

**BUILD USA**  
PRESENTS

# OPTIMIZED BUILDING

White Paper Three



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# EXECUTIVE SUMMARY

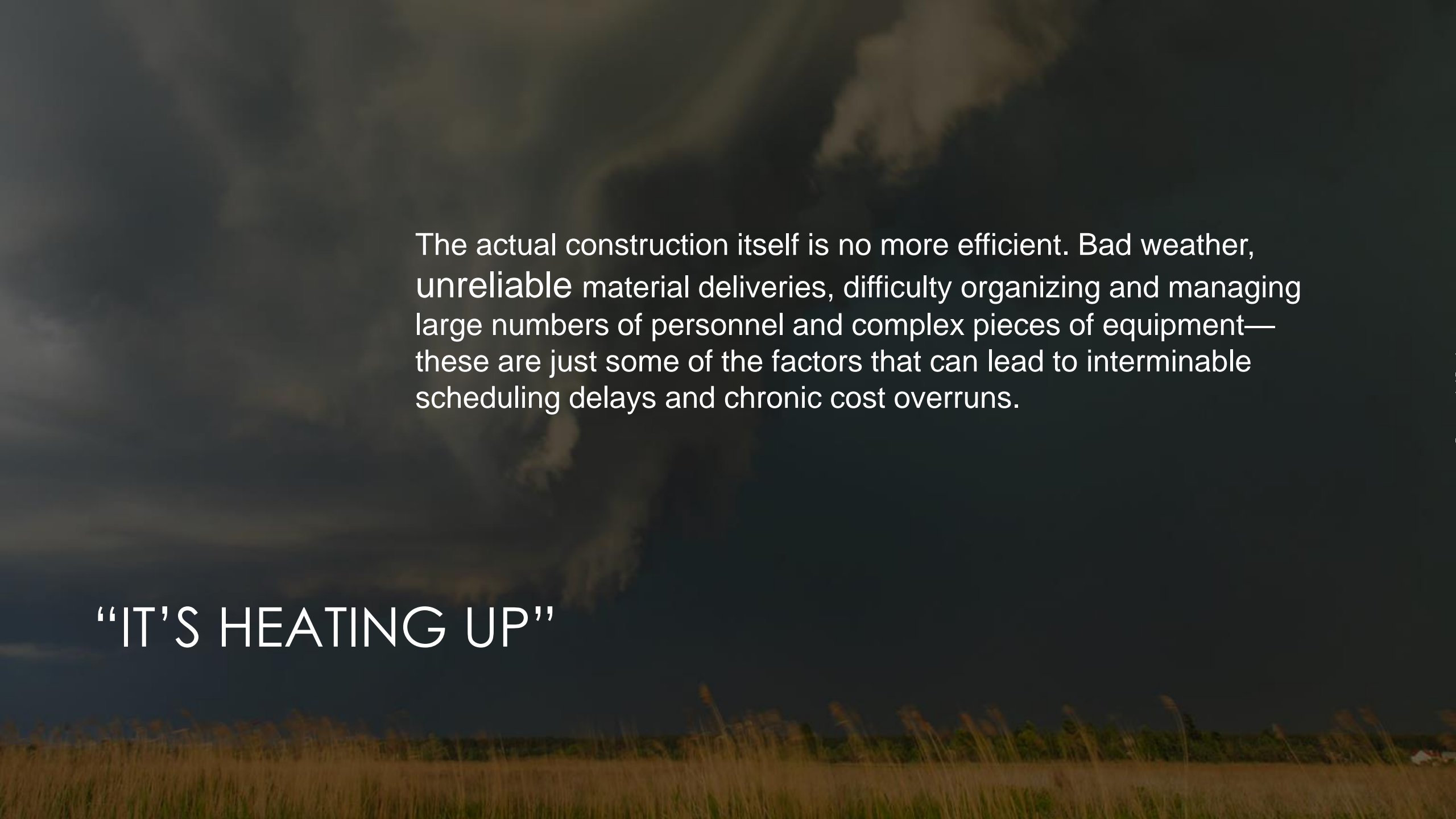
“Optimized” building and modular construction represent a significant portion of the future of building development. They are poised to have the most significant impact on the building industry. The ability to consistently deliver high quality, high-performing buildings in shorter time and at lower cost will enable “Optimized” building to achieve prominence.

# INTRODUCTION



# TODAY'S ENVIRONMENT

The traditional on-site building process is notoriously inefficient. Typically, it involves the coordination of multiple, disjointed teams, each inhabiting their own walled-off silos of knowledge and jealously guarding their professional turf. Even in the pre-construction phase, before the real building gets going, this situation often results in a series of **miscommunications**, conflicts, and **costly errors**.



The actual construction itself is no more efficient. Bad weather, unreliable material deliveries, difficulty organizing and managing large numbers of personnel and complex pieces of equipment—these are just some of the factors that can lead to interminable scheduling delays and chronic cost overruns.

“IT’S HEATING UP”



# CRACKS IN THE FOUNDATION

As projects become more complex and larger in scope, and environmental and safety standards become more exacting, the inefficiencies of traditional construction become more intolerable to all involved

# MODULAR DESIGN IN 1.. 2.. 3..

Modularization is a construction method in which an entire unit of a building is produced **off-site** in a factory setting and then shipped to a construction site for assembly.

Among the various offsite or prefabrication methods, modular construction has emerged as a potential industry **game-changer** that helps deliver projects faster, safer, and cheaper.

Modular units require the least amount of on-site construction time, as all plumbing, electrical, and design finishes have typically already been installed in the facility.





THROUGHOUT HISTORY

# ANCIENT HISTORY

Historically speaking, modular construction is not a new concept. [The longer history of modularization](#) goes back to ancient Greek architecture and its creation of three classic column types or orders:

- ▶ Doric
- ▶ Ionic
- ▶ Corinthian

Ancient Roman armies built their forts from prefabricated sections which they carried as they marched.



In the modern era, Sears, Roebuck and Co. first popularized modular housing in America when they began selling “**kit homes**” whose components could be shipped and assembled upon delivery.

From 1908-1948, Sears sold approximately 75,000 homes via catalog.

The modern use of modular peaked during the **post-WWII building booms** in the US and Europe, when there was an urgent need for speedy reconstruction due to widespread housing shortages.

# MODERN HISTORY

**\$2,065<sup>00</sup>** Completely **BUILDS AND FINISHES**  
This **\$3,000.00** Ten-Room Residence  
As Proven by Our FREE Plans, Specifications and Complete Itemized Bill of Materials.  
THESE PLANS ARE FREE OF CHARGE TO YOU ON CONDITIONS EXPLAINED ON PAGE 2.



**\$725<sup>00</sup>** and Our **FREE B**  
WILL BUILD, PAINT AND COMP  
THIS INVITING \$1,100.  
We tell you on page 2 how we furnish, free, the plans for this house.



MODERN HOME No. 111

The arrangement of this house is as follows:

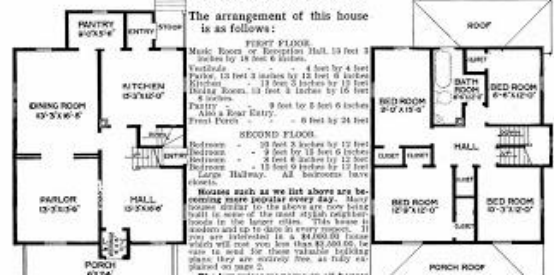
**FOR LESS THAN \$2,500<sup>00</sup> YOU CAN BUILD**  
THIS ELEGANT CONCRETE AND FRAME CONSTRUCTION  
NINE-ROOM \$4,000.00 HOUSE

BY USING OUR PLANS, SPECIFICATIONS AND BILL OF MATERIALS WHICH YOU CAN GET FREE, AS EXPLAINED ON PAGE 2.



MODERN HOME No. 111

The arrangement of this house is as follows:



**SIX ROOMS AND BIG PORCH**



At the price quoted we will furnish all the material to build this six-room house, including lumber, siding, nails, window sashes, wall coverings, insulation, roof trusses, doors, windows, radiators, hardware and painting material. We think you'll like it.



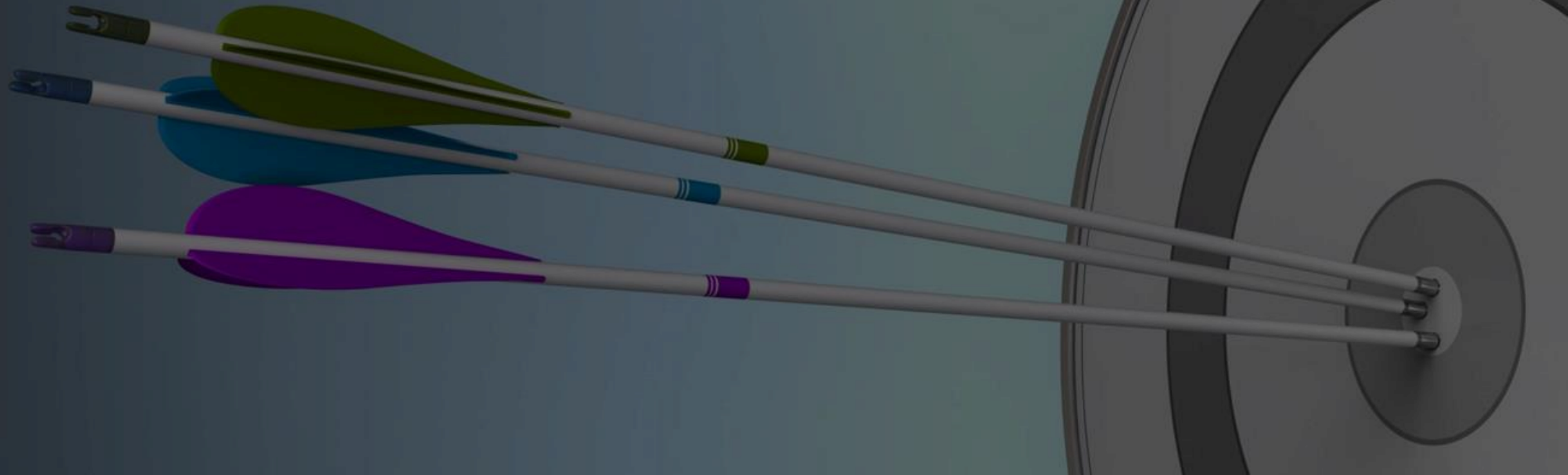
# TODAY

Today, modular is no longer a niche approach and is attracting unprecedented interest and investment. It's being adopted for projects as varied as ***hospitals***, ambulatory medical centers, high-end ***condos***, apartment complexes, and ***hotels***.



The market for modular construction will continue to grow as owners and developers become aware of the advantages of modular over traditional construction and become accustomed to new project delivery methods.

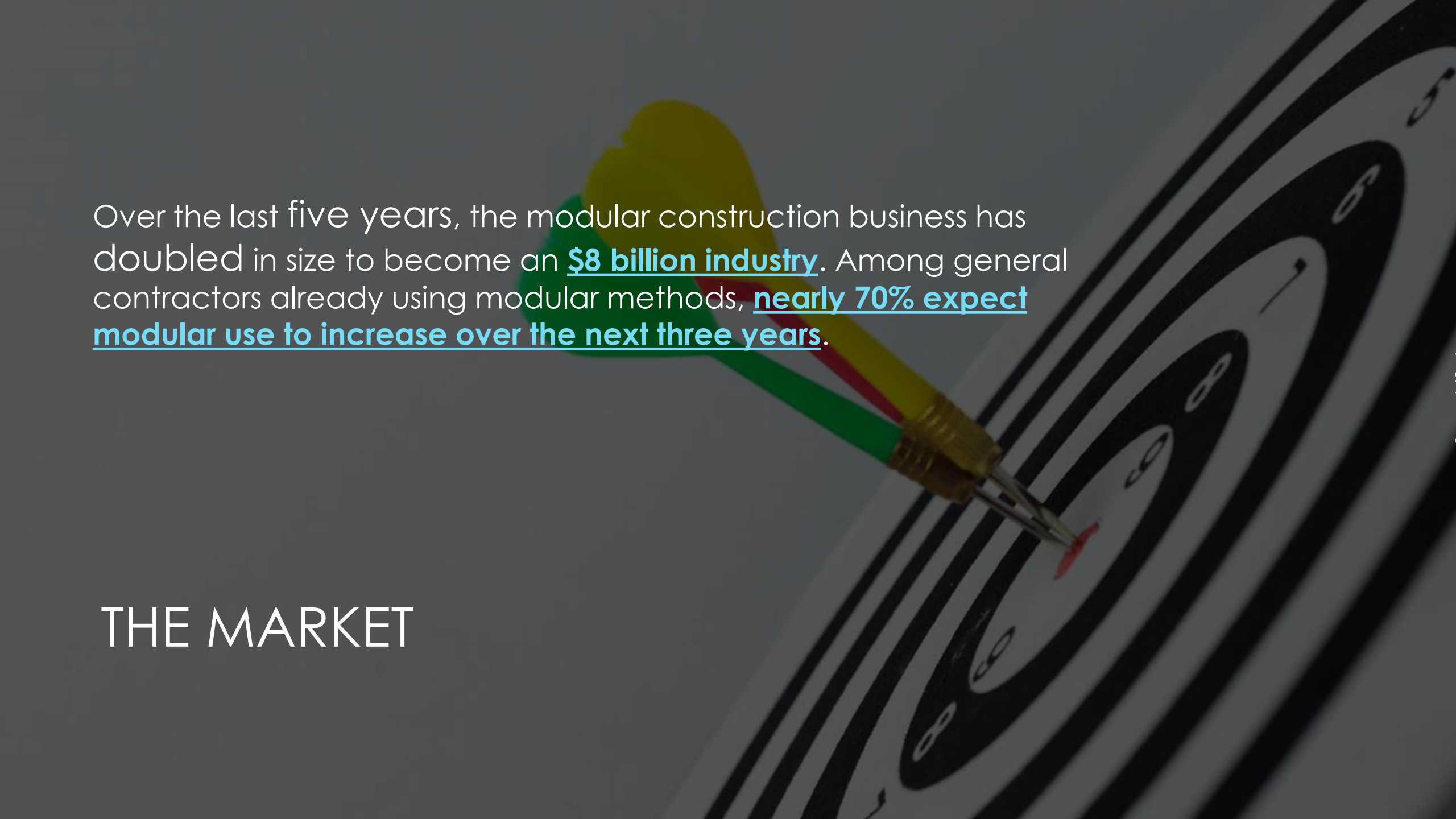
# THE MARKET



A hand is shown moving a black chess piece on a chessboard. The background is dark and out of focus, emphasizing the hand and the piece. The text is overlaid on the right side of the image.

Under modest assumptions of penetration, the market value for modular in new real estate construction alone could reach [\\$130 billion in Europe and the United States by 2030](#). The growth of modular could help give the industry a much-needed [productivity boost](#), solve housing issues in many markets, and significantly revise established building practices.

## THE MARKET

A target with a dart hitting the bullseye. The target is a circular board with concentric rings and numbers. A dart with a yellow, green, and red shaft is embedded in the center bullseye. The background is dark and slightly blurred.

Over the last five years, the modular construction business has doubled in size to become an **\$8 billion industry**. Among general contractors already using modular methods, **nearly 70% expect modular use to increase over the next three years**.

## THE MARKET


# THE RISE OF MODULAR





- **Digital Technology:** The rise of digital technology has helped modular construction by facilitating the design of modules, increasing precision and productivity in manufacturing, and optimizing delivery logistics. Thanks to digital tools such as BIM, it is becoming easier to create more sophisticated systems of modular components and to integrate them into conventional buildings.
- **Consumer Perception:** Consumer perceptions of modular housing are beginning to change as new, more diverse material choices enhance the aesthetic appeal of buildings, and builders start to focus on sustainability and customization.
- **Leadership Mindset:** New entrants and first movers, dissatisfied with the industry's lack of innovation and poor productivity, are starting to disrupt the market and change the mindset of incumbents. Industry leaders are beginning to realize it may be time to reposition themselves.
- **Economic Demands:** Modular is more appealing in the current environment of accelerating skilled labor shortages and increasing cost and schedule pressures.

## THE RISE – FACTORS



By transferring a large portion of the building process from an unpredictable on-site environment to a controlled factory setting, modular construction mitigates the waste, delay, and inefficiency associated with traditional construction

## MODULAR BENEFITS



*Accelerated  
Schedule*



*Reduced Risk*



*Higher Quality*



*Lower Costs*



*Reduced  
Environmental Impact*



*Facilitate O&M*



*Limitless Design  
Opportunities*

---

# MODULAR'S SUPPORTING BENEFITS

Modular construction, combined with new methods of data sharing and decision-making, is the industry's best bet for improving the overall quality and efficiency of the traditional building process.

## REDUCED RISK



Modular construction is far less subject to the legal and financial risks inherent in complex collaborations with subcontractors. Plus, the indoor construction environment reduces the risk of dangerous accidents and related liabilities for workers, resulting in improved safety and security.

## ACCELERATED SCHEDULE



Construction of modular buildings occurs simultaneously with the site and foundation work, and any delays experienced on-site do not impact the production process. This enables modular projects to be completed 30%-50% sooner than traditional projects. In turn, the occupancy and revenue-generating stage of a project can begin much sooner.

## HIGHER QUALITY



Modular buildings are designed to meet or exceed the same building codes and architectural specifications as traditional buildings. Thanks to standardization, a controlled environment, and factory quality checks, the modular process permits superior quality management. For best-in-class producers, the defect-free rate on new buildings is now above 95%.

## **LOWER COSTS**



The controlled, weatherproof workplace increases the productivity of individual employees, while also allowing economies of scale, optimized logistics, and lean manufacturing. Minimizing the inefficiencies, delays, and wasted materials associated with the traditional building process can reduce overall costs by up to 20%.

## **REDUCED ENVIRONMENTAL IMPACT**



Traditional construction produces significant waste and environmental impact. When the building process takes place in a factory setting, waste is reduced by controlling inventory and recycling materials. Pollutants are prevented from entering the surrounding environment. Production efficiencies can cut emissions in half.



## **FACILITATE O&M**



Modular buildings can be disassembled, and the modules repurposed for new uses, reducing the demand for raw materials and conserving expenditure.

## **LIMITLESS DESIGN OPPORTUNITIES**



Modular buildings are very versatile and can be designed to serve almost any function. Modular units can integrate seamlessly with the aesthetic features of existing buildings. Once assembled, they are virtually indistinguishable from their site-built counterparts.





# MODULAR CHALLENGES

# MODULAR CHALLENGES

A construction worker in a high-visibility vest and hard hat is working on a large concrete slab in a factory setting. The worker is using a tool to smooth the surface of the slab. In the background, other workers and industrial equipment are visible, along with large concrete structures and a door marked with the number 15.

Despite the numerous advantages of modular construction, many North American owner organizations remain reluctant to fully embrace off-site project delivery methods. According to recent research, only **38% of owner organizations have a high rate of acceptance of off-site projects, and nearly 50% still opt for the traditional design-bid-build approach.**





*Image  
Problem*



Lack of  
awareness



*Risk Aversion*



Regulation



Costs

---

# MODULAR CHALLENGES

## **LACK OF AWARENESS**



More than 70% of general contractors say their primary reasons for not choosing modular construction are: 1) clients aren't requesting modular projects and 2) architects aren't developing designs for modular projects. Due to the irregular nature of demand, off-site factory space is underutilized.

## **IMAGE PROBLEM**



Modular has a poor image due to traditional misconceptions about quality, price, and the potential for customization. Modular is often associated with low-quality, uniform, aesthetically unappealing housing.

## **RISK AVERSION**



The building industry is risk-averse. Both builders and clients are overly cautious when it comes to adopting new processes and technologies. Contractors, in particular, are wary of investing significant funds in off-site factories. Further, there is increased risk involved in committing to particular off-site suppliers due to the underdeveloped state of the market.



## REGULATION



Traditional construction is typically subject to strict labor rules regulating the activities of on-site personnel or specifying the minimum number of workers for a particular task. Such rules are incompatible with the off-site labor model, which is based on small teams of broadly trained workers. Other rules, often local, including health and safety regulations, planning codes, and mortgage or insurance requirements, have also hindered the development of offsite construction.

## COSTS



Upfront costs can be considerable and securing loans can be difficult. For example, modular projects often require a significant upfront deposit for building materials that may account for **25% of the total construction cost**. In addition, the cost of transportation can be high, especially in cases of long distance between the factory and the site. In general, prices are elevated due to the lack of scale and competition in the current market.






# THE NEAR FUTURE

1. **Boutique** projects that offer high-end, custom building solutions based on the unique preferences of an owner or client.
2. **Iconic** projects that develop large-scale structures that push the boundaries of current building technologies and techniques.
3. **Optimized** projects that include extensive modularization, focus on buildings used throughout the built environment and do not require one-off customization for optimal performance.
4. **Hybrid** projects that combine features of #1, #2, and #3.


# JUST OVER THE HORIZON

The four building delivery processes that will emerge in the near future of the building industry

A sunset over the ocean with a rainbow arching across the sky. The sun is low on the horizon, casting a warm glow over the clouds and water. The rainbow is a vibrant arc of colors, starting from the horizon and curving upwards into the darkening sky. The overall scene is serene and hopeful.

Of all these processes, Optimized building is poised to have the most significant impact on the building industry. The ability to consistently deliver high quality, high-performing buildings in shorter time and at lower cost will enable Optimized to achieve prominence.

OVER THE HORIZON

An astronaut in a red space suit is floating in space, with the Earth's blue and white surface visible in the background. The astronaut is positioned in the lower right quadrant of the frame, looking towards the left. The Earth's curvature is prominent, showing a mix of blue oceans and white clouds. The overall scene is set against the blackness of space.

The automotive industry offers a useful analogy for Optimized building. Like cars, Optimized buildings will be developed on standardized chassis, with a sufficient variety of modular components to satisfy the customer's operational needs and aesthetic preferences. And, like options on cars, these modular components will offer the customer a menu of options for each building (including a preset project schedule with definitive deadlines).

WHAT DOES IT HOLD?

# ADDRESSING THE CHALLENGE

In addition, the development of optimized modular buildings can create corresponding changes in AECM business relationships. In the same way that an auto dealer sells different automobile models and supports specific warranties, the AECM can sell different building models directly into the surrounding community.

Finally, like automotive production, modular production occurs in a controlled environment with consistent standards and workflows. Thus, modular can enjoy the primary benefit of producing at scale: **higher quality at lower cost.**




# THE 5 STRATEGIES

5 primary approaches to tackle the challenges of Optimized Building.

# THE 5 STRATEGIES

1. *Work jointly with the material procurement chain to further develop Optimized construction systems. Develop products in conjunction with manufacturers and their regional distributors.*
2. *Tailor on-site construction processes to the use of modular components and systems.*
3. *Work to establish industry-wide standards for modular components and processes.*
4. *Educate the general public and industry professionals on the benefits of modularization and best practices for executing modular projects.*
5. *Develop specific products that prove out the concept.*



Optimized building and modular construction represent a significant portion of the future of building development. After decades of relatively slow growth, the rapid rise of modular looks likely to disrupt the building industry. Innovative owner organizations that are aggressively adopting offsite construction are already achieving significant results through enhanced efficiency and more transparent delivery mechanisms.

Moreover, ongoing advances in digital production methods such as robotics and 3-D printing, and collaborative platforms such as BIM and digital twin technology, will only complement and support the growth of Optimized building.

# CONCLUSION

These transformative developments will affect companies all along the value chain. Industry players should evaluate the considerable upside potential of Optimized Building and assess their strategic choices to ensure they don't get left behind. The initial investment doesn't have to be all or nothing—most of today's offsite-active companies started off with a small side project and gradually increased their involvement over time. However, the time to invest is now.

## CONCLUSION

# SOURCES

- [Modular Construction: from Projects to Products](#)
- [Modular Construction: Priorities for Real-Estate Developers](#)
- [Reinventing Construction](#)
- [Imagining Construction's Digital Future](#)
- [Seizing Opportunity in Today's Construction Technology Ecosystem](#)
- [The Offsite Revolution in Construction](#)
- [Building the Housing of the Future](#)
- [The Transformative Power of Building Information Modeling](#)
- [Shaping the Future of Construction: A Breakthrough in Mindset and Technology](#)
- [A New Era for Modular Design and Construction](#)
- [2020 Engineering and Construction Industry Outlook](#)
- [Digital Disruption in Engineering and Construction](#)
- [Digital Twins: Taking modular construction to the next level](#)
- [What is Modular Construction?](#)
- [New Report Shows that the Modular Construction Business is Booming](#)
- [Modular Construction Use Is 'Booming' in Commercial Building](#)
- [Will 3D Printing Remodel the Construction Industry?](#)
- [Modular Buildings](#)
- [The Differences Between Prefab and Modular Construction](#)
- [U.S. Chamber of Commerce Commercial Construction Index](#)
- [The History of Modular Construction](#)