WHITE PAPER
Patented technology enabling mass production of buildings

draft 0.0.2
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0. ABSTRACT

According to the annual *State of the Nation’s Housing Report* from Harvard’s Joint Center for Housing Studies, nearly 39 million American households cannot afford their housing\(^1\).

Boxabl technology was created to enable mass production of buildings through technological innovations that enable repeatability in manufacturing.

Boxabl’s primary innovation is a patented building construction technology that allows for manufacturing of almost any size and style of residential and light commercial building in a factory.

Individual rooms are built on an assembly line and packed down to the size of a shipping container, then shipped to site using standard transportation infrastructure. Once onsite they are unpacked and assembled into a finished building, with no compromise.

No compromise means beautiful architectural styles, higher quality, spacious rooms, and nearly endless customizability.

Our boxabl boxes connect together like Lego on site to build virtually any structure.

The resulting cost savings – created through a more efficient manufacturing process and less capital lost due to time value of money – will revolutionize the international housing market.

1. [http://www.jchs.harvard.edu/research/state_nations_housing](http://www.jchs.harvard.edu/research/state_nations_housing)
1. INTRODUCTION

Since the industrial revolution, most products are no longer built by hand one at a time, but rather on an assembly line, using automation, resulting in increased efficiency, quality and lowered costs.

1.1 SIZE PROBLEM

One product category, however, escaped this transition: building construction.

Because of its sheer size and need for customizability, the construction industry – among the biggest industries in the world – is stuck in the past. Buildings are built one at a time, by hand. Tools and laborers are transported to the product each time one is built. This makes the manufacturing of such a vital product expensive, inefficient and slow. We’ve yet to establish the possible means for building something so large in a factory - until now, until Boxabl.
1.2 SIZE SOLUTION

Although Boxabl has designed, patented and prototyped many technologies for its housing solution, our **packing technology** is the fundamental breakthrough that allows for the manufacturing of massive structures inside of a factory and on an assembly line.

A house is made up of rooms and rooms are mostly empty space. Generally less than 40% of a typical room is fitted with space-consuming fixtures like, bathrooms, kitchens, closets, stairs and HVAC systems. However, the remaining 60% is simply empty space.

Boxabl’s patented packing technology innovation allows that 60% empty space to simply be folded into itself so that we aren’t shipping empty space. With this breakthrough, it is less expensive to ship a finished house than it is to ship raw materials to a building site.
1.3 MISSION STATEMENT

“When we are talking about access to suitable living conditions on an international scale, cutting costs and increasing access to financing means less human suffering. It is the Boxabl mission to enable a societal transformation by slashing building manufacturing costs.”
Boxabl has the technology, patents, and skills to disrupt the trillion dollar construction industry, slash costs, speed up production, increase quality and dramatically expand accessibility to housing for the world by bringing building construction manufacturing out of the field and into the factory.

Boxabl buildings are custom designed online, built in a factory, shipped to site using standard shipping infrastructure, and assembled into finished buildings all in record time with no compromise on size, customizability or build quality.
2. HOW THE PRODUCT WORKS

Boxabl room technology is based in three key inventions:

2.1 ROOMS THAT CONNECT

The Boxabl room floor plan is based on a grid system. By placing windows, doors and other elements strictly on the grid system multiple rooms can easily connect together. Connecting on the grid enables hallways, doors and windows to easily line up in thousands of different combinations to create almost anything. The system is similar to a favorite childhood toy, Lego.
2.2 ROOMS THAT PACK

A Boxabl room is too big to transport, so the room packs down in a few simple steps for easy shipment.

2.3 ROOMS THAT SHIP

By bolting wheel sets to each end of a packed Boxabl room it becomes readily transportable to most places around the world by pick-up truck.
3. PRODUCT TECHNOLOGY

3.1 WALL TECHNOLOGY

Boxabl walls are a high tech sealed composite of various materials. All materials such as the horizontal beams and vertical supports adhere to the grid system for benefits previously stated. A major innovation is the removal of traditional wall studs in favor of a single major support beam spanning the entire wall length. The horizontal beam itself houses data and power wiring as well as other utility lines as needed.

By removing traditional wall studs insulating material can flow uninterrupted between the majority of the walls length for superior insulation against external cold and heat.

By removing the traditional wall studs in favor of a major single spanning support beam any opening of any size can be cut into the wall panel without requiring a custom support header directly above the opening. This provides unprecedented design freedom and speed impossible with traditional or other alternative wall systems.

The vertical supports, which operate in pairs are inset from the ends of the horizontal beams. This allows customs designs of Boxabl room to eliminate the corner of the walls completely, underscoring the design freedom the system provides.

3.2 CEILING & FLOOR TECHNOLOGY

Boxabl ceilings and floors utilize a unique joist manufactured to fall within the grid system enabling the easy passage of utilities, HVAC, water and heat lines. Joists are substantially lightened without a measurable decrease in strength and the material removed is recycled for a zero material loss in processing.
3.3 WHEEL TECHNOLOGY

Boxabl wheel technology provides an affordable, comprehensive solution to moving large product around the world, over varied terrains, within existing transport regulations.

Traditional tractor trailers are impractical for moving maximum volumes due to the wasted space below the wheels. Boxabl wheel technology bolt-on wheel sets make full use of all available space without which traditionally acceptable room volumes would be impossible.

Boxabl wheel technology addresses the different ride height requirements for pick up and delivery, overland transport and rough ground requiring a great deal of clearance.
3.3 WHEEL TECHNOLOGY (CONT)

Boxabl wheel technology addresses the practical realities of maneuvering large objects overland by steering one or both of the wheels sets for different turning radii and also the ability to pull the product from either wheel set.

The efficient return of Boxabl wheel set is accomplished by daisy chaining wheel sets together, additionally stacking them. This enables the return of multiple wheel sets by only one transporter.
4. HOW THE PROCESS WORKS

4.1 IMPORTANCE OF A FACTORY

The industrial revolution marked significant improvements in methods used for manufacturing products, factory methods and machine tools.

Moving from hand production methods to mechanized production allowed technological advances and products to change the world.

This transition to new manufacturing processes was responsible for improvements that reached all corners of everyday life. Technology was not only created, but it was manufactured and mass produced in a cost effective way that allowed it to be accessible to the average man and change the world by significantly enhancing standards of living.

During this period we see the inception of the assembly line. Products were able to be manufactured in a significantly more cost-effective way. The main concept of an assembly line lies in Adam Smith’s idea of specialization of labor—breaking down large complex jobs into individual components and assigning workers smaller tasks that can be accomplished more efficiently with less waste.

Consider the building of a house and the job of a plumber: lay the pipes around the house, install toilets etc. Much time is wasted walking from room to room, pulling different tools out of a bag, planning the plumber’s next step. If the plumber’s job can be reduced to one task, for example simply connecting one shower faucet fitting over and over again, maximum efficiency and maximum quality can be achieved.

The assembly line achieves this goal by bringing the product from worker to worker, allowing the worker to master performing one task on each product.

Using the famous example of Henry Ford’s Model T assembly line, we see the time it takes for a car to be assembled moving from 12 hours down to 2.5 hours. Imagine the massive cost savings that is created by this innovation. Now imagine how that cost savings affects the accessibility of that product to the average man. This assembly line allowed the cost of the car to be lowered from $850 to $300, a 65% cost savings. Innovation leading to cost savings like this has the capability to change the world.
Several hundred years late, the biggest product in the world, with one of the biggest markets, finally meets the biggest innovation in manufacturing: the assembly line.
Being able to manufacture buildings in a factory means something amazing: we are able to bring the time it takes to manufacture a 2 bedroom home to 90% completion from 6 months down to 6 hours.

Traditional hand building moves material & labor around the building.

An assembly line brings the building past materials & labor.
4.2 FACTORY LAYOUT

The efficiency gained from factory assembly vs hand building in the field cannot be overstated. Each assembly station would consist of specialized laborers combined with specialized equipment who would complete the same tasks, with a finely tuned process and zero downtime.

Each Boxabl room is assembled by moving past 6 Assembly Stations.

- **frames 2x4, 2x6, 2x12, end pates** → **assembly 1**
- **runs plumbing, electrical, gas, HVAC** → **assembly 2**
- **exterior board, interior dry wall, floor** → **assembly 3**
- **door, window, trim, closet, cabinetry, exterior** → **assembly 4**
- **sink, shower, bath, boiler, appliances** → **assembly 5**
- **pressure test, quality inspection, fold, wrap** → **assembly 6**

As raw materials are dropped off they are built into components and fed into the assembly lanes.
Each assembly station is fed components by a dedicated **Manufacturing Lane**.
Trailers feed **lanes** which feed **stations**, packing & waste are re-cycled out hourly.

Each lane docks two raw material trailers side-by-side. Trailers are also used to store and manage inventory.
4.3 SHIPPING

With Boxabl packing tech, it costs about the same to ship a finished home, as it would to ship raw materials to site for a traditional stick build.

Rooms built in factory, packed down to shipping size, delivered to site and assembled like lego bricks.

By packing the rooms down, we are not shipping empty space like a modular, or shipping partial truck loads like a stick built. The transportation fees, that exist for any home type, are now being managed in the most efficient way possible. Not only do Boxabl rooms require a less skilled driver than a regular home construction but we use fewer drivers to get the job done.

Shipping has long been a problem when attempting to construct buildings in factories. Modular, factory built, homes lose much of the money saved from factory construction due to high shipping costs associated with shipping oversized loads.

Oversized loads can require multiple state and local permits, front and rear additional escort ‘flag’ cars follow cars and specialized drivers. As a result of the high shipping costs, buildings cannot ship cost effectively at distances greater than a 150 mile radius from the factory, eliminating the possibility for effective large scale manufacturing.

The Boxabl solution means rooms pack down to become a standard trailer load, allowing them to ship using standard shipping infrastructure by land sea rail and even air. Boxabl’s packing technology is so effective that even a modern pickup truck can tow a Boxabl room. Boxabl rooms weigh only between 8,000 to 12,000 lbs, depending on level of finish.
5. CUSTOMER TYPES

**Developers** – *Developers coordinate the process of taking a real estate development project from paper to reality.*

Large developers of all types would fit well into the Boxabl ecosystem and likely be our largest customer. Whether developing a strip mall, condominiums, or an upscale housing community, Boxabl can work towards fulfilling large custom orders for communities faster and with more concrete pricing.

### Top 15 largest developers in the U.S. in 2016

<table>
<thead>
<tr>
<th>COMPANY</th>
<th>RANK</th>
<th>PREV. RANK</th>
<th>TOTAL CLOSINGS 2016</th>
<th>GROSS REVENUE (MILLIONS)</th>
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<td>D. R. Horton</td>
<td>1</td>
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<td>41,652</td>
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<td>Lennar Corp.</td>
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<td>26,563</td>
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<td>PulteGroup</td>
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<td>14,229</td>
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<td>KB Home</td>
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<td>6</td>
<td>9,829</td>
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<td>Taylor Morrison</td>
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<td>Meritage Homes Corp.</td>
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<td>Hovnanian Enterprises</td>
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<td>6,687</td>
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<td>Toll Brothers</td>
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<td>6,098</td>
<td>$5,170</td>
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<td>Beazer Homes USA</td>
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<td>5,649</td>
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<td>M.D.C. Holdings</td>
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<td>M/I Homes</td>
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<td>TRI Pointe Group</td>
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<td>4,211</td>
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<td>LGI Homes</td>
<td>15</td>
<td>15</td>
<td>4,163</td>
<td>$838</td>
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**SOURCE:** [http://www.builderonline.com/builder-100/builder-100-list/2017/](http://www.builderonline.com/builder-100/builder-100-list/2017/)
General Contractors – Responsible for the day to day oversight of a construction site

A GC is often hired by a homeowner to build their dream home, or may even be in the business of building and flipping properties themselves. The GC will usually manage sub contractors that will deal with land prep, electrical, foundation and other duties that are involved in erecting a Boxabl building. General contractors will use Boxabl to fulfil customer orders for housing, build their own projects faster, undercut competitor pricing, and provide more options and more guarantees to their customers.

Retailers – A retailer is a big-box store

Our vision is that big retailers like Home Depot or Lowes will serve a showcase for Boxabl tech, both selling homes and connecting locals to the resources they need to build the boxabl home of their dreams.

FEMA – Federal emergency management agency

FEMA and other disaster relief organizations around the world could benefit immensely from shelter that is so transportable and fast to manufacture and deploy. A standing order for available inventory and storage fees in case of disaster could be a great contract for Boxabl.

Military – US and foreign military organizations

Military housing is a great use case for Boxabl, we can even air drop units into remote locations.
Imagine if the day after hurricane Harvey hit Texas, BOXABL shipped thousands of rooms that could be set up in a day.

Once the emergency passed they are easily moved and re-assembled into finished buildings, providing not only shelter, but useful jobs and new communities.
In 2016, new construction put in place in the United States was valued at around **1.16 trillion** U.S. dollars, up from around **788 billion** U.S. dollars in 2011.\(^1\)

Worldwide construction is a huge market with increasing costs and housing shortages in many places around the world.

Global construction costs are expected to increase by **3.5 percent** in 2017 after growing by **3.7 percent** in 2016.\(^2\)

California, for example, has such a serious housing shortage, that low income earners are being forced out of the state.\(^3\)

On average, US households spend approximately **20% of their income** on housing.

At Boxabl, we think that’s **too much**.

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7. WHAT WE CAN BUILD

Boxabl boxes can be connected together like Lego, this means the possibilities are endless. Beginning with one Boxabl room of 750 sq ft, more can be added to create structures of unlimited size and shape that can be stacked up to 7 stories high.

Different interior and exterior trim can be selected stock from the Boxabl factory. This means different colored walls, different style kitchens, different floor types, or even just order a blank building box for full custom finish on site.

Markets Boxabl Serves

Residential
- Single Family
- Low Income
- Luxury
- Multi-family
- Condo / Apartment
- Townhomes
- Home Additions

Commercial
- Office
- Storefront
- Hotels
- Gas Station
- Restaurant

Specialty
- Disaster Relief
- Military
- Third World
- Temporary Worker Housing
7.1 FLOOR PLAN EXAMPLES

1. 1B/2FLS FLOOR PLAN A, 1ST FL
   1/8" = 1'-0"

2. 1B/2FLS, FLOOR PLAN A, 2ND FL
   1/8" = 1'-0"

3. 1B/2FLS, FLOOR PLAN A, 1ST FL
   1/8" = 1'-0"

4. 1B/2FLS, FLOOR PLAN A, 2ND FL
   1/8" = 1'-0"
7.1 FLOOR PLAN EXAMPLES (CONT)
7.1 FLOOR PLAN EXAMPLES (CONT)
7.1 FLOOR PLAN EXAMPLES (CONT)
7.2 EXAMPLE BUILDING STYLES: HOUSES
7.2 EXAMPLE BUILDING STYLES: TOWNHOUSES
7.2 EXAMPLE BUILDING STYLES: APARTMENTS
7.2 EXAMPLE BUILDING STYLES: HOTELS
7.3 INTERIOR LAYOUT STYLES: SOUTHWEST
7.3 INTERIOR LAYOUT STYLES: CONTEMPORARY
7.3 INTERIOR LAYOUT STYLES: COLONIAL
7.3 INTERIOR LAYOUT STYLES: COLONIAL ATRIUM
8. OTHER SAVINGS

Savings don’t end at the lower cost of the building itself. Time costs money.

With an inventoried building that’s ready to ship the moment the customer clicks order, build time is cut from the 7 month national average to zero. Boxabl boxes are already built and sitting in inventory. All that is left is shipping and assembly. Bringing total completion time from months down to weeks. Cutting time off the pre build cycle, ending lost time from weather delays, eliminating some architect and attorney needs all add up to huge savings.

The 2014 Survey of Construction (SOC) from the Census Bureau shows that the average completion time of a single-family house is around 7 months, which usually includes around 25 days from authorization to start and another 6 months to finish the construction.

Less time building means more time selling.

Office
- Cut months from the pre-build cycle
- Build twice as much with less staff
- Use less professional services
- Turns competitors into customers

Onsite
- Less weather delays & weather damage
- Fewer skilled trades (labor shortage)
- Eliminate most site theft

Quality
- Approve a physical sample in weeks
- Pass along a factory warranty recourse
- Standardized consistent quality

9. CUSTOMER EXPERIENCE

Download the boxabl app and turn your mobile phone into an immersive 3d experience where you can not only build and price your boxabl home in real time, but see how it feels to stand in your boxabl room.

Boxabl will provide the simplest and most user friendly home construction ever seen.

Customers will visit a web-based configurator where they can drag and drop Boxabl rooms to design a custom building, or choose from a set of pre-configured options. One click allows for different interior and exterior finishes, colors, trim, and floor planning.

They will then be instantly provided with real time pricing, floor plans, a bill of materials, and a ship date. Ideally, rooms can ship in as little as 0-4 weeks depending on level of customization and inventory.

Boxabl rooms arrive to customer’s prepared site, are unpacked and stacked using only a crane and standard hand tools. Final hook ups are completed and the building is ready for final inspection.

0-4 weeks
(varies by customization level)
estimate average shipping time for Boxabl rooms
10. PATENTS

Boxabl patent protection is strong. Currently with US patent number 8474194, 8733029 and CA 2442403 issued, several more completed and filed pending issuance.

Protection on our innovations not only secures Boxabl but our investors interests too. Ensuring that we maintain ability to utilize the tech we have invested so much time and money in developing.

**Modular prefabricated house**

**US 8474194 B2**

**ABSTRACT**

A prefabricated house including two or more modules, each module having one or more foldable walls. The foldable walls have one or more multi-frame openings. The two or more modules are structured to be joined at one of the one or more multi-frame openings.

**DESCRIPTION**

**CROSS-REFERENCE TO RELATED APPLICATION**

This application claims priority under 35 U.S.C. §119(a) to provisional application Ser. No. 60/467,046, filed Aug. 30, 2002, which is incorporated by reference, and is related to commonly assigned concurrently filed U.S. patent application Ser. No. 60/467,022, filed Aug. 30, 2002, entitled “METHOD OF SELLING PRE-FABRICATED HOUSES”.

**BACKGROUND OF THE INVENTION**

1. Field of the Invention

This invention relates to prefabricated houses and, more specifically, to a modular, expandable prefabricated house.

2. Background Information

**CLAIMS**

(4)

What is claimed is:

1. A prefabricated house comprising:

   - two or more modules each module having a frame, said frame having a plurality of studs;
   - said module frames having one or more multi-frame openings;
   - each said multi-frame opening incorporating two studs from said module frame plurality of studs and having a plurality of medial cross-members;
   - said two or more modules structured to be joined at one of said one or more multi-frame openings;
   - wherein each cross-member in said plurality of cross-members is coupled to said studs in a manner sufficient to support any additional components
11. GREEN

Standardized factory building and volume uniform production allows us to hone in on the best practices for energy efficient building. This means lower energy costs for the homeowner and for the environment.

Construction sites create a tremendous amount of waste. Excess materials like wood and packaging end up directly in a landfill. These types of waste can be minimized through recycling and efficient logistics that can be achieved through scale.
12. SUPPLY CHAIN

In a large organization, an efficient supply chain can drop savings directly to the bottom line.

In a small operation, it is harder to avoid small inefficiencies, a driver is late, you run out of lumber and need to make an extra trip, a nail gun breaks, multiple half loads of materials come from different vendors.

These types of inefficiencies can be eliminated in a large scale operation, waste accrued and time lost can be recouped and lead to a massive reduction in costs.

Imagine how the efficiencies achieved by amazon or walmart can translate when applied to housing.

Efficiencies gained through mass production of buildings have transformative implications for society.