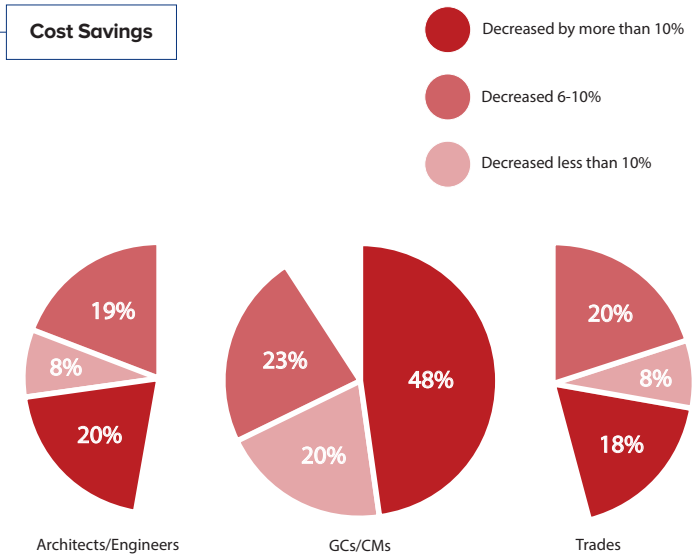
If you have ever tried to build a custom building in the dead of winter or during hurricane season, you understand that the weather has a huge effect on how long it takes your building to be constructed. Inclement weather can cause site-constructed buildings to take months longer than anticipated.

The ability to construct building modules in a factory while simultaneously preparing the building site work leads to a shortened construction schedule, quicker occupancy, and therefore, quicker return on investment.

Time is money, especially where construction is concerned. If you are

creating a business, delays in construction equal delays in revenue. Hotel rooms cannot be rented, hospital equipment cannot be installed, and inventory cannot be stocked until your building is complete.

Modular buildings are significantly faster to build than traditionally crafted buildings. In fact, numerous case studies demonstrate that modular buildings take 25-50 percent less time to build than traditional buildings.



Impact of Modular Construction on Project Budget Performance

(Percentages Reporting Each of Three Levels of Improvement)

Dodge Data & Analytics, 2020

Cost Savings

Dodge Data & Analytics' Prefabrication and Modular Construction 2020 Smart Market Report captured cost savings data from general contractors and construction managers. Ninety-one percent of all general contractors/construction managers responding (48 in total) reported a favorable impact on project budget performance, with many citing "cost certainty' as a key benefit.

Over the years, MBI has found some contractors and companies that benefit from the advantages of modular construction may have in fact experienced a cost increase on their first modular project but gained efficiency and savings on future projects due to a greater understanding of the process.

Environmental Impact

According to the Environmental Protection Agency, construction waste and debris is one of the largest contributors to landfills annually. While construction demolition of existing structures represents about 90 percent of this landfill waste, new construction activity accounts for nearly fifty-seven million tons of landfill waste.

One huge opportunity that modular construction provides to reduce the negative environmental impact is the ability to design for the relocation of an entire building. As modular buildings are constructed in modules, the buildings can be more easily "deconstructed" and used for secondary purposes.

During the 2010 Vancouver Winter Olympics, city officials had the forethought to consider what would be done with the structures used to house athletes after the games ended. The units for the athletes' village were

disassembled and reconfigured to provide transitional social housing throughout out the community.

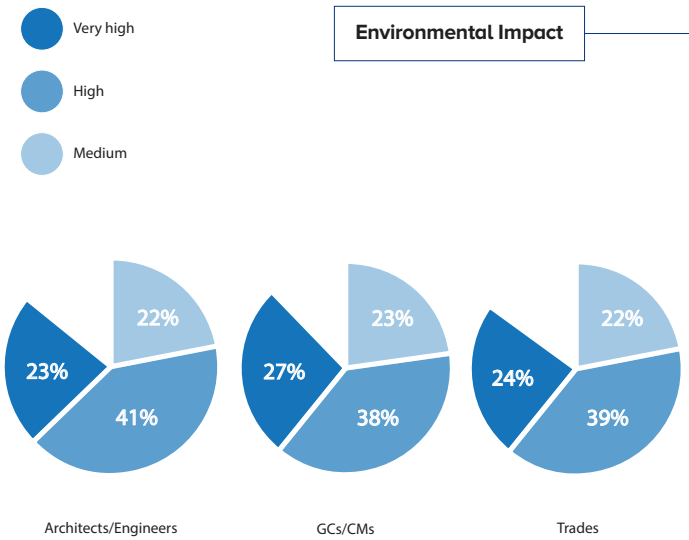
On two occasions, MBI commissioned university-based research to determine the environmental impact of modular construction compared to traditional site-built construction.

The University of Virginia conducted a study (Quale, et.al.) using life cycle assessment to quantify the environmental impacts of constructing a typical residential home using two methods, based on data from several modular construction companies and conventional homebuilders. The study, peer-reviewed and published in the *Journal of Industrial Ecology,* included impacts from material production and transport, off-site and on-site energy use, worker transport, and waste management.

In terms of materials usage and waste, homes constructed using a modular process were found to use about 17 percent less material overall. This included greater material use for modular mate lines and transportation but significantly less material waste for modular. In fact, the modular homes sent about 75 percent less wood and drywall waste to the land fill per project (1,380 lbs. for modular vs 5,500 lbs. for conventional). Worker transport to the jobsite daily had a negative impact for conventional construction while energy use in the factory reduced the environmental impact of modular construction projects.

The analysis revealed that environmental impacts from modular construction are, on average, lower than those from on-site construction with total greenhouse gas emissions about 30 percent less by using modular construction.

A study conducted by the University of Alberta (North Ridge CO2 Analysis Report - Al-Hussein, et.al.) comparing modular and on-site construction noted even greater advantages for modular construction. The research found that by using modular construction, the overall schedule was shortened by four months on an 11-month project and CO2 emissions were reduced by 43 percent.



Impact of Modular Construction on Construction Waste Reduction

(Percentages Reporting Medium, High, or Very High Contribution)

Dodge Data & Analytics, 2020

BROAD Garden A1 (interior)
Built by BROAD U.S.A. Inc.
First Place, Permanent Modular
Multifamily over 25,000 Sq. Ft.

According to a March 2022 article by McKinsey & Company, the world will see a once-in-a-lifetime wave of capital spending on physical assets between now and 2027. This surge of investment—amounting to roughly $130 trillion —will flood into projects to decarbonize and renew critical infrastructure. Ninety-three percent of CEOs say that sustainability issues are important for the future success of their business, and 54 percent expect sustainability to be embedded within the core business strategies of most companies in the next decade.

Worker Safety

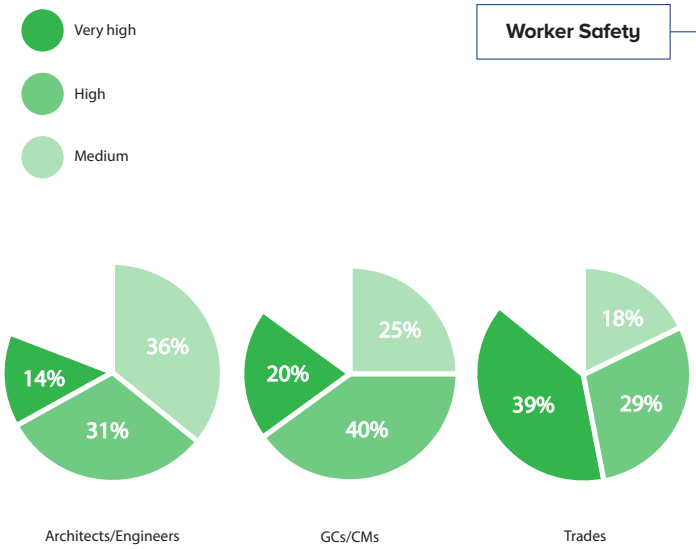
In 2020, the latest year construction safety data is available, the construction industry accounted for about one in five workplace deaths (1,009 of the 4,764 total). Of those one thousand construction industry deaths, over one third are attributable to fall hazards. *(Source: bls.gov)*

Modular construction has demonstrated the ability to provide a safer environment for the construction workforce. By shifting as much as 80 percent of the building construction to an off-site, factory-controlled setting, workers have a much more predictable and consistent work atmosphere. Additionally, the ability to construct multi-story buildings in modules while remaining on the ground floor of a factory virtually eliminates hazards associated with falls, potentially saving hundreds of lives annually.

The 2020 Dodge Smart Market Report addressed the issue of workplace safety, and their research findings support MBI's position. Of the 203 responses received regarding safety, only five percent of architects, engineers, and contractors indicated that the use of modular construction had no demonstrated safety benefits, while 89 percent indicated it did (six percent unsure).

Of the forty-eight general contractors responding, only eight percent said that modular construction had no impact on improving safety, while 69 percent said it had a high or very high impact.

The results are even more dramatic among large contractors with revenues over $100 million annually. Among the eighteen contractors in that subset, half said that modular construction had a "very high" impact on safety. A full 100 percent of these respondents said that modular construction had a medium (11 percent) high (39 percent), or very high (50 percent) impact on worker safety.



Impact of Modular Construction on Improved Safety Performance

(Percentages Reporting Medium, High, or Very High Contribution)

Dodge Data & Analytics, 2020

SECTION 3

DESIGN Considerations

BEST PRACTICES FOR ARCHITECTS

Seattle South Lake Union Hotel (exterior)
Built by Polcom Modular, a division of Volumetric Building Companies
First Place, Permanent Modular Hotel
Over 10,000 Sq. Ft.

Seattle South Lake Union Hotel (interior)
Built by Polcom Modular, a division of Volumetric Building Companies
First Place, Permanent Modular Hotel Over 10,000 Sq. Ft.

Design for Modular Manufacturing

In 2019, MBI worked with the American Institute of Architects to help develop a new guideline called "Modular and Off-Site Construction Guide." This Guide serves as a primer on the modular approach for architects and includes:

Value and opportunities of modular design

Pitfalls designers should be wary of

Case studies that exemplify successes and obstacles

The document can be downloaded for free at:
https://www.aia.org/resources/6119840-modular-and-off-site-construction-guide

Architect's Role

In general, the architect's role in a construction project is critical to its overall success. The decision to utilize modular construction should be made prior to design and should factor in the following considerations:

- Three-dimensional modules have widths that are typically nominal eight, 10, 12, 14, and 16 feet, with 12 and 14 feet being the most common. Framing dimensions are typically two inches less than nominal size.
- Module lengths are up to seventy feet, usually in two feet increments.
- Module heights vary from approximately eleven feet, six inches to thirteen feet, not including the height of the unit's transport trailer or frame.
- Wood-frame construction is the most common type of construction; however, manufacturers also build with steel and concrete and can meet the requirements for Type-I, -II, and -III construction
- Multi-story modular buildings can be built up to the maximum stories allowed by code. While most modular buildings are one- to four-stories, a growing number of projects have exceeded 10-stories in recent years, including a 32-story project in New York.
- Restroom areas should be designed so that a module "marriage line" does not split the space.
- Multiple roof-framing styles are available. Some can be completed in the factory, and some may require the installation of trusses on-site.
- Modular buildings can be configured using modules of various lengths and widths.
- Design elements need to be decided earlier in the process (paint color, for example) as the off-site construction process begins and is completed more quickly.

(Excerpts taken from MBI's Modular Advantage *magazine: May/June 2021)*

The Pitch (exterior)
Built by Falcon Structures
First Place, Permanent Modular Retail

BEST PRACTICES FOR DESIGN OF MODULAR PROJECT

Once the scope of the project is understood, Eric Parnell says it is important to understand any and all codes and/or ordinances that need to be followed. "Local codes and ordinances are another area to research and pre-plan to comply or work with local authorities to ensure a smooth project. Local codes and ordinances can vary wildly by different jurisdictions and can include setback restrictions, location of occupancy restrictions, exterior finish requirements, and even an outright ban on modular construction (as discussed earlier). To avoid endless delays and issues, a meeting with local authorities to discuss the plans and to show that a custom modular does not resemble a 'traditional portable building' can ensure the process can move forward before being offered to a client."

Eric Parnell, *architect and founder, ArchBoutant LLC*

Once it is time for to begin construction, Nick Gomez underscores the need for a finalized design. "It is essential to establish a design freeze using a modular construction approach because of the factory production schedule and process. Design changes late in the process can be costly and require permit drawings modification and impact factory shop drawings. Unlike traditional construction processes, up-front decision-making and design freezes are critical for the modular construction processes, leaving little time in the schedule for alterations."

Nick Gomez, *Studio Director, Multi-Family Housing, Lowney Architecture*

Richmond Great Point Development LLC, Meadows II - Phase 1 (exterior)
Built by Signature Building Systems of PA & The Richmond Company, Inc.
First Place, Permanent Modular Multifamily Over 75,000 Sq. Ft.

During the construction phase, Kendra Halliwell recommends spending time at the factory to ensure compliance and to see the process firsthand. "The Architect/Engineers of Record and contractor/installers on site are ultimately responsible for closeout and affidavits. Our General Contractor maintained oversight of the boxes in the factory during construction, with observation from the representative of the state review board. The mechanical contractors also visited the factory, so they were aware of exactly what was coming to the site. Additionally, visiting the factory allowed the team to see the benefits of modular construction firsthand: construction jobs are created in a safe, controlled work environment, with less waste and no exposure to weather."

Kendra Halliwell, AIA, LEED-H AP, *Associate Principal, Practice + Design Team Leader, ICON Architecture.*

SECTION 4

BEST PRACTICES
for Owners & Developers

Duffin Cove Oceanfront Lodging (exterior)
Built by Nomodic Modular Structures Inc. & Muchalat Group
First Place, Permanent Modular Hotel Under 10,000 Sq. Ft.

Recent research conducted by Jin Ouk Choi, S.M.ASCE, et.al titled "Critical Success Factors and Enablers for Optimum and Maximum Industrial Modularization" identified twenty-one of the most influential critical success factors (CSFs) to better enable modularization. Among the most influential factors relative to the owner's role:

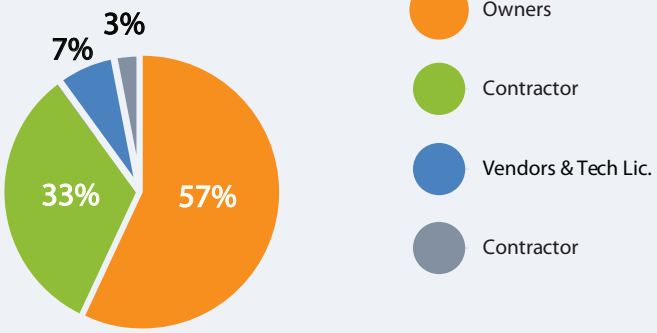
- **Alignment on Drivers:** Owner, consultants, and critical stakeholders should be aligned on important project drivers as early as possible in order to establish the foundation for a modular approach.
- **Owner's Planning Resources & Processes:** As a potentially viable option to

The Center for Well-Being, University of Maryland, Baltimore County (exterior)
Built by MODLOGIQ & Whiting-Turner
First Place, Permanent Modular Healthcare Over 10,000 Sq. Ft.

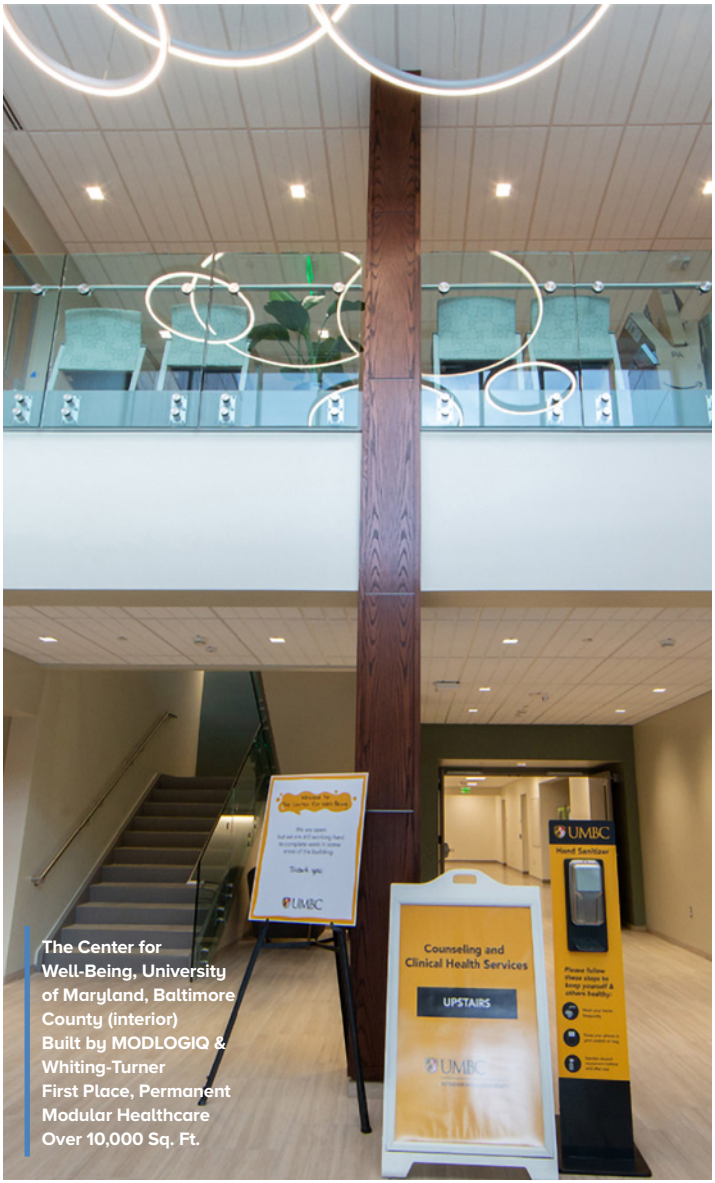
Critical Success Factors by Responsible/Lead Party

Jin Ouk Choi, S.M.ASCE, et. al. J. Constr. Eng. Manage., 2014, 140(6): 04014012

The critical success factors identified by Dr. Choi were analyzed for the best timing of deployment by project phase and to identify the best responsible or lead party. This chart illustrates the findings from these analyses. Who is responsible for seeing that CSFs are fully addressed? The project owner primarily, with the contractors being secondary. As for timing, to facilitate successful modularization, significant owner involvement is clearly needed early on.



The Center for Well-Being, University of Maryland, Baltimore County (interior)
Built by MODLOGIQ & Whiting-Turner
First Place, Permanent Modular Healthcare
Over 10,000 Sq. Ft.



The Center for Well-Being, University of Maryland, Baltimore County (interior)
Built by MODLOGIQ & Whiting-Turner
First Place, Permanent Modular Healthcare
Over 10,000 Sq. Ft.

conventional stick building, early modular feasibility analysis is supported by owner's front-end planning and decision support systems, work processes, and team resources support. Owner comfort zones are not limited to the stick-built approach.

- **Timely Design Freeze:** Owner and contractor are disciplined enough to effectively implement timely staged design freezes so that modularization can proceed as planned.

- **Early Completion Recognition:** Modularization business cases should recognize and incorporate the economic benefits from early project completion that result from modularization and those resulting from minimal site presence and reduction of risk of schedule overrun.

- **Cost Savings Recognition:** Modularization business case should incorporate all cost savings that can accrue from the modular approach. Project teams should avoid the knee-jerk misperception that modularization always has a net cost increase.

- **Data for Optimization:** Owner and Pre-FEED/FEED contractor(s) need to have management tools/data to determine the optimal extent of modularization, i.e., maximum net present value (NPV) (that considers early revenue streams) versus percent modularization.

New Contract Eases Use for Prefab and Modular Buildings

The ConsensusDocs Coalition has just published the industry's first standard contract document to address one of the most important and growing trends in the design and construction industry – prefabricated construction. ConsensusDocs has been working for two years with industry leaders to offer a standard prefabricated construction contract document. The Modular Building Institute (MBI) recently joined the ConsensusDocs Council as result of the successful work conducted by the working group. The new ConsensusDocs 753 Standard Prefabricated Construction Contract addresses the most common use case scenario of prefabricated construction in which a constructor, general contractor, design-builder, or Construction Manager contracts with a prefabricator to fabricate a component off-site that is later installed on a project worksite.

While prefabricated construction or modular buildings have been around for decades, important contractual and legal issues have remained unaddressed in most construction contracts. Finally, with ConsensusDocs leadership, there is now an off-the-shelf solution that defines important new industry definitions and scenarios that are unique to prefabricated construction. Using a typical construction subcontract or purchase order for prefabricated construction is dangerous.

"As someone who often represents General Contractors and Prefabricators, I have written several custom agreements to address the unique risk presented by modular building and prefabricated construction generally," comments Ron Ciotti, a partner at Hinkley Allen and chair of the ConsensusDocs Prefab Working group. "The new ConsensusDocs Prefabricated construction contract advances the understanding and risk allocation desperately needed because prefabricated construction is revolutionizing the way construction will occur in a post pandemic construction world."

ConsensusDocs Executive Director and Senior Counsel Brian Perlberg comments, "This is one of the most anticipated contracts in ConsensusDocs history because there is a glaring need to address the growing trend of prefabricated construction or modular building, and current contracting practices simply do not cut it."

SECTION 5

Key North American MARKETS

Permanent modular buildings are considered real property, built to the same building codes and requirements as site-built structures, and can be financed, sold, and depreciated in a similar manner. As such, the markets for permanent modular construction are like the markets for site-built contractors, with few exceptions.

MBI analyzed 45 U.S.-based projects and ten Canadian projects completed over the past two years in the following markets: Multifamily (18), Education (9), Institutional and Assembly (8), Office (7), Retail (6), Healthcare (4), and Hospitality (3).

Twenty-six projects were steel frame while 29 were wood frame. Forty-eight of these projects were 1-4 stories, while seven were 5-11 stories.

The projects were on average 26,378 square feet and took a total of 309 days to complete at an average total cost of $9,012,900. At just over an average of $300/sq. ft., the cost seems high in terms of national averages. However, twenty-two of the projects were from the higher cost areas of California and British Columbia.

Sixteen of these projects utilized the design-bid-build procurement process, while nine used design-build, one CM at-risk, and one public private partnership (PPP). The remaining projects did not identify a delivery method.

LifeMoves Mountain View (exterior)
Built by UrbanBloc Inc., Falcon Structures, Connect Homes & Indie Dwell
Honorable Mention, Permanent Modular Dormitory Over 10,000 Sq. Ft.

LifeMoves Mountain View (rendering)
Built by UrbanBloc Inc., Falcon Structures, Connect Homes & Indie Dwell
Honorable Mention, Permanent Modular Dormitory Over 10,000 Sq. Ft.

Across all markets and regions, the modular portion of the total cost averaged 42.5 percent, significantly lower than the 55 percent used in prior MBI reports.

Office and Administrative

Permanent modular buildings serve as corporate headquarters, satellite offices, institutional and administrative buildings, and offices for all business types. Modern single- and multi-story buildings can be configured in several ways to include independent offices, conference rooms, elegant lobbies, kitchens, restrooms, and large open spaces for cubicles or other partition systems.

MBI members have architectural and engineering designs for workspace planning, storm water management, landscaping, parking, and zoned heating and air conditioning. If it is time to capitalize on company growth, modular construction offers a fast, economical approach. The business and office market historically represents one the largest building sectors for the industry. In 2020, manufacturers reported that 25.8 percent of all production was in the office and administrative market, the highest among all markets reported. For 2021, this figured dropped to 16.5 percent of total production.

MBI obtained data and analyzed information on an additional thirteen projects completed in 2019 and 2020. The average size of these projects was smaller than the prior averages, at 9,882 sq. ft., consisting of an average of 16 modules each. These projects took on average 202 days to complete from approval to occupancy.

MBI also reviewed seven additional office projects completed in 2021. These projects were 18,678 sq. ft. on average, consisting of twenty-seven modules and took an average of 269 days to complete.

Multi-Family Housing

Federal, state, and local governments around the world are struggling with policies to help address the growing housing crisis. Modular construction offers the ability to provide condominiums, apartments, and student dorms in about half the time as traditional, site-built construction methods.

In fact, the multifamily market is now the largest and fastest growing segment of the industry, from seven percent of industry production in 2019 to nearly 23 percent in 2021. Twenty-seven companies reported building for the multifamily market in 2021, with nine indicating that multifamily production constituted ninety percent more of total output. For context, no other market had more than three companies with such a concentration. (retail).

MBI analyzed eighteen multifamily projects completed in 2021 in the U.S. and Canada. Seven of these projects were steel frame while eleven were wood based. These projects on average were 50,815 sq. ft. and between three and four stories tall. The projects consisted of 88 modules and took 382 days to complete. The average total project size was $14,789,149 for an average cost per square foot of $291.03.

Many factors determine the total cost per square foot including location, labor availability and cost, design considerations and finishes, and the construction teams' experience working together. Seven of the projects above were based in California, five were in British Columbia, and one was in New York, generally some of the more costly markets to build.

Education

From single classrooms to complete campuses, modular construction offers public, private, and charter schools what other construction methods cannot: accelerated project timelines, more economical pricing, and less site disruption. Permanent modular schools are indistinguishable from other schools and can be constructed to any architectural and customer specifications. MBI members design and build schools of all types and sizes using traditional building materials such as wood, steel, and concrete.

Coast Community Health (exterior)
Built by Modern Building Systems, Inc.
First Place, Permanent Modular
Healthcare Under 10,000 Sq. Ft.

Virtually any size permanent school can be built, installed, and ready for occupancy in as little as 90 days. Perhaps most importantly, using off-site technology, open construction sites are eliminated while school is in session. Students are safer, and teachers do not have to compete with noises and construction-related disruptions.

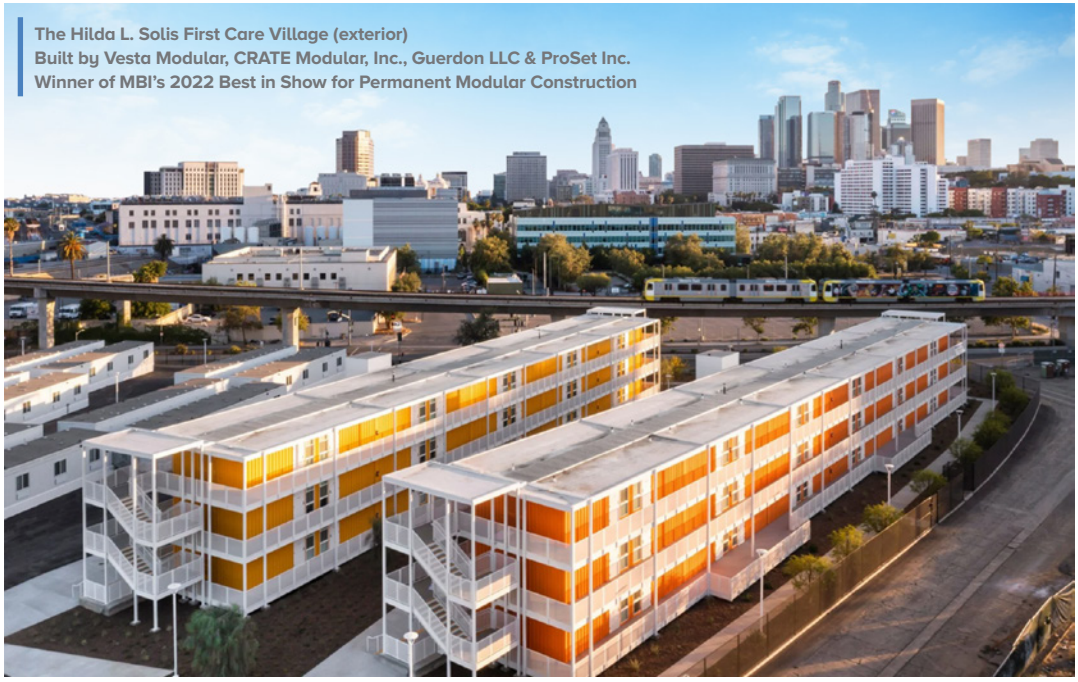
MBI also reviewed a total of nine permanent educational projects completed in 2021. The average size of these projects was 10,655, down from 14,197 sq. ft. the prior year.

All of the projects were one or two stories and on average consisted of 22 modules and were completed in 247 days, ranging from a low of 53 days to a high of 486 days. Based on seven educational projects, the average total cost was $287 per sq. ft. with the modular portion of the cost making up approximately 56 percent of the total cost. Given the limited number of projects available with cost data for 2021, we caution against using this figure as a benchmark.

Institutional & Assembly

This market includes police and fire stations, prisons, security, facilities for industrial complexes, and workforce housing, as well as facilities used for assembly, such as churches. Combined, this market accounts for 8.1 percent of all reported manufacturing production in 2020. This analysis does not include relocatable workforce housing projects, common in more remote areas with natural resources extraction. *(See MBI's Relocatable Buildings Report).*

MBI obtained data on seven projects completed in 2021, at an average project size of just 1,319 sq. ft. Many of these projects were single modules and all were one story. On average these projects took 190 days to complete with



The Hilda L. Solis First Care Village (exterior)
Built by Vesta Modular, CRATE Modular, Inc., Guerdon LLC & ProSet Inc.
Winner of MBI's 2022 Best in Show for Permanent Modular Construction

an average cost per project of $510,671. Many of these projects were smaller and highly customized, resulting in a higher cost per square foot of $387 on average.

Healthcare

Now more than ever, many hospitals and healthcare facilities are turning to modular construction solutions for quiet, safe, and clean applications for medical, surgical, clinical, and dental use. The global pandemic and other natural disasters have highlighted the need for quick and safe medical facilities. Modular construction also results in much less on-site disturbance during the construction phase.

Healthcare facilities made up only 5 percent of all new construction starts, clearly indicating that not all modular manufacturers have the experience or desire to enter this market. Additionally, healthcare projects tend to be steel framed and a vast majority of manufacturers in North America still build with wood.

MBI reviewed ten healthcare projects completed between 2019 and 2021. The average size of these projects was 13,413 sq. ft. and took 312 days to complete from approval to occupancy.

Commercial & Retail

Simply put, quicker occupancy equals quicker return on investment. Modular construction is accelerated construction. Why is this important to banks, restaurants, convenience stores, childcare centers, and other retail establishments? Because earlier occupancy means a customer generates revenue faster. In fact, it is not uncommon for many modular buildings to be up and running within a week—an important consideration for retailers of all types.

Typical retail applications include restaurants and diners, banks, golf pro shops, convenience stores, gas stations, car washes, and concession stands to name a few. MBI contractors provide a full array of services including site, mechanical, and electrical work. Customers can accommodate their emerging business with modular buildings customized to their financial needs, space requirements, and deadlines.

MBI obtained data for six retail projects completed in 2021 with an average size of 3,139 sq. ft., comprised of one or two modules per project. The average total cost of these projects was $817,394. These projects were completed on average in 190 days. Given the small sample size and cost variables (location, labor, level of customization) a cost per square foot average is not a reliable benchmark for this market.

Hospitality/Hotels

A shorter construction schedule means quicker occupancy for owners, and that means guests checking in months earlier than with conventional construction methods. It should come as no surprise that companies like Marriott Corporation, Citizen M, and Hilton have made modular construction part of their strategic plan. This market, perhaps more than others, suffered during the pandemic as new projects were delayed or put on hold.

As with the multifamily market, a big incentive for utilizing modular construction in this market is the shorter construction schedule which leads to quicker occupancy and quicker return on investment. Across the board, owners are indicating that the modular process results in their hotels opening four to eight months earlier than if site built.

SECTION 6

FINANCIAL Data

McFadden Intermediate School (exterior)
Built by Silver Creek Industries
First Place, Permanent Modular Education Under 10,000 Sq. Ft.

Overview

MBI obtained 2021 data from 88 of its North American manufacturer members. Not all manufacturers provided all the data we requested. Nonetheless, this information represents the most comprehensive data available and the best source of information on the North American modular construction industry.

Factory Output

Based on data obtained from 65 manufacturers, the average company produced 180,972 sq. ft. of "product" in 2021. The output was reported in the following markets:

- Office & Administrative = 16.5%
- Multifamily = 22.9%
- Education = 14.5%
- Institutional & Assembly = 19.9% (prisons, industrial, workforce housing, churches, fire, and police stations)
- Retail = 11.4%
- Healthcare = 5.1%
- Other = 9.7% (hospitality, datacenters, equipment shelters, bathroom pods)

Revenue & Market Share

This report provides estimates of PMC market share from 2015 to 2021 for markets that frequently utilize PMC techniques.

In estimating the overall North American market share for commercial modular construction, it is necessary to make a series of calculations and adjustments to compare to a baseline figure more accurately.

MBI uses data from Construct Connect Insights as its baseline measurement for new construction starts in the key markets previously mentioned. MBI obtains revenue and production data from its manufacturer base to determine the average (mean) revenue per manufacturer. That number is then multiplied by the total number of North American manufacturers engaged (or partially engaged) in PMC projects.

McFadden Intermediate School (interior)
Built by Silver Creek Industries
First Place, Permanent Modular Education Under 10,000 Sq. Ft.

The industry's revenue survey generated fifty-five responses from manufacturers, with the overall modular building industry estimated to encompass 252 firms. For the average building project using PMC technologies, the modular construction team supplied approximately 42.5 percent of the total value of the project put in place in 2021. This was determined by reviewing 55 PMC projects completed in 2021 across all markets and geographies. Consequently, to obtain the value of projects using PMC, these revenues have been multiplied by the ratio 1/0.425.

For 2021, MBI collected revenue data from manufacturers engaged in PMC in North America, totaling $1,042,657,015. The average revenue of these manufacturers was $17,377,617 about equal to the average of $17,844,411 in 2020.

When scaled by 1/0.425 and multiplied by the total number of industry participants, the total value of modular building construction projects for 2021 can be estimated at $10,303,904,619 up from 2020. As a result, the modular industry increased its market share to 5.52 percent of new starts.

Disclaimers:
In preparing this report, there are numerous variables, adjustments, and calculations that are necessary to arrive at the final numbers.

Not all the 252 firms engaged in commercial permanent modular construction in North America are exclusively serving the commercial sector. Several also manufacture single-family residential modules or relocatable (temporary) products.

Another challenge is that some manufacturers are engaged in three-dimensional volumetric modular construction while others are primarily

PMC Market Shares, 2015-2021

Year	PMC Firm Revenue	Value of PMC Projects (divide by .55)	Construction Start Value	Annual PMC Market Share
2015	$2,040,500	$3,710,000	$173,729,905	2.14%
2016	$3,301,664	$6,003,025	$244,509,444	2.46%
2017	$3,979,680	$7,235,782	$246,089,662	2.94%
2018	$4,943,067	$8,987,396	$243,316,997	3.69%
2019	$5,025,355	$9,137,010	$255,013,842	3.58%
2020	$4,496,791	$8,175,984	$186,315,485	4.39%
2021	$4,379,159	$10,303,904	$186,653,947	5.52%

(US $000s) • Source: Modular Building Institute, Construct Connect

two-dimensional panelized factories, making comparisons and calculations difficult.

MBI is also aware of multiple PMC projects that were fabricated by companies outside North America and incorporated into projects here. While the value of these projects is most likely captured in the overall new construction starts (baseline measurement), MBI did not attempt to include this production and revenue data for purposes of this report. MBI included only revenue and production data from North American manufacturers.

Using the averages provided by the MBI survey and manufacturers input of data, it is possible to estimate certain information about the industry as a whole. The calculated information is reliable only to the extent the data provided by the industry participants is accurate. Nonetheless, MBI's data comes directly from its modular manufacturer members and represents the most comprehensive and accurate industry information available in North America.

To what code are modular buildings constructed?

It is helpful to think of "modular" as a construction process rather than a building type. A modularly constructed building simply means that the materials were delivered to an off-site location (the modular manufacturing facility), assembled into components or three-dimensional building modules, then transported to the final site for assembly. As such a building constructed in this manner must still meet all the same building codes and requirements as if it were built on-site. This is most commonly a version of the International Building Code (IBC) in the U.S. or the National Building Code (NBC) in Canada.

Do the buildings last as long as site-built? Same quality?

A building constructed using modular methods will last as long, if not longer than, a traditional site-built structure. Again, the building is constructed to the same building codes and must meet the same wind, snow, and seismic conditions. While there is limited research to prove this point, one such study does exist. Following Hurricane Andrew in 1992, FEMA commissioned a study called "Building Performance: Hurricane Andrew in Florida" comparing site-built, modular, and manufactured housing. In that report, FEMA found "Overall, relatively minimal structural damage was noted in wood-framed modular housing developments. The module-to-module combination of the units appears to have provided an inherently rigid system that performed much better than conventional residential framing."

Is modular construction cheaper/less expensive?

Generally speaking, yes. There are a lot of variables with a modular project, just as there are with a conventional construction project. The availability and cost of on-site labor is a key factor. In larger urban areas where labor is scarce and/or more expensive, shifting construction to an off-site (often rural) location can yield significant cost savings. Additionally, the overall efficiency of the process can lead to cost savings. Fewer labor hours are needed to complete a comparable project and waste is significantly reduced. The shortened construction schedule can reduce the time needed for a construction loan and can dramatically advance the occupancy date, critical considerations for revenue-generating businesses such as hotels and fast-food restaurants.

McGraw-Hill published a Smart Market Report titled "Prefabrication and Modularization: Increasing Productivity in the Construction Industry." Through an internet survey of hundreds of AEC professionals, the report found: "Sixty-five percent report that project budgets were decreased—41 percent by 6 percent or more."

Perhaps as significant as the cost reduction is the cost certainty with modular projects. Early communication and integration of the entire construction team leads to fewer change orders and a more predictable budget.

Isn't this a new, untested method for construction?

Far from it! A report from 1670 indicates a prefabricated building was shipped by boat from England to the United States. In the 1800s, demand for modular housing increased as the country expanded westward. During the Gold Rush of 1849, more than five hundred preassembled homes were shipped from factories in New York to destinations in California.

In the 1920s, Sam Kullman began manufacturing the popular "Kullman Diners" along the northeast coast.

In 1933, the first of Franklin Roosevelt's New Deal communities, Arthurdale, West Virginia, was established. All types of modular structures were shipped there: post offices, stores, homes, and schools. After World War II, modular construction offered fast and low-cost homes to returning servicemen.

In the 1940s, the industry began to expand into commercial projects with the founding of industry giants Williams Scotsman (now WillScot), and ATCO in Alberta.

In 1969, Zachry Construction utilized modular construction techniques to complete a 21-story modular hotel on the Riverwalk in San Antonio. The hotel, still in operation, was the tallest modular building in North America until the recent completion of the 32-story Pacific Park building in Brooklyn, New York.

Disney Corporation followed with completion of its Contemporary and Polynesian Resorts in 1972, constructed by U.S. Steel. There is a long history of innovative companies successfully utilizing modular construction techniques.

I have heard about "pop-up" or project specific manufacturing plants. Is that the same as a modular factory?

The modular factories detailed in this report are not project specific plants. Rather the companies build for several clients within a given geographic region (typically about a 500-mile radius from the factory). MBI has seen some examples of general contractors renting vacant warehouses near larger project sites and using these "pop-up" factories for some preassembly work and for materials staging and coordination. These are not automated plants and often do not incorporate assembly-line processes or lean manufacturing techniques. Rather these locations are often just an extension of the existing job site.

Do prevailing wages apply for work done in a modular factory?

No. Davis-Bacon rates and state prevailing wages laws typically are limited to the work performed "at the site." By definition, work done in a modular factory is "off-site." That said, there are many considerations and nuances to understand about the applicability of prevailing wages. Often state laws vary on this subject, so when in doubt, seek a legal opinion. Also, if a factory is established for a specific project and intended to only serve that project (see the pop-up example above), it will be considered an extension of the jobsite and prevailing wages will likely apply.

So, why hasn't it caught on before now? Why the sudden interest?

Until recently, developers and contractors seemed content with the status quo, regardless of the inherent and understood inefficiencies. Planning and preparing for those inefficiencies seemed easier than learning a different way of building for many.

Today, developers and owners are facing the "perfect storm" in the construction sector, including:

- A widely recognized skilled labor shortage that will not get better anytime soon.
- High housing costs and low housing availability in urban areas, a condition that is worsening.
- A widely documented lack of productivity in construction; and, as previously mentioned.

- The increasing need for shorter construction schedules.

Adding to those factors, the construction industry has more fully embraced innovations and technologies that are leading towards more of an "industrialized construction process."

More environmentally conscious customers are demanding greater accountability regarding wasted resources and the massive amount of construction debris that ends up in landfills annually. Modular construction is a proven solution to reduce construction waste.

Where is the industry headed? What other trends do you anticipate? Will this interest lead to greater adoption of modular construction?

If history is any indication, we will see a significant shift towards modular and off-site construction techniques over the next five years as greater numbers of the skilled labor force retire. The construction industry will (and must) evolve into a more industrialized and

automated process – it is just inevitable. Every major industry has undergone this same transformation. The construction industry is the last holdout while clinging to a lost cause. The companies that build modular now and build it into their strategic plans will be more successful sooner.

In North America, the movement has begun. We are seeing some large general contractors and developers establish their own modular divisions, while others partner with existing modular manufacturers.

How many square feet does the typical manufacturer produce in a year?

This is where the averages can be misleading. The number of modules a particular manufacturer produces each year depends on a few factors such as the type of project the company is building, the level of customization involved in the project, and the scope of the manufacturer's contract (i.e., whether the customer wanted certain work to be completed on-site). Based on overall data obtained from seventy-six manufacturers in the U.S. and Canada, the average square footage produced in 2020 was 202,496.

Where can I learn more about modular construction?

The Modular Building institute's website, www.modular.org is loaded with case studies, research, articles, and links to companies in your area.

DEFINITIONS

MBI adopted the definitions contained in the ICC/ANSI standard 1200 and 1205 for consistency. Sources for other terms not used in the standard include state administrative programs as well as the National Institute for Building Sciences.

Accessory Dwelling Unit (ADU). A smaller, independent residential dwelling unit located on the same lot as a stand-alone (i.e., detached) single-family home. (Source: American Planning Association).

Authority Having Jurisdiction (AHJ). Organization, political subdivision, office, or individual charged with the responsibility of administering and enforcing the provisions of the applicable building code. The authority having jurisdiction shall include a state agency or local building department.

Building Envelope. The physical separator between the interior and the exterior environments of a building. It serves as the outer shell to help maintain the indoor environment (together with the mechanical conditioning systems) and facilitate its climate control. Building envelope design is a specialized area of architectural and engineering practice that draws from all areas of building science and indoor climate control.

Building Site. A lot, the entire tract, subdivision, or parcel of land on which industrialized housing or buildings are sited.

Building System. The design and/or method of assembly of modules or modular components represented in the plans, specifications, and other documentation which may include structural, electrical, mechanical, plumbing, fire protection, and other systems affecting health and safety.

Certification Label. A decal, insignia, or alteration decal.

Closed Construction. A building, component, assembly, subassembly, or system manufactured in such a manner that all portions cannot be readily inspected at the installation site without disassembly or destruction thereof.

Commercial Structure. An industrialized building classified by the building codes for occupancy and use groups other than residential for one or more families.

Compliance (or Quality) Control Program. The manufacturer's system, documentation, and methods of assuring that industrialized housing, buildings, and modular components, including their manufacture, storage, handling, and transportation conform with this chapter.

Compliance Assurance Program. Procedures that state the guiding principles and define the framework for ensuring that construction documents approved by a design review agency, or that modular buildings inspected by a third-party inspection agency, comply with the applicable building codes.

Component. A subassembly, subsystem, or combination of elements for use as a part of a building system or part of a modular component that is not structurally independent, but may be part of structural, plumbing, mechanical, electrical, fire protection, or other systems affecting life safety.

Data Plate. A plate attached by the manufacturer or installer, to a modular building, or modular component that contains identifying information allowing code officials or end users to determine if the structure is suitable for installation in their jurisdiction, location, or project.

Decal. The approved form of certification issued by the authority having jurisdiction, to be permanently attached to the modular building, modular component or panelized system indicating that it has been constructed to meet or exceed the applicable building code requirements.

Deconstruction. The process of taking a building or structure, or portion thereof, apart with the intent of repurposing, reusing, recycling, or salvaging as many of the materials, products, components, assemblies, or modules as possible.

Design Package. The aggregate of all plans, designs, specifications, and documentation required by these sections to be submitted by the manufacturer to the design review agency or required by the design review agency for compliance review, including the compliance control manual and the on-site construction documentation. Unique or site-specific foundation drawings and special on-site construction details prepared for specific projects are not a part of the design package.

Erection/Installation/Set. The process of blocking, leveling, and anchoring a modular building unit on the building site upon delivery.

Industrialized Building. A commercial structure that is constructed in one or more modules, or constructed using one or more modular components, built at a location other that the commercial site and is designed to be used as a commercial building when the module or modular component is transported to the commercial site and erected or installed.

Industrialized Housing. A residential structure that is designed for the occupancy of one or more families, is constructed in one or more modules, or constructed using one or more modular components, built at a location other that the permanent site and is designed to be used as a permanent residential structure when the module or modular component is transported to the permanent site and erected or installed on a permanent foundation system.

Insignia. The approved form of certification issued by the authority having jurisdiction to the manufacturer to be attached to the modular building, modular component or panelized system indicating that it has been constructed to meet or exceed the applicable building code requirements.

Manufacturer. The entity responsible for the manufacturing of assemblies, panelized systems, modular buildings, or modular components.

Manufacturing Plant. The location other than the building site, at which modular buildings, modular components, modules, panels, or tiny houses are assembled or manufactured prior to transport to the final construction site.

Marriage Wall/Cross Over Connections. The joint between the modules in a complex, commonly called a mate-line or mod-line.

Modular Component. A sub-assembly, subsystem, or combination of elements, including panelized systems, building shells or bathroom pods, for use as a part of a modular building that is not structurally independent, but is a part of structural, plumbing, mechanical, electrical, fire protection, or other systems affecting life safety.

Off-Site Construction. The planning, design, fabrication, and assembly of building elements at a location other than their final installed location to support the rapid and efficient construction of a permanent structure. Such building elements may be prefabricated at a different location and transported to the site or prefabricated on the construction site and then transported to their final location. Off-site construction is characterized by an integrated planning and supply chain optimization strategy (source: National Institute of Building Science).

Open Construction. A modular building, modular component, panelized system, or tiny house manufactured in such a manner that all portions can be readily inspected at the building site without disassembly, damage, or destruction thereof.

Permanent Modular Construction (PMC). An innovative, sustainable construction delivery method utilizing off-site, lean manufacturing techniques to prefabricate single or multi-story whole building solutions in deliverable module sections. PMC buildings are manufactured in a safe, controlled setting and can be constructed of wood, steel, or concrete. PMC modules can be integrated into site-built projects or stand alone as a turnkey solution, and can be delivered with MEP, fixtures, and interior finishes in less time, with less waste and higher quality control compared to projects utilizing only traditional site construction.

Prefabricated. The manufacture or fabrication of sections of a building at an off-site location which are delivered to and assembled at the building site.

Quality Control. Controls and inspections implemented by the manufacturer, as applicable, to ensure the material provided and work performed meet the requirements of the approved construction documents and referenced standards applicable building codes.

Registered Design Professional. An individual who is registered or licensed to practice their design profession as defined by the statutory requirements of the professional registration laws of the state or jurisdiction in which the project is to be constructed.

Relocatable/Industrialized Building. A partially or completely assembled building that complies with applicable codes and state regulations and is constructed in a building manufacturing facility using a modular construction process. Relocatable modular buildings are designed to be reused or repurposed multiple times and transported to different sites.

Site or Building Site. A lot, the entire tract, subdivision, or parcel of land on which industrialized housing or buildings are sited.

Third-Party Inspector. An approved person determined by applicable statutory requirements to be qualified by reason of experience, demonstrated reliability, and independence of judgment to inspect modular buildings, and portions thereof, for compliance with the construction documents, compliance control program, and applicable building code. A third-party inspector works under the direction of a third-party inspection agency.

Tiny Houses. A dwelling that is designed and constructed in accordance with the IRC with additional requirements as specified in IRC Appendix Q.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