



CONSTRUCTION REVOLUTION

SUMMIT REPORT and
ACTION PLAN FOR MINNESOTA

**A CROSS-SECTOR COLLABORATION TO
REDUCE THE COST OF HOUSING BY CREATING AN
INNOVATION HUB FOR OFFSITE CONSTRUCTION**

JUNE 2020



June 2020

Dear Reader,

In Minnesota, we are not building enough homes to meet our needs. Rents and home prices are unaffordable to many, and we owe it to ourselves to explore all available solutions. Offsite construction could have a major impact by dramatically reducing the cost of residential construction and the time to build new housing.

In 2018, leaders in Minnesota put forth an ambitious set of goals. Among them: to build 300,000 homes by 2030 and to make Minnesota a hub for construction innovation.¹ The Construction Revolution evolved as a response to this mandate—to help achieve these goals by accelerating the use of offsite construction in Minnesota.

This report is based on the findings of the Construction Revolution Summit, a first-of-its-kind event held in September 2019 that brought together more than 150 leaders from all sectors of the construction industry and all parts of the state. At the Summit, participants explored both the benefits of, and obstacles to, offsite construction, led by local and national experts.

Summit participants also contributed to an action-planning workshop, which we refined into the action plan you will find at the end of this report. Leaders in our state have been hard at work since September to complete the first stages and to build momentum for more. We are excited to share this report and action plan, and we look forward to partnering with you to advance this important work.

A handwritten signature in black ink that reads "Mary Fingertal".

On behalf of the Construction Revolution Core Team: Sarah Berke John Patterson
Stephanie Brown Jamie Stolpestad
John Micevych

Contact us at info@constructionrevolution.io and check out our website (ConstructionRevolution.io) for updates and resources.

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A note to our readers:

This report is being published in June 2020, only a few months into the COVID-19 crisis in the United States. It is likely that the offsite construction sector, along with traditional construction, will be impacted by this disruption in ways that are difficult to predict. Still, the fundamental benefits of offsite construction remain, and some may have become even more urgent. Offsite construction can bring projects to market more quickly, use construction materials more efficiently, and more effectively leverage our skilled tradespeople. While the crisis may slow the adoption of these techniques in the near term, we believe that they will be adopted, and will unlock significant benefits in the long term.

Pressures on residential construction continue to grow

Minnesota faces a significant housing shortage - 300,000 homes needed by 2030 - yet the residential construction industry faces major obstacles to meeting that demand:

- Housing costs are rising, driven in part by construction costs
- Construction industry productivity has been nearly stagnant since the 1970s
- 90% of builders report difficulty finding skilled labor, a challenge expected to worsen

Offsite construction: High quality, lower cost, shorter timeline

Offsite construction has long been viewed as a transformative innovation, and there are reasons to believe that its time has come. Around the world, the use of offsite techniques has begun to unlock significant benefits in residential construction: The early benefits appear to be substantial:



20-50% ↓

Schedule compression



20% ↓

Cost savings



Sustainable
design
opportunities









Workforce
development
opportunities



Units on the production floor at the newly-opened Rise Modular factory in Owatonna, MN

Adopting offsite construction in Minnesota will require shifts from all sectors

Offsite construction is an integrated model of production and the transformation to offsite will require shifts from every sector. At the Summit, participants explored key barriers to overcome:

	Current state	Barriers to overcome	Future state
Offsite Manufacturers 	<ul style="list-style-type: none"> Limited presence and capacity in Minnesota, beyond single-family homes 	<ul style="list-style-type: none"> Limited demand for offsite projects in Minnesota 	<ul style="list-style-type: none"> New factories open across the state, boosting the economy and creating jobs
Developers & Contractors 	<ul style="list-style-type: none"> Reliance on traditional construction, with some leaders adopting panelized elements 	<ul style="list-style-type: none"> Limited local experience with more advanced offsite techniques 	<ul style="list-style-type: none"> Growing pipeline of offsite projects, delivered with predictable cost & time savings
Architects & Engineers 	<ul style="list-style-type: none"> Fully customized designs for each project, requiring significant effort on low-value elements 	<ul style="list-style-type: none"> Uncertainty around market acceptance of broader standardization 	<ul style="list-style-type: none"> Focus on highest-value design elements, with full standardization of others
Lenders 	<ul style="list-style-type: none"> Perception of additional risk and conservative processes inhibit lending to offsite projects 	<ul style="list-style-type: none"> Distinct capital timing and security requirements for offsite projects 	<ul style="list-style-type: none"> Offsite projects financed readily through accepted processes and lending products
Local Officials 	<ul style="list-style-type: none"> Perceived local uncertainty around building permits limits confidence 	<ul style="list-style-type: none"> Low familiarity with offsite construction and state regulatory process 	<ul style="list-style-type: none"> Efficient state and local permitting for offsite, enabling widespread adoption
Labor & Workforce 	<ul style="list-style-type: none"> Demand for skilled workers exceeds supply in construction industry 	<ul style="list-style-type: none"> Traditional work roles and conditions limit workforce growth 	<ul style="list-style-type: none"> New offsite careers and training options attract new sources of talent

Next steps for a system-wide revolution

To reduce the cost of housing, the Construction Revolution has set an ambitious vision: **By 2025, 10% of multi-family residential developments in Minnesota will meaningfully use advanced, offsite construction techniques.** At the Summit, participants contributed to an action-planning workshop and identified five cross-sector actions to make this vision a reality:

- 1. Launch multi-sector innovation cohorts** to explore the potential and challenges of offsite construction techniques in actual projects.
- 2. Develop and promote learning opportunities** to highlight Minnesota's progressive building standards and inspections process for offsite construction.
- 3. Foster local collaboration** to develop a fast-track or pre-approval process for projects using offsite concepts.
- 4. Incentivize a series of pilot projects** using offsite construction through a public-private partnership request for proposals.
- 5. Attract new modular manufacturers and investors** to Minnesota through a robust economic development campaign.

Many of these recommendations are already underway. Contact us at info@constructionrevolution.io to get involved, or check out our website ([constructionrevolution.io](https://www.constructionrevolution.io)) for updates and resources.

INSIGHTS FROM THE SUMMIT

Challenges facing residential construction in Minnesota

The following sections describe the keynote speakers at the Summit and the key insights they shared. Stephanie Brown of Yellow House Ideas provided an opening address on the unique dynamics of the housing market in Minnesota, and T.G. Jayanth from McKinsey & Company explored the impact of national and global trends.

Minnesota is experiencing a tight housing market

Housing construction has not kept pace with population growth since the Great Recession, resulting in the lowest statewide rental vacancy rates in two decades.² The Twin Cities region, for example, added 226,000 residents since 2010, but only 63,000 new homes.³

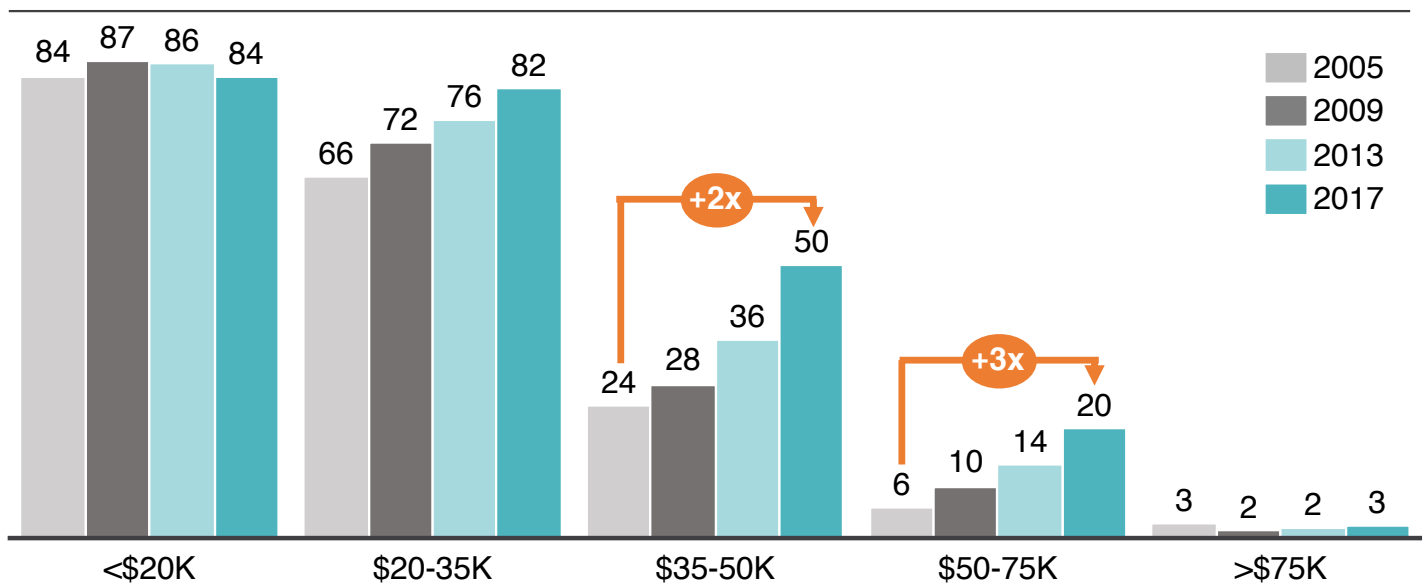
The result has been a spike in housing prices and rents. Compared to 20 years ago, incomes are effectively flat while the real cost to buy a home in Minnesota has gone up by 33%.⁴ According to Greater MSP's Regional Indicators Dashboard, median apartment rents increased 4.8% in 2018 in the Twin Cities metro —twice the rate in the previous year and more than in many peer cities.

One-quarter of families in the state are now cost-burdened, meaning they spend an unsustainable portion of their income on housing.⁵ Exhibit A shows that both low and moderate-income families have been hit by this trend, with the rate of cost burden for families making less than \$35,000 per year rising to over 80% in 2017 and the rate for families making \$35,000 to \$75,000 per year doubling or tripling from 2005 to 2017.⁶

Exhibit A

Largest cost burden increases have been for households with incomes between \$35-75k

% of tenant households that are cost burdened over time by income bracket



Construction costs have risen

Construction costs in major U.S. cities are up nearly 24% since 2004, due in part to a shortage of skilled labor.⁷ During the last decade, many workers left the industry and were not replaced. 90% of Minnesota contractors are now struggling to find the skilled workforce they need.⁸ Compounded by high raw material costs and regulations that constrain the ability to develop land, this labor shortage has driven development firms to focus new construction on the higher end of the market.

Exhibit B

Productivity increases in the United States



The construction industry is ready for disruption

Construction Revolution speakers pointed to the history of the construction sector as evidence of the need for change. Specifically, they pointed out that we still build homes largely the same way we have for the last century. Research from McKinsey & Company shows that construction productivity has been nearly stagnant in the United States since the 1970s, while other industries have achieved major productivity gains.⁹ Gains in other industries from 1940 to 2020 (Exhibit B), notably in manufacturing, indicate that there is a similar opportunity for the construction sector if it can adopt new technology, mass production techniques, and modern materials.

“ The residential construction industry has been on the cusp of revolution for too long. It is time to be bold and take action so that we can expand the housing supply faster and with more affordability for those that need it most.

- **James Lehnhoff**, Assistant Commissioner for Multifamily, Minnesota Housing Finance Agency

Global trends are affecting the construction industry in Minnesota

Three global macroeconomic trends also are affecting residential construction in Minnesota:

- 1. Urbanization:** As people move to cities, the demand for new housing in urban areas is increasing, which is accelerating the demand for materials and labor.
- 2. Infrastructure:** Aging infrastructure will require upgrades in the coming years and create demand for skilled labor that competes with residential construction.
- 3. Sustainability:** Buildings produce nearly half of global greenhouse emissions and new strategies, materials, and approaches are needed to address the climate crisis.

Other parts of the world have responded to these trends by increasing their use of offsite. For example, 45% of residential construction in parts of Scandinavia uses offsite construction, compared with 3% in the United States.

MAKING THE CASE FOR OFFSITE CONSTRUCTION

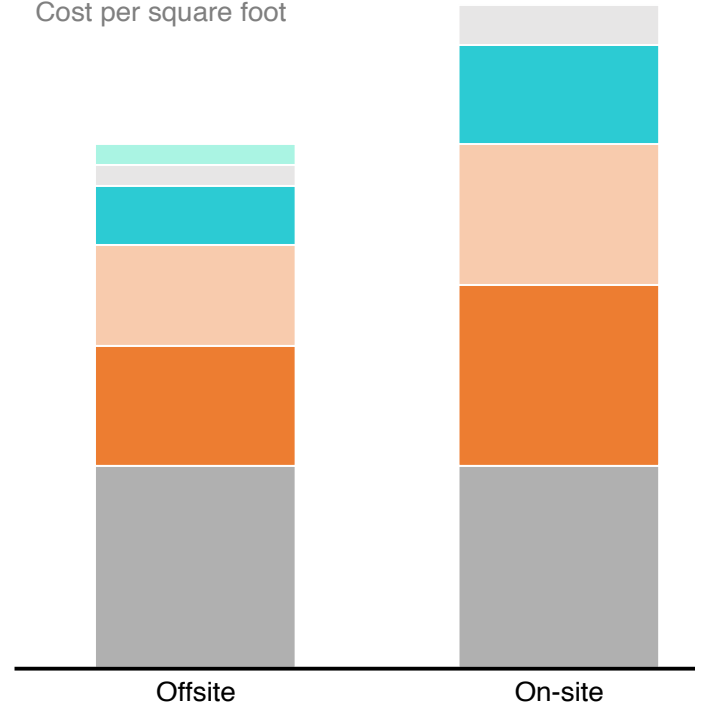
Potential for transformative cost savings

Offsite construction has the potential to unleash transformative cost savings. Research shows the potential for a 20-50% reduction in overall project cost, with early systems demonstrating an average cost savings of 24%.¹⁰ For an average unit in Minnesota, this would create enough savings to make rent levels attainable for an additional 140,000 households.¹¹ In addition, construction waste, which now averages 10-15% percent per project, can also be reduced to less than 5% by designing and building to the clear standards used in offsite construction.¹² The chart to the right (Exhibit C), developed by the Turner Center for Housing Innovation, shows sample savings from a project, consistent with the savings seen in McKinsey & Company’s report and other similar research.¹³

Exhibit C

Sample costs per project

Cost per square foot

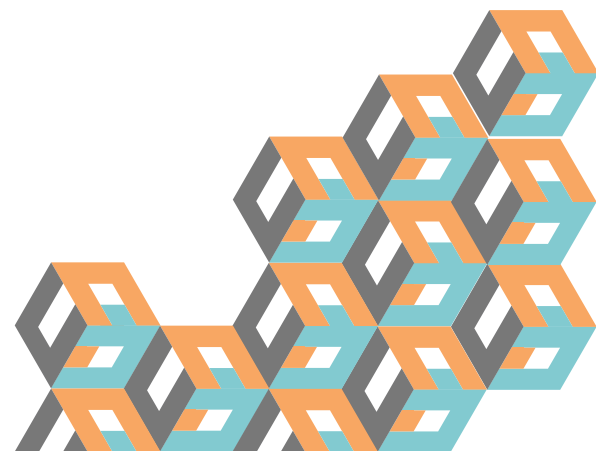


“As national leaders in commercial real estate services, we know that technology will continue to change the way we build, and we believe that offsite fabrication will play an important role in how things change.

- Pat Ryan, Chairman, Ryan Companies

“Supporting growth in the offsite residential construction industry helps to create a future where everyone can live in an affordable, energy efficient home.

- Jeremy Schroeder,
Minneapolis City Council

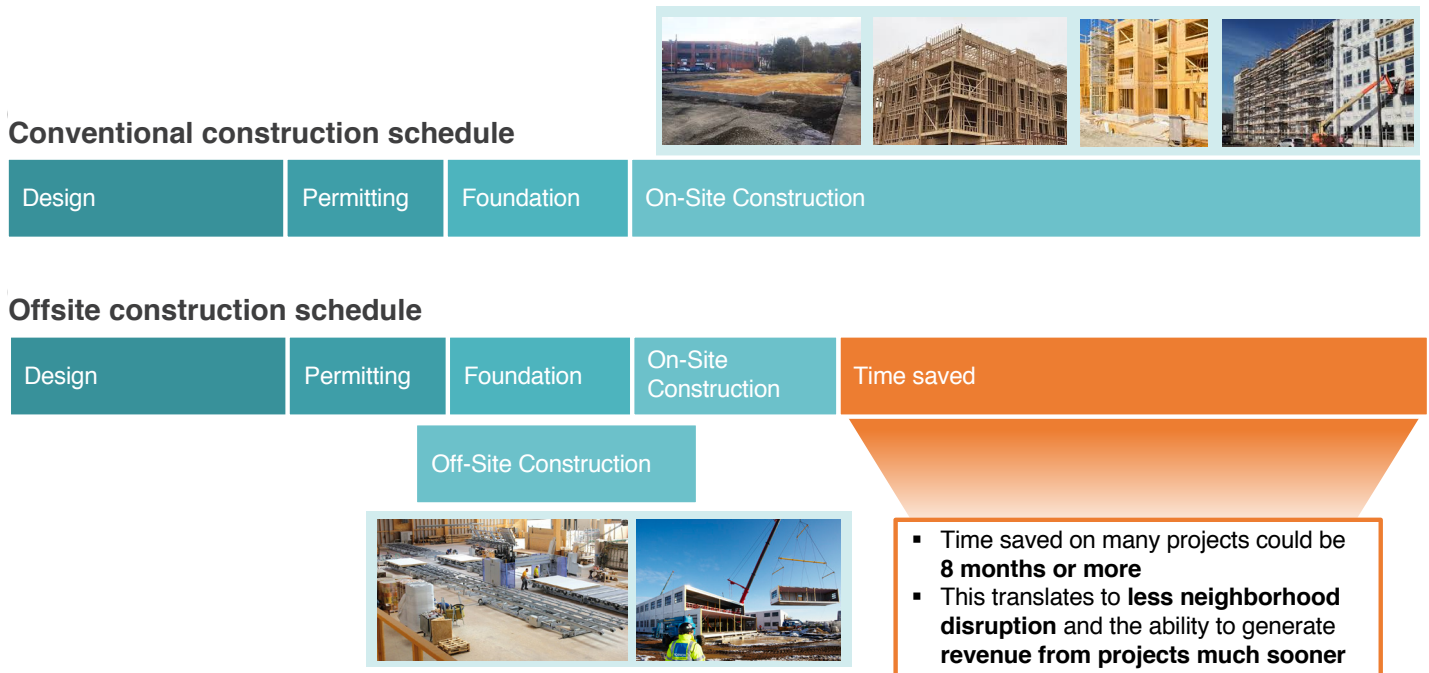


Potential for transformative savings in time

Even with the sizable potential for cost savings, schedule improvements may be the most significant benefit from an offsite approach. Early projects have seen schedules shortened by 20-50%.¹⁴ Planning and design time is compressed, and offsite manufacturing can begin in parallel with site prep and substructure construction. On-site assembly compresses the timeline further, and an end-to-end design approach reduces rework. The below graphic (Exhibit D), adapted from WSP, illustrates how time savings are achieved in offsite construction.¹⁵

Exhibit D

Estimated timeline changes



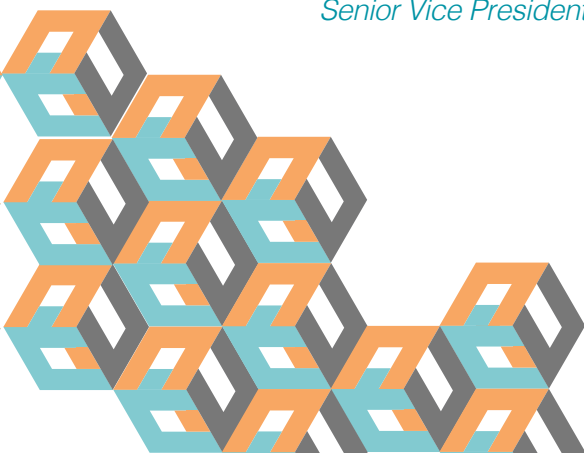
“ As a long-term investor in housing, we know that we must look at ideas like offsite construction to shorten the time and reduce the cost of building new housing that can be affordable to more people.

- Dan Smith,

Senior Vice President, U.S. Bancorp

“ We want to lead in the development of innovative projects that will meet the needs of communities across the country. We will continue to explore how offsite construction can help us deliver on that goal.

- Scott Ewing, Vice President of Construction & Architecture, Dominion



Offsite construction offers a range of approaches

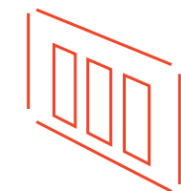
There is no single “right” way to do offsite construction, but it is clear that we can go beyond what we see in Minnesota today. There are many misconceptions about “modular” or “manufactured” housing, many of which are driven by historically negative attitudes about mobile homes. Modern offsite construction manufacturers are producing units for both single family and multifamily projects that are dramatically changing that picture, with some of the comparisons outlined in Exhibit E.

Exhibit E

Offsite construction IS:	Offsite construction IS NOT
<ul style="list-style-type: none"> • High-quality • A modern, effective, and efficient way to build • A system change in how we create, deliver, and purchase our homes • Apartment buildings and single-family homes • Driven by technology, data, and automation • An opportunity to expand and modernize the construction workforce 	<ul style="list-style-type: none"> • Low-quality • Building a home the same way we’ve always built it, just indoors • The work of any single part of the industry alone • An assumption that one size fits all communities • A simple or inevitable change

The typology (Exhibit F), developed by WSP,¹⁶ illustrates the range of options available. Many construction projects in Minnesota today use some elements of offsite construction, such as the prefabricated components of Typology 1. Typology 2, panelized construction, is also on the rise in our region, although most projects currently only utilize panelized framing as a component, rather than adopting a pre-finished panelized approach. A number of Minnesota manufacturers produce volumetric or modular units for single family homes, with the manufacturers of volumetric units for multifamily just beginning to emerge.

Exhibit F



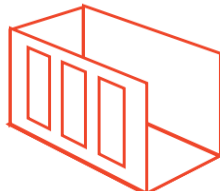
Typology 1: Components

On the side of the spectrum with low off-site work, Typology 1 includes many conventional site-built structures, so long as they include some prefabricated product such as roofing, flooring, or glazing systems.



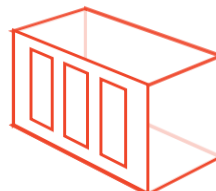
Typology 2: Panelized

Projects in the panelized typology are approximately **60% complete offsite** and use non-volumetric modular such as floors, roofs, and interior and exterior walls.



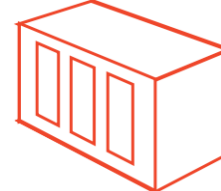
Typology 3: Hybrid

Hybrid projects are a mix of typology 2 and typology 4. Projects in the hybrid typology are made of volumetric modules but are not fully enclosed. Manufacturers may have removed interior walls or ceilings to eliminate superfluous panels.



Typology 4: Volumetric

This typology defines the most common projects – three-dimensional modules **80% to 90% complete off-site**. Modules arrive on-site without interior or exterior finished.



Typology 5: Complete

Projects in this typology are also delivered to site as a volumetric module, though in this case the modules are almost complete (90 to 95%) when they arrive on site. These projects require virtually no on-site construction before occupancy.

Mass construction through mass production

Jason Landry, an expert in engineering, logistics, and prefabrication, led Summit participants through a deep dive into mass production and its implications for residential construction. In his session on the “The Promise and Imperative of Mass Customization,” Landry pointed out four keys to accelerating the use of offsite construction:

- 1. Standardization:** Consistency in core components and the frame of a residential unit allows for a repeatable, accelerated approach.
- 2. Customization:** Standardizing base components enables creativity, design, and tailoring of options while preserving manufacturing certainty and efficiency.
- 3. Education:** New models require collaborative learning and hands-on partnerships to develop the correct mix of standardization and customization for each product.
- 4. Innovation:** Emerging technologies and new materials can allow for greater cost and environmental benefits, including healthier building materials for residents.

By applying customization on a standard frame, architects can adjust the exterior of the building to match the local context and adjust the interior of a home to match the occupant without losing time and money.

Katerra’s models illustrate how different finishes can dramatically change the feel of a unit built with the same module (Exhibit G).¹⁷ They demonstrate how customization can be applied to exteriors as well. With customized exteriors, mass production in residential construction could quickly develop homes that fit better for the people who will live in them, while still responding to community context.

Exhibit G



EARLY REGIONAL LEADERS IN OFFSITE CONSTRUCTION

The Summit featured leaders from local, regional, and national firms currently operating business models in offsite residential construction. Each leader highlighted the unique elements of their firm's approach, as well as the compelling opportunities they see ahead.



Dynamic Homes is a 50-year-old modular home builder based in Detroit Lakes, Minnesota. It builds primarily single-family homes out of its 180,000 square foot facility, with several commercial projects as well.



KATERRA

Katerra is a vertically-integrated, venture-backed firm that considers itself a technology company in the construction business. Katerra specializes in panelized elements and plays many roles across the construction value chain.



Rise Modular is a Minneapolis-based offsite construction company with a 150,000 square foot facility in Owatonna. Rise specializes in wood frame volumetric modular construction of multi-family, hospitality, senior housing, and student housing.



Skender is a Chicago-based design and construction firm focused primarily on corporate, residential, and healthcare projects. CEO Mark Skender realized the potential of modular construction and reorganized the firm around it.

You can watch their full presentations on the Construction Revolution [website](#). In addition, another company using offsite techniques participated in a breakout session later in the day:



Frana Construction has operated a Minnesota-based offsite plant for constructing wall panels for almost 20 years and uses them extensively in its general contracting business. It provides both steel and wood framing options.

Since the Summit:



Rise Modular has built out its manufacturing facility in Owatonna, MN and began construction on this 30-unit project in Minneapolis, MN in early May.









Dynamic Homes completed a three-story, 36-unit modular market-rate and affordable residential project in Cloquet, MN in January 2020.

REAL CHANGE COMES FROM SYSTEM-WIDE ACTION

Throughout the Summit, presenters emphasized the message that the transformation to offsite is not the work of a single sector. Offsite construction is an increasingly integrated model of production that relies on enabling efforts from the public sector as well as integration with the financial sector, capital markets, labor, supply chains, and logistics. Exhibit H shows the key barriers that each stakeholder group can overcome to adopt offsite construction.

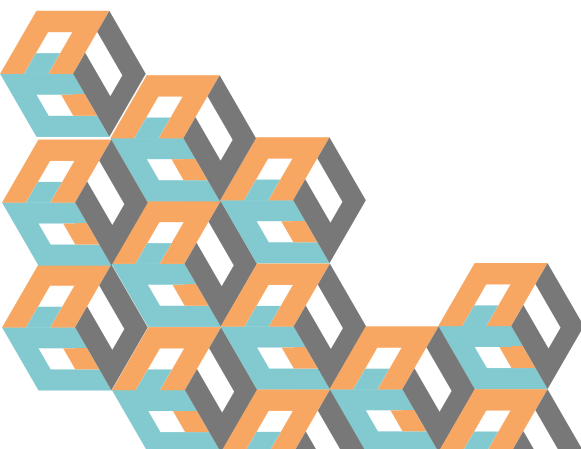
Exhibit H

Adopting offsite construction in Minnesota will require shifts from all sectors

	Current state	Barriers to overcome	Future state
Offsite Manufacturers 	<ul style="list-style-type: none"> Limited presence and capacity in Minnesota, beyond single-family homes 	<ul style="list-style-type: none"> Limited demand for offsite projects in Minnesota 	<ul style="list-style-type: none"> New factories open across the state, boosting the economy and creating jobs
Developers & Contractors 	<ul style="list-style-type: none"> Reliance on traditional construction, with some leaders adopting panelized elements 	<ul style="list-style-type: none"> Limited local experience with more advanced offsite techniques 	<ul style="list-style-type: none"> Growing pipeline of offsite projects, delivered with predictable cost & time savings
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Local Officials 	<ul style="list-style-type: none"> Perceived local uncertainty around building permits limits confidence 	<ul style="list-style-type: none"> Low familiarity with offsite construction and state regulatory process 	<ul style="list-style-type: none"> Efficient state and local permitting for offsite, enabling widespread adoption
Labor & Workforce 	<ul style="list-style-type: none"> Demand for skilled workers exceeds supply in construction industry 	<ul style="list-style-type: none"> Traditional work roles and conditions limit workforce growth 	<ul style="list-style-type: none"> New offsite careers and training options attract new sources of talent

“As we head into this new decade, automation and offsite fabrication will become more common in Minnesota’s construction industry. The industry needs to embrace, train, and prepare for these innovations.

- Harry Melander, President, MN State Building & Construction Trades Council



ACTION PLAN

In delivering the closing keynote at the Summit, Carol Galante, Faculty Director of the Terner Center for Housing Innovation at UC Berkeley, reminded us that our nation has increased the pace of construction to meet its housing needs before. As troops returned from World War II, there was not enough housing to go around. In response, we mobilized finances, factories, job training, and education programs, and built at twice today's level of construction.¹⁸

One important goal of the Construction Revolution Summit was to determine what needs to come next to reduce the cost of housing and achieve our ambitious vision (at right). Through a facilitated action-planning workshop, industry leaders from around the state collectively identified five next steps:

Vision: By 2025, 10% of multi-family residential developments in Minnesota will meaningfully use advanced, offsite construction techniques

- 1. Launch multi-sector innovation cohorts** to explore the potential and challenges of offsite construction techniques in actual projects.
- 2. Develop and promote learning opportunities** to highlight Minnesota's progressive building standards and inspections process for offsite construction.
- 3. Foster local collaboration** to develop a fast-track or pre-approval process for projects using offsite concepts.
- 4. Incentivize a series of pilot projects** using offsite construction through a public-private partnership request for proposals.
- 5. Attract new modular manufacturers and investors** to Minnesota through a robust economic development campaign.

The Construction Revolution team has confirmed early commitments to this work and will continue to foster conversation, learning, and hands-on project development.



Units on the production floor at the newly-opened Rise Modular factory in Owatonna, MN

1 LAUNCH MULTI-SECTOR INNOVATION COHORTS

Companies, organizations, and jurisdictions want to know what it takes to deploy offsite approaches, but few want to tackle the R&D alone. Collaborative efforts could both reduce the cost and increase the reach of these learning efforts. Further, the collaborative energy at the Summit was palpable, and it is critical to find a way to maintain the connections that were made there.

The goal of the Multi-Sector Innovation Cohort program is to create plans—including designs, specifications and budgets—that apply offsite modular construction techniques to a range of housing projects. These plans can then serve as case studies for similar housing projects or housing typologies. When these plans are implemented, they will result in housing developments that serve as real-world models.

Targeted to begin in late 2020, cohorts will include both Project Teams, which are organized around a specific offsite housing project, and a Core Learning Team. Project Teams are currently in formation and will reflect a variety of models, from large-scale affordable housing developments to smaller-scale, market-rate infill projects. The Core Learning Team will work across projects, providing a solutions-oriented group of experts to tackle challenges that emerge from the work of the Project Teams. The Teams will document the barriers to the offsite construction approach and create open-source concept models that can benefit the entire field.

The Construction Revolution will facilitate the cohorts and regularly bring together the Core Team and Project Teams for collaborative half-day sessions, during which the Project Teams can draw on the Core Team for problem-solving, as well as learn from one another. Cohorts will collectively develop a body of work that can be brought to the whole field at a future Construction Revolution Summit event.

2 DEVELOP AND PROMOTE LEARNING OPPORTUNITIES

For offsite construction to flourish, both local officials and construction industry leaders must understand relevant inspections protocols and codes. **Minnesota has a competitive advantage over other states in this area, with a state-level process already in place for inspecting offsite panels and modules.** However, these codes and protocols are not well known or deeply understood by local officials or the broader industry.

The Minnesota Department of Labor and Industry has committed to developing a training program to expand awareness and utilization of this process. This program will be rolled out in the next year and we are working to incorporate sessions on offsite construction into state and local code official training. Further partnerships could help bring these opportunities to life through awareness programs, interactive tools, and real-world projects.

Since the Summit:



The Construction Revolution proposed the launch of multi-sector innovation cohorts, and this proposal was named a Top 25 Finalist for the Ivory Prize for Housing Affordability, a national competition for solutions that are “ambitious, scalable, and feasible.”



The Minnesota Department of Labor and Industry has committed to creating and delivering a training program for local building officials on the state-level process in place for regulating offsite panels and modules.

3 FOSTER LOCAL COLLABORATION

Partnership with local communities is critical to the goal of accelerating the use of offsite construction more broadly. At the Summit, participants considered a variety of ways that local governments could provide incentives to increase the adoption of offsite construction.

As with any innovation, offsite construction can create challenges for local governments working to apply existing regulations to modern approaches. At the same time, we have seen significant interest from local governments in the potential of offsite construction to address the current housing shortage. Summit participants expressed a strong desire that offsite projects could eventually go through a standardized, streamlined permitting process that allows for replicable projects to be pre-approved, further accelerating timelines and increasing cost savings. **Local governments should seek to identify partners who can help their city apply their local codes to offsite projects as well as pre-emptively identify codes that may need to be modernized to enable offsite construction.** But they need not explore this uncharted territory alone.

The Regional Council of Mayors, sponsored by the Urban Land Institute (ULI) Minnesota has already expressed an interest and begun hosting conversations that include the potential of offsite construction. ULI Minnesota is also working with a public-private cohort to explore new design opportunities, including offsite construction, to address the need for moderately priced housing. Findings from these efforts can be shared through their existing technical assistance networks. Additionally, the League of Minnesota Cities and the Minnesota chapter of the National Association of Housing and Redevelopment Officials (NAHRO) can provide opportunities to facilitate learning and collaboration among local leaders. This area is one in which Minnesota's colleges, universities, and other educational institutions could also play a role.

4 INCENTIVIZE A SERIES OF PILOT PROJECTS

At the Summit, participants identified that a steady pipeline of projects is needed to enable capital investments in offsite factories – and that early pilot projects will be critical to building this pipeline in Minnesota. These projects can serve as prototypes, helping partners along the learning curve and working through potential obstacles in design, logistics, and approvals. Because these projects require additional upfront work and trouble-shooting throughout, they may not initially achieve savings at the desired level – that will require repeatability and scale. However, creating an incentive for these early projects would do much to build a pipeline on which development teams could justify their upfront capital investments.

Since the Summit:



A recent focus group convened by ULI MN on middle-income housing concluded that offsite construction, if it can be delivered at scale, is an attractive option to reduce cost to construct.



Minnesota Housing expressed support for offsite construction in its 2020-2022 strategic plan and an interest in incorporating incentives for offsite construction techniques in its RFP process to reduce costs and bring new housing to market faster.

State and local governments are best positioned to incentivize these early pilots, and affordable housing developments would be the best project candidates, while also meeting a critical need for the state. The Construction Revolution team is working to establish a state-level request for proposals that incentivizes the use of offsite projects to achieve cost savings and bring new housing to the market faster. Early conversations are underway with Minnesota Housing and other affordable housing funders on the potential to create a public-private partnership request for proposals, which includes incentives to pilot offsite projects and dissemination of learnings. This type of targeted investment has paid dividends in the past, and it can enable development teams to collaboratively explore the offsite model, particularly if participating in a Multi-Sector Innovation Cohort (see #1 above). Local governments could also build on this momentum by offering investments of land, regulatory flexibility, or other incentives.

5 ATTRACT MODULAR MANUFACTURERS AND INVESTORS

Construction is an economic driver and opportunity for our entire state. We generate \$3.2 billion in new investments and 30,000 jobs for every 10,000 new homes we build.¹⁹ Bringing offsite construction to Minnesota in a big way means more jobs, gains in our GDP, and increases in tax revenues. Offsite construction also holds unique promise as an export product, while providing a critical, foundational resource for Minnesotans—a place to call home.

Compared to other parts of the country, Minnesota has limited activity in the offsite construction market, especially for multifamily properties. As attention and opportunities for offsite construction increase in Minnesota, we will need to see increasing efforts, through home-grown modular companies and investments from out-of-state companies, to build projects and factories here. While this is the most future-oriented recommendation from the Summit, inaction here would be a barrier to seeing impact at scale.

Economic development agencies and local governments should see offsite housing as a target industry to attract to our communities. Existing manufacturers could be persuaded to site a second location in Minnesota, drawn by Minnesota's clear inspections framework and other favorable conditions. New investment could enable local companies to expand into the offsite market. Job training programs could demonstrate the strength of our labor market for these modern manufacturing jobs. This opportunity will be realized somewhere in the upper Midwest—why should it happen in some other place?

Since the Summit:



Prosperity's Front Door identified Rise Modular and the Construction Revolution Summit in its 2020 Minnesota Housing Scorecard as key innovators in cost-saving construction techniques to increase homebuilding.

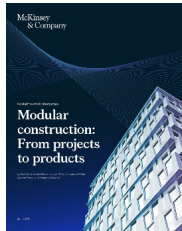


The Minnesota Multi-Housing Association featured offsite construction as a part of a Housing Innovations panel at its 2020 Perspectives event in early May, following its groundbreaking presentation by Mark Skender of Skender Construction at its 2019 Perspectives event.

ADDITIONAL RESOURCES

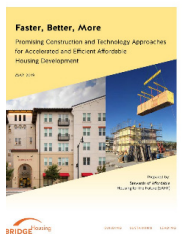
There are many resources and opportunities available to explore the potential of offsite construction. The Construction Revolution website (www.constructionrevolution.io) will continue to serve as a hub for these and other resources. Below is a short list of reports which have been most useful to Summit participants.

Reports



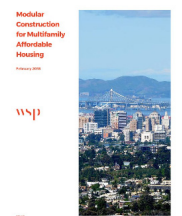
McKinsey & Company, June 2019

Modular construction: from projects to products



Bridge Housing, May 2019

Faster, Better, More: Promising Construction and Technology Approaches for Accelerated and Efficient Affordable Housing Development



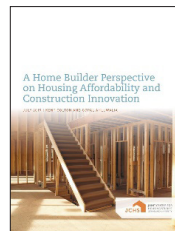
WSP, February 2018

Modular Construction for Multifamily Affordable Housing



Terner Center for Housing Innovation, March 2017

Building Affordability by Building Affordably: Exploring the Benefits, Barriers, and Breakthroughs Needed to Scale Offsite Multifamily Construction



Joint Center for Housing Studies of Harvard University, July 2019

A Home Builder Perspective on Housing Affordability and Construction Innovation



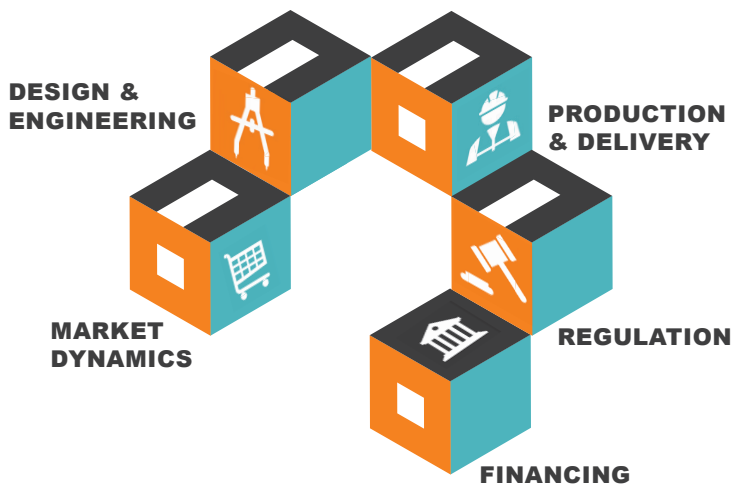
Enterprise Community Partners, July 2019

Enterprise Community Partners. New Reflections on Affordable Housing Design, Policy, and Production. Overcoming Barriers to Bringing Offsite Construction to Scale

References

- 1, 5, 19 *More Places to Call Home: Investing in Minnesota's Future*, Governor's Task Force on Housing, August 2018.
- 2 *Key Issues and Trends in Housing*, Minnesota Housing, February 2019.
- 3, 4 *One-Page Fact Sheet*, Prosperity's Front Door, 2019.
- 6 U.S. Bureau of the Census – American Community Survey; Minneapolis-St Paul-Bloomington Metropolitan Statistical Area
- 7 "Why it costs so much to build a house," *The Washington Post*, 30 January 2019
- 8 "Skilled labor remains big issue for Minnesota employers," *Star Tribune*, September 2019.
- 9 *Reinventing Construction: A Route to Higher Productivity*, McKinsey Global Institute, February 2017.
- 10, 14 *Modular construction: From projects to products*, McKinsey & Company, June 2019.
- 11 For every \$1,000 reduction in the price of a home, an estimated 2,800 additional Minnesota households can afford to live there. Minnesota Housing analysis of data from the U.S. Census Bureau's American Community Survey (2016, 1-year sample), development cost data from Minnesota Housing, and data from other sources.
- 12, 15, 16 *Modular Construction for Multifamily Affordable Housing*, WSP, February 2018.
- 13 *Building Affordability by Building Affordably: Exploring the Benefits, Barriers, and Breakthroughs Needed to Scale Off-Site Multifamily Construction*, University of California Berkeley Terner Center for Housing Innovation, March 2017.
- 17 *Company Overview*, Kattera, September 2019.
- 18 *3-year period that changed cities forever – The Veterans' Emergency Housing Program*, City Clock, June 2014.

BREAKOUT SESSION SUMMARIES



The Summit's breakout sessions were organized into five integrated tracks. Illustrated in the graphic above, these tracks were designed in recognition of the need for system-wide change, but also to give participants a chance to tailor their experience. Throughout these sessions, participants elevated key opportunities and barriers, which we have highlighted in this report.

Regulation

The regulatory track looked at regulatory advances that the state of Minnesota has already put in place to enable offsite construction, as well as regulatory approaches used in other states. Top insights included:

- There are several regulatory elements of offsite construction, including state building codes, inspections protocols, and local regulations.
- The state of Minnesota uses a straightforward and modernized approach to approve and inspect prefabricated modules and panels for residential construction, as well as a streamlined process for interacting with manufacturers and local officials. This is a competitive advantage for Minnesota, but it is not well-understood.
- There is a similar regulatory process in place in California, where state approvals have been relatively smooth. Although local officials were initially unfamiliar with the state process, they are overcoming this hurdle through education and transparency.
- Successful education approaches include factory tours and high-quality detailed video documentation of manufacturing and inspection processes.

Overcoming Regulatory Barriers to Using Offsite Construction

Carol Galante – Faculty Director, Temer Center for Housing Innovation at UC Berkeley and Director of the Innovation Lab at Factory O_S

Scott McKown – Assistant Director, Minnesota Department of Labor and Industry

Financing

- While traditional construction carries real estate risk, offsite construction carries both manufacturing and real estate risk. It will take time for lenders to learn to account for this, and consistent partnerships will be needed to validate this model.
- Offsite facilities are capital intensive and risky, creating challenges to acquire upfront capital. A steady pipeline of projects could reduce this risk substantially.
- Banks are unlikely to be innovative risk-takers. Early projects may need to explore new sources of funding. Both Kattera and Rise Modular received large up-front investments from unconventional sources such as venture capital.
- Developers believe that a key benefit of using modular is to complete a project in less time, which generates a return on the investment sooner. Later projects should also enjoy construction cost savings. There is a steep learning curve, and the developer, working with the manufacturer, likely must take the lead in educating the architects, general contractors, and lenders.

Financing Developments in Offsite Construction

Eric Whittaker – Vice President of Finance and Business Development, Rise Modular

Dan Smith – Senior Vice President, U.S. Bancorp Community Development Corporation

Chris Wilson – Senior Director of Real Estate Development, Project for Pride in Living

Financing a Business Model in Offsite Construction

Justin Van Leuvan – Director, Business Development, Kattera

Christian Lawrence – Chief Executive Officer, Rise Modular

Design & Engineering

The Design & Engineering track focused on past examples of offsite construction, internationally and within Minnesota. Environmental sustainability was also a theme within the track. Highlights from these discussions included:

- Several other countries, including Sweden, have embraced offsite construction. Notably, Japan has adopted modular construction in part because it offers improved climate and earthquake resilience.
- Offsite construction offers a host of benefits for environmental sustainability, including improved efficiency and reduced waste in the manufacturing process.
- In general, other countries were able to develop offsite and related sustainable building practices when they invested in robust research and development efforts, supported by a triad of academic research and education, government support, and private sector pilots. This support is needed in our region to make the same advancements.

Sustainable Building: Opportunities for Improved Environmental Performance

Richard Graves – Director and Associate Professor, Center for Sustainable Building Research

Simona Fischer – Architect, MSR Design

Pete Kobelt – Director – CLT Mass Timber, Kattera

Ivan Rupnik – Partner, MOD X

Tailored Designs and Customer Specifications

Jason Landry – Founder, Jason Landry Consulting, LLC

Production & Delivery

The Production & Delivery track examined Katterra's approach to supply chain and logistics as well as Skender's approach to labor and workforce development. Highlights included:

- Katterra was founded on the belief the greatest efficiencies require fully owning its supply chain, from raw materials through installation.
- Katterra has achieved integration through venture capital and acquisitions of existing firms. It can “work with anyone,” and is currently offering a catalog of products to general contractors and other customers nationally.
- For Skender, the transition of production from the site to the factory has created new job types, partnerships, ways of working, and opportunities to solve persistent social problems.
- Skender has negotiated a working relationship with the Chicago Regional Council of Carpenters, under which workers are paid union wages using a manufacturing scale rather than construction trade scales and are provided benefits similar to Skender's existing workers.

The Power of Vertical Integration: Supply Chains to Installation

Pete Kobelt – Director – CLT Mass Timber, Katterra

Justin Van Leuvan – Director of Sales and Business Development, Katterra

Building the Future: Partnerships to Create the Next Generation Workforce

Timothy Swanson – Chief Design Officer, Skender

Market Dynamics

This track focused on bringing together a wide range of participants and demonstrating the similarity of physical components within different housing types. It illustrated several lessons:

- Key elements of buildings can be thought of as “modules,” (e.g., bedrooms, bathrooms) which can be combined into a final product in consistent, predictable ways.
- The exterior skin of a building, (e.g., colors, window finishings, balconies) can drive a wide range of architectural styles and differentiation without changing the basic structural model.
- Interior finishes can also vary widely, allowing for differentiation in the final product and price point.
- By distilling a project down to its core components, repeatability and cost efficiencies can be achieved. Offsite manufacturers can achieve the depth and consistency of demand needed to support their business model.
- Minnesota businesses in the past and the present have experimented with offsite construction, with varying levels of commitment and success.
- Keys to local success include partners committed to using offsite techniques, regulatory navigation, labor retention, standardized roles and responsibilities, and overall workforce acceptance of offsite construction.

Market Acceptance and Building a Demand Pipeline

Jamie Stolpestad – Managing Partner, Minnesota Opportunity Zone Advisors

Paul Mellblom – Principal, MSR Design

Paul Okeson – CEO, Dynamic Homes

Offsite Construction Techniques in Minnesota: Lessons Learned

Harry Melander – President, Minnesota State Building and Construction Trades Council

Jim Boo – Principal, Team Boo at High Pointe Realty

Darrel Debele – Plant Manager, Frana Construction

Paul Okeson – CEO, Dynamic Homes

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Scott Ewing | Dominion

Richard Graves | University of Minnesota Center for
Sustainable Building Research

Maureen Kavanagh | 3M

Harry Melander | Minnesota Building and
Construction Trades Council

Scott McKown | Minnesota Department of Labor
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Cecil Smith | Minnesota Multi Housing Association

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