

# The Indirect Architect: Linking Design Services and Mass-Production to Improve Workforce Housing

by

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B.Arch, Architecture  
University of Oregon, 2003

SUBMITTED TO THE DEPARTMENT OF ARCHITECTURE IN PARTIAL  
FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF SCIENCE IN ARCHITECTURE STUDIES  
AT THE  
MASACHUSETTS INSTITUTE OF TECHNOLOGY

JUNE 2007

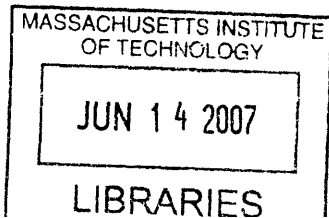
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# ABSTRACT

## The Indirect Architect: Linking Design Services and Mass-Production to Improve Workforce Housing

by  
Carey Rose Clouse

Submitted to the Department of Architecture on May 24, 2007 in Partial Fulfillment of the requirements for the Degree of Master of Science in Architecture Studies

Architects have grappled with their role in the development of prefabricated building technologies and workforce housing for the last century. Historically, the architectural profession has witnessed limited participation and a narrow impact on this building type. As mass-production increasingly becomes a viable means of developing budget housing, and as companies seek to market these building products, architects stand to grow their role within the design field.

This thesis is supported by a literature review, coupled with interviews and case studies. In compiling information from existing building projects, reflections from practicing experts, and theories from written work, projections for the future role of the architect have been developed.

When architects participate in the development of prefabricated housing, they exchange their role as the client's direct representative for a more amorphous identity within the indirect retailing of architectural services. This shifting role effects changes to the entrenched and specific definition of architectural responsibility. The architectural field will need to bend around new versions of liability and legal responsibility, different payment systems, an emphasis on generating design work that appeals to the majority, and the development of architecture as a product over a service. The building industry will need to shift as well, changing the way the job site is treated, their treatment of transportation, the development of materials, and the technological innovation embedded in architectural work.

Thesis Advisor: Reinhard Goethert

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# DEDICATION

It is estimated that only 2% of new American homebuyers work directly with an architect.<sup>1</sup> This research is dedicated to the work of improving access for the other 98%.

# PREFACE

In 1973, my parents bought an empty lot along an alleyway in Eugene, OR, with the intention of building a small shop. With a \$2,800 inheritance and basic building skills, they constructed a bare-bones structure. Over the next ten years, they rented the house to skilled tradesmen in exchange for labor, growing the simple shop into a garden-utopia and two-story house. The house has hosted tenants that range from these contractors to a weekly newspaper and ultimately, top-dollar renters. Thirty-five years later, this small investment has paid for itself a hundred times over, and provided my parents with the equity for other building projects.

This thesis grew out of my interest in an often overlooked sliver of the socio-economic spectrum-- the workforce--- and the dearth of accessible routes to home-ownership for this group. It comes from my love affair with homebuilding, and the belief that self-sufficiency encompasses all of the basic human needs, including shelter. It is wrapped up in an understanding that homebuilding offers opportunities for place-making, community-building, and financial freedom.<sup>2</sup> It is tied to the belief that opportunities for empowerment stimulate economic resurrection. It comes from seeing how a single shed built in 1970 has become a cash-cow (and also a jumping-off point) for a couple with minimal resources.

While prefabricated architecture doesn't necessarily dictate a bigger role for the homeowner, it does ensure improved access to architectural products, offer a greater variety of dwelling choices, and an opportunity to participate in the building process. The industrialization of architecture holds the potential to transform architectural elitism into an opportunity to connect design services and the workforce.

<sup>2</sup> Understandably, homeownership should not be considered a catchall solution for the problem of affordable housing. According to MIT's Associate Professor of Urban Studies and Planning, Xavier de Souza Briggs, it is stable housing, including rental housing, that makes for effective affordable housing. Indeed, homeownership lures many people into unsupportable mortgage commitments, or responsibilities that outstrip their abilities. Interview with Briggs, October 23, 2006.

# ACKNOWLEDGMENTS

Thanks to my thesis committee:

Advisor, Reinhard Goethert: Principal Research Associate in Architecture, MIT School of Architecture  
Primary Reader, Adèle Naudé Santos: Dean of the MIT School of Architecture

Thanks to the people who granted interviews:

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John DeMoncheaux, Professor, MIT School of Architecture and Planning, Cambridge, MA  
Jhaelen Eli, Empyrean Design Director, Acton, MA  
Jessica Ellingson: Educator, University of Oregon, Eugene, OR  
Rob Forbes: Founder, Design Within Reach, San Francisco, CA  
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Angela Matt: Architectural Designer, Christiani Johnson Architects, Inc, San Francisco, CA  
Jarrett Smith: Merchandising Director, Lowes Companies, Mooresville, NC

Thanks to my friends and family, for their interest and input:

David Clouse  
Brian Pearson  
Gena Peditto  
Jake Wegmann  
Albert Wei  
Ai Yamamoto

# INTRODUCTION

In a country where architectural services address the far ends of the economic spectrum, only the very rich and the very poor benefit from direct design guidance. The gap between, or America's underrepresented lower and middle income earners, lacks access to both architectural services and the construction industry. Prefabricated housing components, particularly those which incorporate the synergies of mass-production and thoughtful design, offer innovative ways of bundling architecture and homebuilding for the working poor.

Home-ownership has long been a measure of success in the American social tradition.<sup>3</sup> Over the last two centuries, pattern books, notions of self-sufficiency, and catalogue houses have made homebuilding a reality for middle and lower-income families. These routes effectively empowered America's workforce<sup>4</sup> to build for themselves, largely without regard to income, skills, or legal process. Over time, this open access to self-supported homebuilding has diminished: zoning and codes are more regularly enforced, property has become more expensive, and people are growing increasingly divorced from the skills of the building trade.<sup>5</sup> The challenge of providing affordable homebuilding opportunities for the American workforce today can be tackled by pairing this tradition of self-building with more recent technological innovation.

3 For example, former President Jimmy Carter has long championed home-ownership as a means to eliminate poverty housing and homelessness.

4 The workforce refers to Americans who have one full-time job and are filing taxes at 50- 80% of AMI. AMI is defined as the area median income, and figures are updated annually by the U.S. Office of Management and Budget.

5 The U.S. has run out of "free" land, and land parcels within cities grow incrementally smaller over time. American zoning was invented around 1915, setting the stage for future zoning codes, such as those enforced by the Euclid Supreme Court Case in 1926. A growing emphasis on white collar jobs, via policy, education, and a more developed industrial and informational age, has limited the prevalence of the building trade.





Despite these restrictions to self-built housing over the last century, small-scale do-it-yourself building projects and self-assembled industrial objects have garnered increased popularity in the North American market. Companies such as Home Depot, Lowes and IKEA have proven this type of consumption both palatable and profitable, while also demonstrating win-win economic returns for both buyers and sellers. While products from these companies often require either assembly or construction, kit-of-parts housing components and assemblies are becoming more straightforward, involving minimal building expertise. Because manufacturing companies often enlist professional designers to develop products, consumers benefit from advanced design services without the typical expenses associated with hiring a professional.

Applying this over-the-counter, prefabricated business model to a large scale endeavor such as housing is the next step in this emerging U.S. market, one subject to a number of challenges and opportunities. Opportunities include empowerment of the American workforce to engage in homebuilding efforts, improved relationships linking under-represented income groups to the design field, provision of financially and physically accessible housing for Americans, and enabling architects to reach a broader market. Prefabricated housing, in particular, affords the development of more advanced manufactured housing technologies, the improvement of environmentally-conscious building products, and the widespread dispersal of new, limited-market technological innovations. This model takes advantage of some of the inherent benefits of prefabricated homebuilding, including faster construction speed, an overall reduction of construction costs, improved quality control, and a streamlined system for organizing the building process.

Challenges for this building strategy include addressing common assumptions about the nature of the industry, and allowing for unique building solutions, which lead to diverse building types. In redesigning the way that housing is built, industry leaders will need to address the issues of retaining profitable work for the architectural profession and skilled job trades, navigating the legal, political, code and permitting issues specific to different regions, and the problem of retaining a diverse collection of open-source information. In addition, prefabricated building components lack a contextual site response, incur added transportation costs, require improved delivery and construction coordination, and depend upon a significant initial investment for concept design, advertising, and manufacturing.

Beyond these opportunities and challenges, manufactured homebuilding ultimately relies on changing social perceptions and a shifting housing paradigm. By embracing a grass-roots approach to housing the workforce while harnessing the existing power of mass-production, buyers can exploit opportunities to access newfound self-sufficiency, indirect architectural services and ultimately, economic efficiency. This movement offers a response to a particularly salient time in the U.S. housing market: one where the workforce is increasingly pushed out of homeownership opportunities due to lower spending power, lower-to-middle income Americans are growing ever more indebted, mass-production is increasingly becoming the norm, and the desire for homeownership is fundamental.<sup>6</sup>

Bridging the gap between large-scale home suppliers and their customers may only be a matter of streamlining savvy design, marketing and cost-efficiencies. However, architects inherently bring a number of valuable contributions to this process. Beyond the typical stylistic improvements that a regular designer would provide, architects incorporate an understanding of the building trade, a background in architectural theory, and an awareness of light, color, space and form. Ultimately, architects lend a project the sense of credibility necessary to sell the image of fine homebuilding at over the counter prices.

6 Bernstein, 1.

When architects are employed by manufacturers, they lose direct contact with their clients. Although this relationship suggests an improved ability to reach more people and provide greater services overall, it brings up critical questions about the changing nature of architecture as a field. Architects will need to adjust their ways of working to reflect their new role in the design process.

This thesis explores emerging outlets for mass-produced housing, opportunities for workforce homebuilding, and the ability to link these two groups through indirect design services. This thesis emphasizes the potential of mass-produced, pre-manufactured building components<sup>7</sup> as a means for providing architectural services, affordability, accessibility and empowerment to the American workforce in their quest for housing. The role of architecture within this genre of homebuilding knits these themes together, specifically the contribution of architectural services and the potential effect of the widespread distribution of design.<sup>8</sup>

7 Components, in this case, run the gamut from cabinet assemblies to wall assemblies to entire houses. Companies such as Home Depot, Lowes and IKEA offer the entirety of this range.

8 Additional areas of interest, as a means of framing these thoughts, include: green design, social action, community building, new materials, mass production, kit-of-parts building solutions, the difficulties of working within existing zoning, codes and other legal framework, self-reliance, affordability, open-source building technologies, the loss of architecture as a professional field, and the importance of providing the workforce with access to design services while empowering independent homebuilding. These peripheral issues are not to become tangents to the thesis itself, they simply serve as additional topics that may bolster the argument for self-building within the context of housing.

# HYPOTHESIS

Mass-production lends itself both to affordability and the widespread distribution of indirect architectural services: this trend has the potential to redefine the nature of American workforce housing. This thesis will look first at the role of mass-production in workforce housing, specifically how it has served this population to date. Next, this thesis will consider the potential impact of retailing prefabricated housing, in terms of reforming affordability and accessibility. Two hypotheses exist:

1. Housing can be made more accessible to the American workforce by incorporating prefabricated building initiatives with low-cost, off-the-shelf products.<sup>9</sup>
2. The mass-production of housing elements enables architects to reach a previously underserved subset of the American population, workforce homeowners, by redefining the way in which architecture is packaged.

<sup>9</sup> These products run the gamut from wall assemblies and structural panel systems, to whole prefabricated houses.

# METHODOLOGY

This thesis research is supported by a combination of resources: a literature review, real-world case studies, and interviews with practicing professionals.

## Literature Review

Books and articles are referenced to describe:

- a. Production construction, catalogue houses, mass-production, and product development.
- b. Consumerism, marketing, and the companies that specialize in the mass-production of building elements. (This study targets the major players in the U.S. market today: IKEA, Home Depot, and Lowes.)
- c. The socio-economic factors affecting the workforce in the U.S., including access to affordable housing.
- d. Design services in the U.S., and innovative ways of linking architecture and the workforce.

## Case Studies

Case studies from three major building companies provide a secondary, more tangible approach to this research. These studies help to differentiate the unique organizational methods and opportunities for prefabricated housing initiatives, while providing an understanding of current trends and trajectories. These three major frames are IKEA, Home Depot, and Lowes.

These three companies have been chosen because of the breadth of the services and products they offer, as well as their growing role in the U.S. and world markets. Compared to a local lumber company, these corporations have more advanced resources for advertising, mass-production and architectural design. While both types of companies provide the personal support services in house needed to carry out independent homebuilding, they approach this industry from different angles. IKEA has built a reputation as a home furnishings giant, and is growing into a homebuilding provider. Both Home Depot and Lowes already market themselves as homebuilding companies, but they are growing their role within this field by providing bundled and prefabricated house units.

Beyond these three companies, case studies showcasing other innovative companies support and lend depth and breadth to the argument. These case studies are appended to the document and include Sears Catalogue Houses, KB Manufactured Homebuilders, Habitat for Humanity, Cemex, The Rural Studio, Operation Breakthrough, the Yestermorrow Design/Build School, the Case Study Houses Program, Empyrean's Dwell homes, Muji, and Cuba's Micro Brigade for Housing.

The Sears Catalogue Houses case study offers a historic model for a successful kit homebuilding industry, while KB Manufactured Homebuilders, Muji, and Empyrean offer a modern-day prefabricated equivalent. KB dominates the manufactured homebuilding industry, Muji sells houses through its retail outlets, and Empyrean has exclusive rights to the much-publicized Dwell prefabricated house market. Habitat for Humanity, The Rural Studio, and Yestermorrow Design/Build School offer examples of working group-oriented building operations. Cuba's Micro-Brigades have transformed the homebuilding process for workforce Cubans through forty years of state-subsidized building projects, while Operation Breakthrough was an unsuccessful attempt by the government to use prefabrication for social housing in the 1970's. Finally, the Case Study Houses program was an attempt to connect known designers with the market of mass-produced housing in the mid-1940's.

## Interviews

Interviews help to round out this research with real-world perspectives. Experts include professors, practitioners, and people who are engaged in their own versions of homebuilding. These interviews are a means of getting a well-rounded and up-to-date perspective on current prefabrication practice, and the potential it holds.

Interview Subjects include:

### Architectural Critics

Julian Beinart, Professor, MIT School of Architecture and Planning, Cambridge, MA

John DeMoncheaux, Professor, MIT School of Architecture and Planning, Cambridge, MA

Jessica Ellingson: Educator, University of Oregon, Eugene, OR

Karrie Jacobs, Writer, Metropolis Magazine, founding editor of Dwell Magazine, NY, NY

Kent Larson, Principal Research Scientist, MIT Open Source Building Alliance, Cambridge, MA

### Retail Representatives

Rob Forbes: Founder, Design Within Reach, San Francisco, CA

Winston Ledet: VP of Merchandising Strategy, The Home Depot Companies, Atlanta, GA

Jarrett Smith: Merchandising Director, Lowes Companies, Mooresville, NC

### Architectural Designers

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Trevor Lewis: Architect, Skylab Design Group, Portland, OR

Amy Marino: Architectural Designer, Hardison Komatsu Ivelich and Tucker, CA

Angela Matt: Architectural Designer, Christiani Johnson Architects, San Francisco, CA

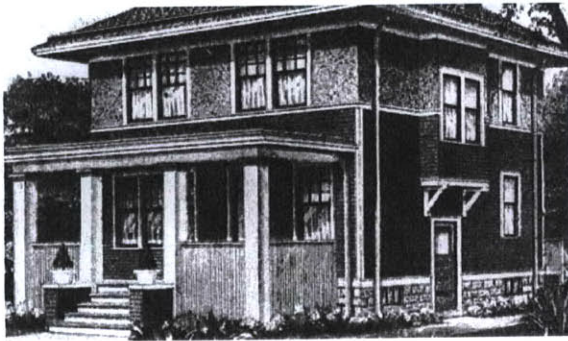
# BACKGROUND: HISTORY OF PREFABRICATION

## Homebuilding: An American Tradition

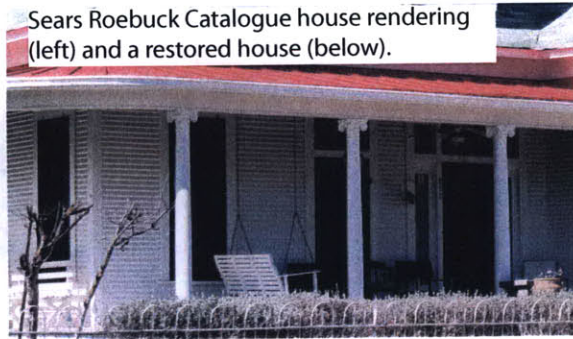
The tradition of independent homebuilding in the U.S. has long been bound to ideals of both success and self-sufficiency. The country was founded upon a homesteading ethic, a national frontier mentality that grew out of the availability of land and materials, and the necessity of providing new dwellings where few existed before. While this early development was inextricably linked to conquest, confrontation, and resource depletion, it continues to be a source of pride and identity for many Americans. Indeed, the founding of the U.S.; and its physical form today, have hinged upon these efforts.

Over the course of the last century, two opposing forces have eaten away at this layman's connection to homebuilding. People have changed, both in terms of their skills and in terms of their family or community structure, so that fewer individuals are capable of independent homebuilding. This informational loss can be attributed to a shift in vernacular styles and the skill sets that support those ways of building. In addition, America's changing family structure, brought about by increased mobility, separates individuals from the labor and information pools (such as other family members, church groups, friends) who might otherwise help out. Secondly, the government has tightened restrictions on self-building efforts, limiting access for many Americans. Although other contributing factors exist, such as diminished access to materials and land, these two shifts have fundamentally impeded independent homebuilding efforts.





Sears Roebuck Catalogue house rendering (left) and a restored house (below).



### Prefabrication and Mass-production

Accounts exist of prefabricated building systems that date back to 216 B.C., when Hannibal employed demountable huts for his troops during invasions on the Roman Empire. However, prefabrication as we understand it today really began in the mid-16<sup>th</sup> century as a means of supporting expeditions in new territories.<sup>10</sup> The earliest example of prefabricated housing in the U.S. occurred in 1624, when English manufacturers shipped panelized wood house components to a fishing village in Cape Ann, Massachusetts.<sup>11</sup> Later examples of prefabricated building efforts include kit houses shipped by rail to California during the gold rush in 1849, iron building components sent to British colonies starting in the 1820's, and wooden structures that played a significant role in the settlement and development of the American Midwest in the 1860's.<sup>12</sup>

When the Ford Motor Company demonstrated the opportunities afforded by assembly-line fabrication, industrial prefabricated houses witnessed newfound popularity. Prefabrication was hailed as an opportunity to improve the quality, affordability and accessibility of housing.<sup>13</sup> This shift occurred in the first decade of the 20<sup>th</sup> century, sprouting new housing companies eager to develop prefabricated technologies.

### Pattern Books

10 Owen 7.

11 Arieff, 13.

12 Herbert, 12, and Owen, 15. According to Owen, the Illinois Catalogue of Sectional Buildings connected Middle West homeowners with the design and product resources of New York and Boston.

13 Arieff, 13.

Although prefabrication has early roots in the housing industry, a more prevalent precursor came in the form of pattern books. "Popular magazines and plan books were a source for those who could not or chose not to hire an architect."<sup>14</sup> These pattern books generated interest among prospective homebuilders and disseminated design ideas throughout the country. Armed with a book, clients could approach builders with a selected design, and these developers felt empowered to depart from earlier vernacular styles. Pattern books provided information, but did little to reinforce dependence upon the building industry's products for those designs.<sup>15</sup>

### Kit Construction

In 1906, Aladdin Read-Cut Houses introduced the first kit house, with building components pre-cut and numbered, but assembled by the end user on site. With kit construction the building industry could improve profits and control product outcomes by specifying the materials used in each project. The house kits also improved access to homebuilding by simplifying the construction process: "for backyard builders who needed more than a couple of drawings to get started and for developers looking for an economy of scale, kits provided the answer."<sup>16</sup>

Sears, Roebuck & Co. launched a catalogue house line shortly thereafter, selling more than a hundred thousand houses in a thirty year period.<sup>17</sup> While this retail giant emerged as one of the most-recognized providers of kit houses, many other companies such as General Houses, American Houses, Inc., American Rolling Mills, the Celotex Corporation, General Panel Corporation, American Homes, Gordon Van Tine, Montgomery Ward, the Hodgson Company and the Homosote Company followed suit.<sup>18</sup>

With the aim of simplifying construction logistics while controlling numerous angles of

14 Randl, 44.

15 Monopolization of the market through material specification offered companies greater profit potential and reduced the vagaries of the finished product.

16 Randl, 101.

17 This thirty-two year period spanned from 1908 until 1940. Arieff, 13.

18 Sheppard, 37.



Mobile home parks have become prevalent throughout the U.S. (left).

the building process, these kits were developed with the intention of bundling all practical building components. It was common for kits to include pre-cut and pre-drilled wood framing members, nails, shingles, windows, doors, hardware, house paint and instructions. Aside from services and land, this whole-house approach ensured that construction outcomes were more reliable, more accurate and ultimately, more homogeneous.

Due to the economies of scale, these kits generated considerable profits despite long and expensive shipping journeys. Although material and construction suffered from reduced quality, the relative costs of standard houses outstripped kit houses by a factor of 1.5 to 1.<sup>19</sup> These savings ultimately were passed on to the client: "the affordable cost and ease of construction made home ownership a real possibility for blue-collar workers."<sup>20</sup>

### Prefabricated Building Systems

Other prefabricated building systems incorporated post-WWII industry advances, including concrete and steel components. These material advances were met with a desire to build; housing shortages after the war spurred a host of new ideas for modern dwelling, including prefabricated housing systems by Le Corbusier, Walter Gropius, and Mies van der Rohe. In their report on industrialized housing, Turner and Turner suggest that post-WWII Japan provided a fertile environment for prefabricated homebuilding, both because of the country's possessed preexisting tatami and shoji modules, but also because the country's devastated housing stock

19 Randl, A-frame.

20 Arieff, 13.



needed to be quickly replaced.<sup>21</sup> Although some early American architects worked to advance modern prefabrication options, notably Robert Tappan, Frank Lloyd Wright, and Buckminster Fuller, these innovations had little effect on the propulsion of prefabricated housing in practice.

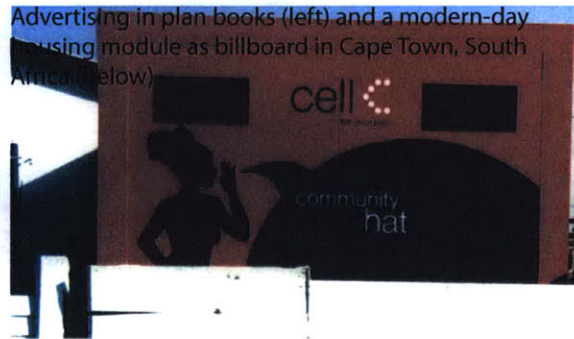
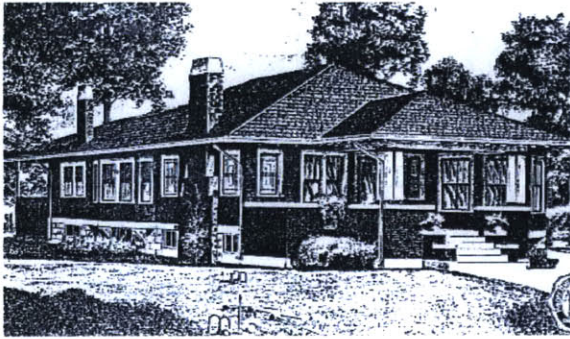
While these international modernists applied a 20<sup>th</sup> century design aesthetic to prefabrication, the American industrialized housing movement remained largely traditional in terms of aesthetic. Kit housing companies limited their production to proven ways of building and traditional house types. This relationship between prefabricated building companies and modernist designers thus began along a divide, reinforcing a split between the two camps that continues today. Perhaps the bold modern dwellings designed by architects, coupled with a radical production method, were simply too much for risk-adverse buyers.<sup>22</sup>

The Case Study Houses program was launched by John Entenza in 1945, and developed a physical library of thirty-six different houses. This collection featured modern domestic architecture and was intended to serve as “a model for future construction on a mass scale.”<sup>23</sup> This program allowed architects to explore the opportunities for low-cost construction and a modern design aesthetic, but didn’t ever reach the public in the pure form intended. The few companies that

21 Terner and Turner, IV-15.

22 Architectural critics agree that despite widespread architectural interest in this modern prefabrication movement, it lacked the critical popular support needed to take off. This void could be due to a lack of buy-in, poor advertising, difficulty with loan access, or the sheer difficulty in changing people’s perceptions about the housing industry.

23 Arieff, 27.



did develop these modern prefabricated houses were unable to generate a critical mass of interested buyers, facilitate accessible homebuyers loans, and reach the economies of scale in production that such an endeavor required.

That prefabrication has long been an interest of the architectural field, but has lacked successful application within the profession, highlights the disconnect between ideas and practice. Although star-architects have devoted their energy to developing prefabricated building systems, few of these models have garnered any real support. Architects have been unable to harness the prefabricated housing market, either through advertising, cost, or other building trade alliances.

While modern prefabricated dwellings rarely sold well in mainstream America, more standard variations of manufactured housing became the norm. The birth of the single-wide and double-wide trailer housing systems gave rise to a new urban land-use typology. Early prefabrication companies influenced the development of the motorhome and house trailers, and also impacted the construction process for more traditionally built houses.<sup>24</sup>

The government also adopted the prefabrication movement in the early part of the 20<sup>th</sup> century. In 1937, the Farm Security Administration advocated mass-produced housing techniques as a means of improving housing accessibility. Several federal agencies contracted prefabricated houses for sharecroppers and other users. The military embraced the Quonset hut as an

24 By 1963, the mobile home and prefabricated housing industries split completely. Arieff, 28.

DIY building projects in Cape Town, South Africa (below) and at the Yestermorrow Design Build School.



inexpensive, efficient and quick building type.<sup>25</sup> In 1946, President Harry Truman supported a program that called for 850,000 prefabricated housing units for the Veterans' Emergency Housing Program.<sup>26</sup>

#### Responses to Prefabrication in the Construction Industry

Prefabricated building systems also necessitated changes in construction methods. Frank Lloyd Wright developed a housing system based on breaking down wall units into "regular, modular dimensions"<sup>27</sup> that simplified the construction process and allowed for the standardization of parts. Today, a similar way of building has been dubbed "production construction" and is practiced by developing an ad-hoc factory on the building site in order to improve efficiency and quality without excessive expense in transportation.<sup>28</sup>

Developer William Levitt used this production construction technique in a new way with his housing development in Levittown, Pennsylvania in 1945. He brought the factory to the site, and also focused on building an entire town from the ground up, rather than viewing each individual house as a construction project. Levitt's vision of prefabricated housing extended beyond the replication of individual units, instead treating the work of house building as a collective whole. He completed 6,000 houses over a period of three years.<sup>29</sup>

25 About 170,000 Quonset huts were produced during WWII. Herbers, 23.

26 Arieff, 21-23.

27 Nearly 24 of these Usonian houses were developed in the 1930's and 1940s. Arieff, 19.

28 The Cohousing Company in Berkeley, CA develops affordable multi-family dwellings by employing production construction techniques on-site. While this method often entails a great deal of initial drawing coordination and the instruction of each new contractor, it creates significant overall efficiencies.

29 Arieff, 27.

Levittown set the standard for planned community developments--- Levitt was a single developer controlling a new subdivision, using a common set of building footprints and patterns, and incorporating the model of production construction for on-site development. The town flourished in all its homogeneity, and gradually morphed into a varied, diverse collection of independently tailored buildings. Although a number of innovative developers openly fought this type of homogeneous development, ensuing market trends actually reinforced this kind of mono-community.<sup>30</sup>

Construction techniques were impacted by the design field as well. Many architects embraced prefabricated building solutions and actively worked on developing prototypes for this futuristic notion. "Partnering in the late 1950s, the National Association of Home Builders (NAHB) and the Douglas Fir Plywood Association (DFPA) used the triangular form to generate consumer interest in permanent homes. Testing modes of prefabrication, they built a "research house" in South Bend, Indiana, from structural sandwich panels."<sup>31</sup> New forms inspired new construction techniques, and the two fields collaborated to a certain extent.

### Marketing Prefabrication

The Sears Roebuck Catalogue homes were the first to really incorporate advertising into the home ownership realm. They marketed a lifestyle associated with buying a specific type of house, and ultimately connected non-physical ideals to built form. In the first half of the 20<sup>th</sup> century, this company "convinced thousands of Americans that a Sears house would offer them the comfort and security of their dreams."<sup>32</sup>

30 Joseph Eichler, of Eichler Homes, Inc. is a notable exception to this rule. He felt that repetition in communities was unacceptable, and although he would develop many houses simultaneously on one parcel of land, he actively fought homogeneity by hiring various architects, employing an open-scheme post-and-beam construction method, and identifying a connection to the landscape for each specific site. Arieff, 27. Jill Herbers also verifies that time has helped to create diversity in Levittown: "As time passed and families grew, the small houses sprouted dormers, garages, breezeways, and wings." Herbers, 26.

31 Randl, 149.

32 Arieff, 13.

This advertising brought house consumption into the fore, and empowered consumers to view houses as accessible products with a variety of options. In describing her Case Study Houses submission, Ray Eames explains that “it was the idea of using materials in a different way, materials that could be bought from a catalogue, so that there was a continuation of the idea of mass-production, so that people would not have to build stick by stick but with the material that comes ready-made off the shelf.”<sup>33</sup>

Although early prefabricated building systems targeted blue-collar workers and lower-to-middle income earners, a splinter audience has emerged in recent years. Modern prefabricated house design has become a cause backed by Dwell and Sunset magazines, and almost exclusively targets upper-income buyers.<sup>34</sup> This shift has renewed the glamorous intentions of the prefabricated aesthetic, and threatens to elevate the image of manufactured housing beyond poorer associations.

### The Future of Prefabrication

This rift between expensive small-batch modern prefabricated houses and the more accessible manufactured housing on the market stands as a major hurdle in the development of appropriate, affordable and accessible housing. Current models lack the ability to address changing family structures, energy efficiency and environmental stewardship, and dependable material quality. This division between a modern aesthetic and a truly affordable prefabricated house likely stems from the relative isolation between these two camps. Finally, the social stigma associated with prefabricated housing will likely challenge efforts to support an affordable, modern future for prefabricated homebuilding.

33 Herbers, 27.

34 Although design magazines tend to represent the extreme gap between vision and action, they also point towards trends in the design world, and show intentions, ideas and consumer desires.



# BACKGROUND: THE U.S. MARKET

## The Role of DIY in the U.S.

Do-it-yourself building projects have a long history in popular American culture. Construction has been viewed as both a pastime and hobby, stemming, perhaps, from the required shop classes offered by many American high-schools. Because of this robust link to the construction world, mid-1950's mainstream Americans not only favorably viewed the construction industry, but possessed a modicum of skills for participating in this type of activity.

For workforce Americans, DIY presented an alternative to hiring builders and inspired a more engaged relationship to place-making. "Whether it was finishing an attic space or building a vacation home, couples, particularly young couples, saw do-it-yourself activities as a means of acquiring comforts that were increasingly considered necessities yet too expensive to purchase as finished products."<sup>35</sup>

While today fewer people possess the construction skills necessary to build houses for themselves, interest in self-building doesn't appear to have waned. With simplistic connection points, graphic step-by-step instructions, and basic tool requirements, IKEA has ushered in an era of unskilled DIY furniture making. The flat-pack pre-assembled kits help stores reduce showroom space, eliminate in-house assembly time, and cut transportation costs. Because these savings are extended to the customer, IKEA has positively marketed their flat-pack products. Although the IKEA model has already been replicated for many industrial products, this innovation stops short of a complete house.

## Design/Build

Great efficiencies are realized when design services are closely tied to the construction realm. Today, these camps are typically divorced from each other, leading to increased expenses, inefficiencies, change orders, and miscommunication. Architecture schools have sought to repair this rift as it widens. From the Bauhaus education model to the insertion of design/build programs in many architectural departments, academia is fighting to maintain a physical connection to the construction process.

At the Yestermorrow design/build school in Vermont, instructors emphasize the importance of linking design to the construction process early on. "Architects are routinely trained without any building experience that might inform their designs, and builders are trained to execute without a sense of the overarching purpose or design of the project. Combining design and building offers numerous advantages and promotes the creation of intentional and inspired buildings and communities that enhance our world. From the professional design/build to the do-it-yourself design/build homeowner, every designer should know how to build and every builder should know how to design."<sup>36</sup>

In the professional realm, architects and builders often interact, yet maintain their distance. Design/build firms have successfully pulled these two parts together in practice, although they remain rare entities in the working world. It is likely and reasonable that a single homebuilder would want to link design and construction on a personal project. The management and coordination of these two camps seems plausible under one owner with a singular vision, and the flexibility that one achieves makes it far more likely that the advantages will be realized.

## Cowboy Culture and Self-sufficiency

In the American populist tradition, a consistent homesteading ethic has survived from early

36 From the Yestermorrow website: <http://www.yestermorrow.org/about.htm>

exploration efforts to the present day. This interest in looking after oneself has manifested in a preoccupation with the back-to-the-land endeavors and a pride in demonstrating self-sufficiency.<sup>37</sup> This undercurrent has become a recognizable part of the American Way, incorporating homesteading and rugged individualism, freedom, choice, and the development of the self. Moreover, this movement may well have led to the structure of decentralized political power in the U.S.<sup>38</sup>

This shared American individualism plays out in conspicuous consumption as well. Notions of self-sufficiency had emerged as a phenomenon of American life, from football tailgating parties to the family backpacking trip. When paired with shelter, this theme reflects a deep desire to develop houses independently, or adapt, improve, and create a dwelling with some sort of personal engagement. According to Home Depot's VP of Merchandising Strategy, "the key to understanding home-buying is that the home is more of an indication of who you are than any other product on the market. Many personal attachments and notions of identity can be linked to a house, such as your expressed status. Mass-customization in this realm is unpalatable for many because it doesn't offer people the opportunity to develop a sense of identity through their dwelling. The prefabricated house-builder needs to recognize that even a mass-produced building object still needs to belong to an individual."<sup>39</sup>

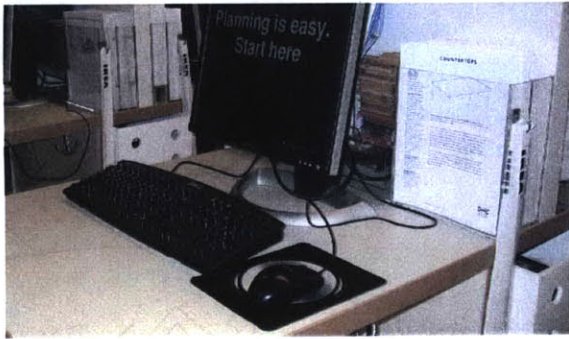
### Social Programs and Homebuilding

Habitat for Humanity builds houses using a program driven by sweat equity and volunteer support. While this model requires more human hours than a comparable market-driven project, it draws on fewer overall dollars. An added benefit is the community building and skill sharing that these projects afford, often breaking down existing barriers between low-income

37 Americans engage in hobbies that practice many of these moot survivalist skills. From bow-skinning to old-time reenactments, Americans are hankering for a connection to their roots.

38 The power of the state, and even smaller local units, has grown from a real desire to maintain localized control. The political structure of the U.S., as a federation of independent states emphasizes local control over a given domain. Personal Interview with Julian Beinart, February 15, 2007.

39 Personal Interview with Winston Ledet, March 19, 2007.



At IKEA, planning experts assist with home design. (above)  
Computer terminals are available for customer use. (left)

residents and volunteers. While the homebuilding tradition is a major undertaking involving significant time and human resources, the empowerment provided by these programs is worth recreating.

In Cuba, the government-sponsored Microbrigades for Housing have opened up homebuilding to workers with no real construction experience. Groups of individuals from diverse backgrounds are teamed together to design and build a shared multi-unit apartment building. This process may take years of evenings and weekends to complete, involves the training of participants with steep learning curves, incorporates community-building efforts, and ultimately empowers regular working Cubans to produce their own housing.

For independent homebuilding efforts, the models provided by many social programs simply don't transfer. Some of these projects entail excessive use of human labor, or are based upon donations and creative financing that don't readily apply to private homebuilding ventures.<sup>40</sup> In addition, many of the challenges facing these programs, such as the widespread use of toxic product donations, highlight the limited options available to clients. Rather than buying into a broken or otherwise ill-fitting program, the independent homebuilder would benefit from a more catered approach.

40 One Habitat for Humanity project, showcased at the Habitat Village, endorsed a program by which builders baked their own handmade bricks, before erecting those units into walls. Jacobs, 230.

# BACKGROUND: THE WORKFORCE

## The American Working Poor: Workforce Demographics

A wide swath of the American public falls into the lower-to-middle income brackets. Indeed, this section of the population is defined as making 50-80% of Area Median Income (AMI), as expressed by the U.S. Office of Management and Budget.<sup>41</sup> Although social scientists and activists sometimes call this group America's working poor, this thesis recognizes this group as America's workforce.<sup>42</sup>

When working-class Americans can't pay the rent, a second job is the logical option making ends meet. However, in 1996, only 6.2 percent of the workforce held second jobs, almost evenly split across genders.<sup>43</sup> Nearly two thirds of these multiple job holders work one full-time job and one part-time job.<sup>44</sup> While the American workforce may not have value in terms of money, it may have the time to invest in building efforts.

Within this income range, the people who could benefit from prefabricated workforce housing solutions must be classified even further. This lower-middle tier is comprised of a wide variety of jobs, identities, needs and abilities. A typical breakdown of workforce employees includes teachers, police officers, and workers in the service sector. Based on income alone, it could

41 The U.S. Office of Management and Budget categorizes AMI for housing policy purposes. Moderate income households earn between 80-120% of AMI. Low income households earn between 50-80% AMI. Very low income households earn no more than 50% AMI. This data, including 2006 AMI levels for all Metropolitan Statistical Areas is available at: <http://www.efanniemae.com/sf/refmaterials/hudmedinc/>

42 Note that the workforce is a broad label and could include low, middle and upper income generators. For the purpose of this thesis, it shall be assumed to encapsulate the more narrow definition provided. In Nickel and Dimed, Barbara Ehrenrich calls this group the working poor.

43 Stinson, "New Data on Multiple Jobholding Available from the CPS."

44 Ehrenrich, 45.



IKEA Boklock interior (below) and a unit getting lifted into place. (left)



include people with widely varied skill sets, including architects, builders, cowboys, truckers, and computer programmers. Ultimately, defining the workforce relative to this thesis becomes a question of who has the will to build, who has been priced out of the standard real estate market, and who is already building for themselves. This thesis addresses those members of the middle-to-lower income generating workforce who have a desire to improve design access in their homebuilding efforts, but would not ordinarily engage the services of an architect.<sup>45</sup>

Parsing the financial status and spending power of this broad group requires breaking down earnings as well as historical trends. These numbers, and their connection to quality of life estimates, vary greatly according to geographic location, family structure, and the fluctuating national economy. Although America's workforce may be calibrated according to salaries and filed tax data, this over-arching data set doesn't address the actual disparities among groups. For example, while the Economic Policy Institute claims that "the next 10 percent-sized slice of Americans (this is the workforce) went from \$6.80 an hour in 1996 to \$7.35 in 1999,"<sup>46</sup> these numbers don't help to pin down a national average that is useful in quantifying real spending power.<sup>47</sup>

It is worth noting that national poverty rates are still calculated by a relatively outdated method established in the early 1960's. When net worth is defined by something like food, which is relatively inflation-proof, it lulls people into underestimating actual changes in poverty.<sup>48</sup> Rent, on the other

45 This includes people who want to build for themselves as well as people who would consider buying a new factory-built house. It includes entire houses as well as components of houses.

46 Ehrenrich, 202.

47 Include EPI graphs here, from [http://www.stateofworkingamerica.org/tabfig\\_05.html](http://www.stateofworkingamerica.org/tabfig_05.html)

48 Poverty rates have remained low (around 13%) for the last decade. Ehrenrich, 200.

hand, has fluctuated greatly over time, increasing from 24% of the average family budget in 1960 to 37% in 1999.<sup>49</sup> “So the choice of food as the basis for calculating family budgets seems fairly arbitrary today; we might as well abolish poverty altogether, at least on paper, by defining a subsistence budget as some multiple of average expenditures on comic books or dental floss.”<sup>50</sup>

### Shelter Budgets: Housing Affordability and Access

Three primary factors inhibit homebuilding efforts by the workforce in the U.S. Salaries in this income group are low enough to stymie spending power but not low enough to merit government aid. “Many working families- with and without union contracts- fall between the cracks of federal housing policy. They earn slightly too much to be eligible for many HUD programs for the poor, but they don’t earn enough to take advantage of FHA mortgages or homeowner tax breaks.”<sup>51</sup> Debt and spending desire outstrip ability to pay bills, keeping people in a loop of consumption that obviates saving money. This is evidenced by the fact that 15% of all homeless people are employed.<sup>52</sup> Finally, due to the high price of rental housing, many people in this income bracket spend an excessive portion of their monthly salary on housing. “According to the Housing and Urban Development (HUD), about 2.4 million working renter households with incomes under \$25,000 spend more than half of their incomes on housing or in severely substandard housing.”<sup>53</sup>

Affordable housing, including homeownership, remains out of reach for many working Americans. In her study on the challenges facing America’s workforce, Barbara Ehrenrich calls this a national policy issue. “Indeed, it is probably impossible for the private sector to provide everyone with an adequate standard of living through wages, or even wages plus benefits, alone: too much of what we need, such as reliable child care, is just too expensive, even for middle-class families. Most civilized nations compensate for the inadequacy of wages by

49 Bernstein, Brocht and Spade-Aguilar, 14.

50 Ehrenrich, 200.

51 Dreier, 40.

52 National Coalition for Homelessness, 1.

53 Dreier, 39.



providing relatively generous public services such as health insurance, free or subsidized child care, subsidized housing, and effective public transportation. But the United States, for all its wealth, leaves its citizens to fend for themselves- facing market-based rents, for example, on their wages alone. For millions of Americans, that \$10- or even \$8 or \$6- hourly wage is all there is."<sup>54</sup> Developing affordable housing solutions without this government assistance might actually present change.

In July, 2005 the median American home cost \$220,000.<sup>55</sup> If a homebuyer agreed to spend 40% of their annual salary on a mortgage, they would need to be making \$88,000 every year.<sup>56</sup> Of course, this seems out of reach for most homebuyers, but given alternative financing, partner support, and innovative methods of borrowing, people are able to secure funding. The challenge for the provision of stable housing is not in flexing to accommodate these home prices, but in reducing the whole house cost.

The disparity between the cost of houses and the actual earnings of the workforce continues to grow, although their desire for homeownership remains strong. This results in an overextension of capital and growing foreclosures, a veritable real estate bubble in most major American cities.<sup>57</sup> "Working families need help paying the rent- or buying a home. But contrary to conventional wisdom, federal housing programs are not geared toward assisting the poor or toward average working families."<sup>58</sup>

54 Ehrenrich, 214.

55 Jacobs, 13.

56 Note that most social housing programs limit this housing cost figure to 30%, and although some lenders will go up to 40%, anything beyond 35% of gross income is considered unaffordable.

57 Blanton, 1.

58 Dreier, 39.



# BACKGROUND: THE STATE OF THE FIELD

Although the provision of affordable housing may ultimately be considered a government responsibility, the architectural field has become enamored with this notion of socially responsible practice. And while architectural magazines, schools, and conferences regularly address this subject, few architects have dedicated their work to this population. The reality, for many architects, is that affordable housing projects don't pay the bills.

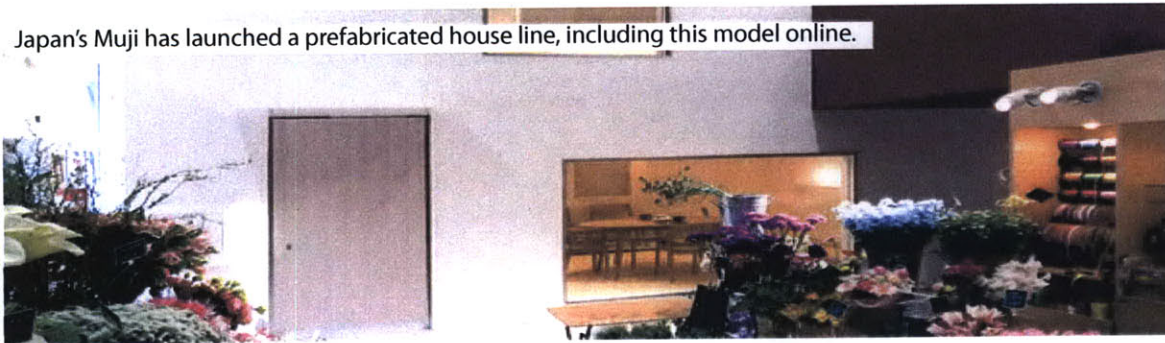
This imbalance between intention and practice is highlighted by the failures of a handful of architects who promoted affordability. "Gene Sternberg came from Europe and brought the socialist tradition of the original modernists with him. He wanted to design homes that were within the means of schoolteachers and college professors."<sup>59</sup> His affordable residential development, Arapahoe Acres in Englewood, CO, caved to the pressure of high-end developers who insisted on increasing the selling price beyond original agreements. Walter Gropius, who also brought these socialist ideals from Europe, championed an architecture that would be "readily accessible to everyone."<sup>60</sup> His residential work, like that of his friend Buckminster Fuller, made waves among architectural critics, but never gained the widespread approval of everyday Americans.

The architectural field's deliberate distinction between high-art houses and functional living quarters may be to blame for its inability to effectively harness prefabricated housing. Architecture, as it has been practiced and accepted in the professional realm, limits itself to

59 Jacobs, 134.

60 Jacobs, 11.

Japan's Muji has launched a prefabricated house line, including this model online.



a narrow sliver of the built world. Architecture schools, architectural critics and architectural designers generally agree on the types of projects included in this swath, recognizing a set of styles, standards and even starchitect heroes. Vernacular architecture, industrial building forms, and the ad hoc constructs that comprise 80% of the built environment lie beyond this camp.<sup>61</sup> In some sense, any building erected without the stamp of a certified architect can be considered beyond the pale of the architecture.

To broaden the scope of the architectural field is to make it more accessible, more inclusive, and more open to different ways of doing and being.<sup>62</sup> Prefabricated architecture, specifically, has the potential to reform the broken parts of the architectural world: "situated outside the architectural field, it (prefabricated housing) has cheerfully ignored architectural law. The strength of the prefabricated house lies in its popularity, its cheapness, and the industrial base from which it operates. These are precisely the areas in which modern architecture is weakest."<sup>63</sup>

The pretense that all relevant buildings are designed by architects is "a fiction tacitly maintained to preserve the illusion that architecture is a real force for change in the world. Ironically, this self-delusion is one of the reasons why architecture is at present not a real force for change in the world."<sup>64</sup> When one considers that the most intimate and everyday effect of the built world occurs in the home, and then reflects on the small minority of architect-designed residences in

61 Davies, 8.

62 The notion of architectural as a field comes from Garry Steven's *The Favored Circle*, with roots in the work of French sociologist Pierre Bourdieu. The loose definition of a field allows for more flexibility in terms of work included, although it also blurs the boundaries of this definition. Architecture is closely related to the fields of both art and construction, though tends to be more closely allied with art than construction. Davies, 3.

63 Davies, 8.

64 Davies, 8.

the U.S., the gap between architectural experience and everyday people becomes more palpable. The dearth of residential architectural design, at least in the traditional definition of the practice, accounts for a growing disjunction that involves class, access, and the responsibility of architects to provide services for people.

Perhaps architecture is not a panacea to the problems of the poor. Perhaps architects are overrated when it comes to providing satisfying housing for the workforce. Many architects argue that “the quality of the built world would be so much higher if architects were allowed to design more of it. But it is common knowledge that architects’ architecture is often disliked by non-architects.”<sup>65</sup> However, as long as architects disassociate themselves with the problem of providing design services for the majority of Americans, they remain out of touch with real life, and lack the ability to incur positive change in the built world.<sup>66</sup>

#### Defining Improvement

If architects endeavor to improve housing, they must define the working and broken components of present conditions. Gauging improvement involves assessing the factors that affect a user’s experience, market considerations and the social, economical and environmental implications of housing developments. Currently, architects have shaped a stereotype for themselves that largely ignores many of these factors, instead fixating upon aesthetics, popular trends, or highly formal attributes.

Moreover, these designers must make a compelling argument for the expertise that they bring to a project. Jerry Couto, AIA, believes that “an architect gives you added value, as much as 1/3 more than you spent,” by saving time to make design drawings, knowing the zoning regulations and building codes for an area, coordinating contractors, monitoring the quality of the work, and verifying the final product.<sup>67</sup> By advocating for a client in these ways, architects ultimately pay for their services. However, if the rest of the building process was more legible, streamlined, and efficient, the architectural services might not be as critical.

65 Davies, 9.

66 Colin Davies asserts that roughly 80% (by value) of building is starved of design talent. Davies, 10.

67 Turgeon, 7.

# THE CHANGING MARKET

Prefabricated building technologies call for a change in the way housing is packaged for the workforce: this fundamental departure entails nothing short of a paradigm shift. It involves not just addressing the expectations, presumptions, and comfort of consumers, but also a complete redesign of the construction process itself. While it is difficult enough to re-envision this process from a design and marketing standpoint, it is also a financially risky business proposition.

Standard prefabricated housing developers already battle common misconceptions and presumptions about their product. Architectural critic Karrie Jacobs acknowledges that “there is a stigma against prefab housing in this country.” However, she also notes that “given the right options and marketing, I don’t think it will be that hard for people to get over this stigma.”<sup>68</sup> Issuing a new type of prefabricated building solution, however- one that incorporates a modern design aesthetic or open-source technologies- could present challenges beyond these existing stereotypes.<sup>69</sup>

Often, the challenges facing companies with drastically different product launches are overcome by aggressive advertising. In *Blink*, Malcom Gladwell asserts that “testing products or ideas that are truly revolutionary is another matter, and the most successful companies are those that understand that in those cases, the first impressions of their customers need interpretation.”<sup>70</sup>

68 Karrie Jacobs Interview, 02.12.2007.

69 National housing manufacturers, such as KB Home Manufacturers or Poultney, defend against claims that their product is too cheap, flimsy, or stereotypically low-budget. They don’t, however, have the added burden of defending a modern design aesthetic, new technologies, or radical open-source building structures. One can imagine that this additional negative stigma might be too much risk for one company to absorb.

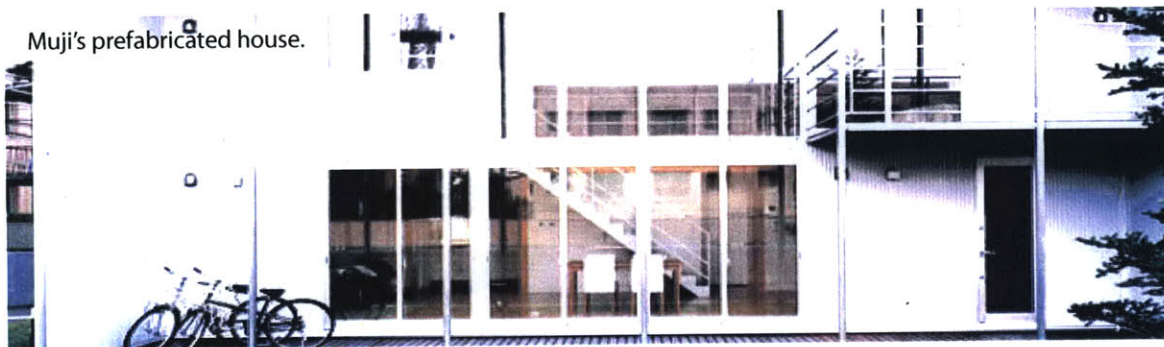
70 Regarding the release of the Herman Miller Aeron chair, Gladwell, 180.



This interpretation, then, is the educational investment that the company must make at the outset. Perhaps this educational step has been skipped, ignored, or under-appreciated by previous design teams: at any rate the market retailers have failed to inflict a paradigm shift that espouses prefabrication.

Part of the resistance to changing building norms derives from the recognition that our existing housing strategy is already reasonably efficient. It has been born out of decades of streamlining the stick-framing business, adjusting standard dimensions, and developing building codes. Ultimately, manufacturers understand that to buy into prefabrication, these standards will need to be reinvented, and many companies prefer to defer those growing pains. Home Depot's head of Merchandising Strategy, Winston Ledet, describes his company's reluctance to adopt new building types, while acknowledging that the large manufactured housing developers instead stand to benefit from this switch: "Home Depot recognizes that the building industry supports very few new homes. Eighty percent of the work out there is remodel-based, representing 200 billion dollars a year. The overwhelming consolidation of home builders in recent years has created an industry in and of itself. Manufacturers such as KB or Poultney stand to have the big opportunity when it comes to using prefabrication. Their business model is built around buying in bulk, negotiating direct discounts, and building houses with machine-like regularity. This business is starting to feel like Ford in the 1900s-- not quite Toyota in 2000 yet--- but still a managed production extreme for homebuilding."<sup>71</sup>

71 Personal Interview with Winston Ledet, March 19, 2007.



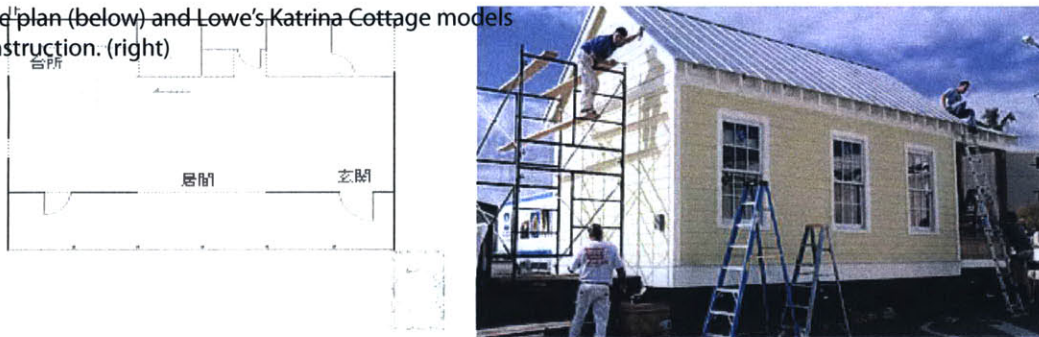
Large companies with established reputations and stable capital are best suited to this initial investment. Not only do these companies benefit from designing the process and setting standards that promote their own direct involvement, but they also rely on pre-existing brand recognition. Major manufactured housing developers are growing increasingly consolidated, amassing strength in terms of experience, employees, financial reserves, and ability to take risks.

According to Ledet, "the big national builders in the U.S. are mass-producing complete houses, and they could benefit from the efficiencies of prefabrication. The top 100 U.S. homebuilders sold less than twenty percent of new homes twenty years ago, and today that number has grown to something like sixty percent. This is a business that has gone through massive consolidation in the last few years. Prefabricated houses have the potential to revolutionize the homebuilding industry at a different scale. It is not really the individual builders, like those who depend upon Home Depot, but the developers who could benefit from these efficiencies. Developers make money by trimming the cost of labor and materials over many units to create a cheaper turn-key product."<sup>72</sup>

Major U.S. homebuilders have made an industry out of producing houses, and these companies have intimate knowledge of the building trades. Compared to IKEA, Home Depot, or Lowes, they comparatively have the advantage, both in terms of knowledge and expertise. What these three corporate companies have to offer instead, is a slightly more slippery set of skills. Each of

72 Personal Interview with Winston Ledet, March 19, 2007.

Muji house plan (below) and Lowe's Katrina Cottage models under construction. (right)



the companies has a loyal brand following, with high quality control and product reputation. They all have aggressive, advanced marketing departments, with national coverage. Each currently sells products in-house that would easily pair with, and perhaps bolster, house sales. Finally, these three companies are new enough to the homebuilding process that they are open to the fresh ideas that could re-address homebuilding, whereas the national homebuilders are already fairly entrenched in one way of doing. In the case of IKEA, Home Depot, and Lowes, these three major players could tap into new market areas by leaning on a reputation created in a unique context.<sup>73</sup>

Given its history as an innovator, particularly in the realm of industry and production, it is surprising that the U.S. has not yet developed a more advanced manufactured housing industry. Architectural critics are quick to point out that "the homebuilding industry in this country makes the auto industry look enlightened by comparison."<sup>74</sup> Despite the understood economic advantages of prefabrication, and the certain potential for growth and money-making in the industry, companies have been slow to invest. Architect Mark Anderson recognizes that despite the advantages of prefabrication, "the least expensive way of building is the most conventional,"<sup>75</sup> and as long as prefabrication is unconventional, it will cease to reap projected economic benefits.

It is precisely because stick-framing is already so efficient that it will be difficult for the industry

73 Personal Interviews with Winston Ledet (March 19, 2007) and Jarrett Smith (March 12, 2007)

74 Jacobs, 13.

75 Jacobs, 104.



Prefabricated houses on the road (left) and Emperyan's Dwell home interior. (below)

to change gears.<sup>76</sup> While efficient, standard construction techniques still have room to improve, prefabricated building offers a host of new benefits, capable of making housing more accessible to a broader audience. Prefabrication presents the potential to link science and industry with an otherwise fairly low-tech and detached building industry. "What has occurred so far in the field of prefabrication indicates that the scientific approach is beginning to be utilized in the application of engineering principles to the structure of the house."<sup>77</sup> While the industry already builds houses out of modular components, such as SIPs, or window assemblies, this trend has not yet fully embraced the scale of an entire wall, room, or house. By integrating technologies in construction and transportation, and layering or overlapping services, this shift could happen.

### Industrial Evolution

Cars, computers and houses represent three product types that have followed parallel paths of industrial evolution. Although these products vary in terms of speed, components and technological innovation, they share similar stages of development over time. In the first stage, craft dominates the production process, as prototypes give way to a standard model type. In the next stage, mass-production is employed, using interchangeable parts to generate multiple copies of a singular, finely-tuned product. The third, and most advanced stage, couples modularity with customization and open source programming to develop an even better product.<sup>78</sup>

76 Jacobs, 256.

77 Bruce, 3.

78 Efficient, finely-tuned products combine the best of both worlds. Personal Interview with Kent Larson, February 26, 2007.



These three stages of development offer a timeline for the progression of prefabricated technologies and a better sense of how those methods could serve the market. "In many ways, this has been a grassroots effort, with people soliciting architects for prefab homes that are both affordable and beautiful and offer an alternative to the senselessly sprawling houses that have dominated the market."<sup>79</sup> Unfortunately, prefabrication doesn't work when it is employed in this piecemeal manner. The real fiscal value in this building type comes from the reproduction of many units, and the dispersal of those products to a wide audience.

### Prefabrication

This fiscal value inherent to prefabrication derives from cost efficiencies as well as access to better design work. In 1957, Los Angeles Architect Craig Ellwood said that "eventually all homes, except for those of the very wealthy, will be bought in prefabricated form."<sup>80</sup> Presumably Ellwood foresaw a future where product mechanization would extend to the scale of the whole house, and although nearly all consumer goods take advantage of factory efficiencies today, housing lags behind.

When serviced by major home construction companies, prefabrication has the potential to apply great efficiency advantages. Economic benefits and increased control of construction come from factory-based manufacturing, the standardization of components and faster construction times.<sup>81</sup>

Prefabricated construction takes much less time to build with than conventional construction techniques.<sup>82</sup> "by some estimates the process (of prefabrication) reduced on-site labor by eighty percent."<sup>83</sup> Granted, this reduction in on-site labor only shifts embodied energy to a different period and location, but these options become meaningful when applied to other working constraints.

79 Herbers, 11.

80 Jacobs, 177.

81 Arieff, 9.

82 Jacobs, 138.

83 Randl, 109.



Prefabrication allows for fabricators to make up models in advance so that homes are ready to sell and install on demand. In the case of some A-frame house companies, houses could be erected on-site in two days, and companies advertised a one-month window from the buyer's moment of decision to their move-in date. "Such speed was important, as many builders discovered that, with the proper persuasion, vacation homes could be made an impulse buy." While standard house-buying can be considered impulsive, the house-building experience rarely is.

Because prefabrication completely controls the quality of the product and the price associated with that unit, this building method can be considered as reliable as buying a computer or a car. This brings housing back into the realm of the consumer product, in an age where homebuilding has become infamous for overextending resources. Prefabrication also offers a less costly connection to design services, when employing an architect for any type of project has nearly become synonymous with budget over-runs.

In general, prefabricated building elements benefit from a higher product quality.<sup>84</sup> These assemblies are typically created in stable factory conditions rather than on an ever-volatile job site, with well-trained labor pools and access to specified products. Although transportation of the final product to the job site presents a challenge for manufacturers, it also ensures that elements are built to withstand the rigors of travel.<sup>85</sup> Factory-constructed products also benefit

84 Jacobs, 79.

85 Emyprean prefabricators build staircases that are guaranteed not to creak, and are overbuilt to ensure that this pledge can be met.



IKEA branding and flat packs.

### How to Build a Cult Brand

Ikea sells a lifestyle that signifies hip design, thrift, and simplicity. For the aspiring global middle class, buying Ikea is a sign of success. Here's how the Swedes do it:

**CREATE THE STORY**  
The retailer is a master of building buzz, which creates evangelists for its brand, who then spread the story by phone, word of mouth, and event blogs from Shanghai to Chicago. The Ambassador of Ikea promotion, for example, gives essay contest winners the chance to camp out in a store before it opens. That excites shoppers and generates huge publicity.

**SEDUCE THE SHOPPER**  
Customer focus is so intense that even senior management must work behind cash registers and in the warehouse for brief stints every year. The stores are laid out to promote fun: Restaurants and play centers encourage shoppers to spend the day. Simple touches, from free pencils to paper measuring tapes, make it easy to shop.

**INSPIRE THE STAFF**  
Employees won't get rich, but they do get to enjoy autonomy, very little hierarchy, and a family-friendly culture. In return they buy into the philosophy of frugality and style that

**SURPRISE ON VALUE**  
Ikea mandates price cuts every year, but designers also deliver on looks and quality. Every year designers must meet stretch goals, like designing a bedroom

from an extra phase of inspection: first on the factory floor, and again in the field.

Considering the natural benefits to prefabricated construction, as well as precedents for this production model, it is surprising that modern prefabricated houses haven't met a more receptive audience. Many architectural critics argue that most prefabricated construction today is tasteless- it exists without good design. However, this doesn't account for the widespread success and popularity of the "under-designed" manufactured housing industry, or the clear failure of the architect-inspired prefabricated design projects to date.

Prefabrication still hasn't truly been accepted by mainstream American buyers, even though so many good examples exist, and the theory works. One major hurdle for this movement is the changing role of the architect and the willingness of buyers to accept prefabricated structures. It has become a legal and logistical problem, as well as one that relies on a fundamental paradigm shift.

#### Construction Quality and Scheduling

Despite common stereotypes about flimsy prefabricated products, manufactured housing may be able to offer higher quality control than their site-built equivalents. In a factory setting, materials are kept under cover, and out of the weather. The recent glut of sick building syndrome houses, and lawsuits over structures that have trapped mold during the construction process, offers an indicator of the growing number of issues associated with building "tight" houses in

the field. Also, materials assembled by factory machines benefit from higher tolerances than those in the field; this accuracy ensures tighter fitting joints and more rigid structures.

Greater economies of scale are realized in buying materials for multiple houses. Because many of the same components are used, a single factory is more likely to have the right parts in stock, so no time is wasted waiting for individual components. Bulk material use allows for larger batch size and thus more selective material use. Finally, poor quality material providers are less likely to get repeat orders, whereas a contractor at a single job site may be forced to simply accept delivered products.<sup>86</sup>

Factory production allows for innovation in scheduling, as well as an overall project timeline. Prefabricated buildings take less time to enclose on site than traditional building projects, reducing the risk of weather damage, tool theft and security breaches. From both a fiscal and logistical perspective, "just-in time inventory techniques can be used to reduce the amount of capital stock tied up in non-producing assets."<sup>87</sup>

### Open Source Building

Open source technologies have already been effectively implemented in the computer and vehicle industries, combining standardization with customization. In open source building, an agreed upon framework is shared by industrial producers, so that a modular system incorporates a standardized interface rather than a standardized device. In the same way that a USB port allows for the connection of various product brands, an open source building could provide the framework for more complicated, changing systems. The flexibility inherent to this system works only when some standards are set, and it requires a critical production mass to work.

Open source building is just beginning to gain popularity in the U.S., and it purports to blend

86 Gietema, 28.

87 Gietema, 30.

Organic building construction.



the most successful components of current building strategies. In a one-off, custom home, the client benefits from a responsive environment that is directly designed for their own needs. In the generic, mass-produced, repetitive communities made by merchant-developers, customers benefit from cheaper units and speedy delivery. The open source model bridges these two ways of building, combining the efficiencies of a common framework with the effectiveness of a customized design approach.

Open source building works only when housing components are disentangled and restructured under a common set of objectives and industry standards. With computer programs and highly accessible communication portals, this coordination has been born out of the industry itself. However, the development associated with this kind of interaction in the building industry is so complicated that few companies have expressed a willingness to participate in shaping the future of open source building. Academic institutions are at the forefront of this movement, and will need to demonstrate conclusive benefits for market participation in order to garner more widespread support.

To a certain extent, the building industry already has adopted elements that could serve as open-source building units. Modular sizes, such as 2 by 4 lumber cuts or 4 by 8 sheets of plywood, have become industry standards. Construction specifications and the universal building code governs many building requirements. The field doesn't necessarily need to be reinvented for open source building to take off.

## Technology

Although the information revolution has radically changed the way Americans communicate, entertain, travel, work, and recreate, it has impacted the construction industry in a comparatively small way. Many of the technologically advanced construction projects have been implemented for public projects, or fueled by a large construction budget. Over the course of the last century, it has been the military, rather than the market, that has driven the most profound changes to the way Americans build.

Advanced technology has the potential to assist the prefabricated housing market in a number of ways. Within the factory, improved tolerances, tools and organization optimize performance. In terms of product types, new constructs, such as glue-lams, SIPs and other pre-formed units are beginning to take advantage of these manufacturing resources. More advanced technologies, such as smart cabinetry, addressable track systems, and snap-fit plumbing and electrical systems begin to push towards a truly responsive environment.

This incorporation of technology into building components is only useful when certain standards have been established at the outset. Building components need to communicate with each other, and to do that they must be totally disentangled.<sup>88</sup> By providing a singular, modular chassis, and then inserting products as desired, manufacturers employ technology somewhere in between the “anything is possible” approach of architects and the “one-size fits all” approach of developers.<sup>89</sup> In Supports, Architect John Habraken’s advocates for this type of open building approach as a means to flexible housing. Although Habraken pioneered this line of thinking in the 1970’s, today he suggests that modern technology can augment the real world application of these ideas.

Technology has also changed the way we communicate information, and it can be used as a

88 The Placelab, in Cambridge, MA experiments with these disentangled systems.

89 Personal Interview with Kent Larson, February 26, 2007.

tool to grow the prefabrication industry. In some ways, the internet offers a medium to combat the challenges presented by a changing social network. At one time, wide family networks, intergenerational living structures and extended communities provided the resources needed for people to build their own homes. Today, the internet provides search engines, information portals, and even online support groups that allow a similar degree of support for individuals.

In 1966, Popular Mechanics made the case for the simplicity of kit building by featuring a step by step instruction set on A-frame construction. "Photos documented the thirty-eight hour construction process, providing an interesting look at how the kit was pieced together."<sup>90</sup> One could imagine the modern equivalent... using technology-based resources like video and the web to demonstrate the building process.

Architectural software empowers people to design for themselves. While design was once inaccessible to the untrained, changing interfaces are making these design tools more readable. Both IKEA and Home Depot have recently launched design software unique to their own products, and it is not unthinkable to imagine a future where design software would be branded and made available to customers as a means of selling products.<sup>91</sup>

In the case of open source building, technology becomes the medium for the communication of ideas, design development, and product retailing. It is possible to develop a parametrically defined design framework using a given substructure (either an open site or a contained building place) as a starting point. By creating a preference engine, a computational design critic would use an algorithm to code the knowledge of an architect as a series of rules. This computer-generated building design could use a google-like approach, wherein the best solutions naturally rise to the top. Multiple visualization tools, such as 3D projections, physical models, and streaming interactive responses allow lay people to navigate a complicated design program.<sup>92</sup>

90 Randl, 105.

91 IKEA makes its software available to customers in the store and also for free on the web: [www.ikea.com](http://www.ikea.com)

92 Kent Larson's open source building research has begun to put these ideas into practice. Personal Interview with Kent Larson, February 26, 2007.

This approach depends upon a centralized retail place for design services. The web could offer such a venue, a sort of Wikipedia for buildings. This portal would be used as a place to share knowledge, while maintaining a self-regulating, iterative/additive, and democratic environment. Within a specific design engine, the best solutions would begin to surface. Standards for new ways of building could emerge in a Darwin-like natural selection process.

The web also offers a resource for the retailing of open source building. Here E-bay-like portals could connect disparate products across the nation. Qualified local assemblers could bid for installation projects in their area. Like Target's current online installation bid service, the customer would view the current low-bidder and price, and secure the lowest bid through open online transactions.<sup>93</sup> The internet offers a much better supply-chain management system than any traditional model to date.

Precedents already exist for this digital design process, and they range from the games children play to the nuts and bolts approach of corporate retailers. From Habbo.com to secondlife.com, people are playing at space configuration. At the Home Depot and IKEA, in-house kitchen designers walk customers through the same process. While in this scenario architects slip out of their typical professional roles, they could assume new function by writing design engines and developing industry standards, publishing their work online, and developing a system of royalties for payment.<sup>94</sup>

93 See target.com for examples of this type of online bidding process for local assembly.

94 Stover, 81.



# DESIGN FOR PREFABRICATION

Architectural designers bring a number of key qualities to the prefabricated homebuilding process. If they represent larger firms, they control the external product image. To a certain degree, architects educate the public about their design work, they help to ensure that the aesthetic doesn't appear to be prefabricated or affordable, and they engage in the development of the minimum house. Architects possess the training necessary to envision clever material use, product innovation and invention, and the development of thoughtful spatial flow, formal qualities, and internal arrangements. Beyond creating designs that remain durable, adaptable, and sustainable, architects manage a project's overall aesthetic.

In the manufactured housing industry, options for homebuyers are far more limited than with traditional building types, and these choices cater to the lowest common denominator.<sup>95</sup> Architectural critic Karrie Jacobs has suggested that this dearth of options may block the success of the prefabricated housing movement. She believes that fewer options preclude win-win situations for homebuilders: "Why is it," she asks, "that the typical American house can be cheap or it can be good but it can almost never be both?"<sup>96</sup>

In Pre-Fab, Architect Peter Anderson explains that the people catered to by prefabricated designs are "perceived as abstract variables rather than specific generators of form and space. In this process, modern housing systems usually reduce the assumed context and house dweller to some lowest common denominator, the assumed-to-be-most-typical site and customer." While

95 Mass-production works because of limited options, and like ADA standards, promote a one size-fits-all approach.

96 Jacobs, 13.

efficient, this system for design breaks down when designers underestimate their clientele, or conservatively play the market. This low bar has ramifications for the development of new design, for improvements in new technologies and materials, and for the breadth of the market itself.

In prefabricated homebuilding efforts, the architect assumes a role that is comparatively disconnected from the end user. In terms of industrial design and pre-built houses, this system already plays out effectively and efficiently in everyday life. Most products are designed for an unknown user, and the market, rather than an individual, responds to those products positively or negatively. This oblique feedback loop then affects future designs, indirectly developing products and solutions that are well-suited to the end user. Jacobs recognizes this correlation as a more accessible, albeit indirect relationship: "if you think about industrial design and products, people have things that they own and that they love. The personal connection to an architect is still somewhat of a luxury, and it is still possible for people to have a good relationship with design even if they are far removed from the user."

### Modern Aesthetic

Modernism is a slippery term in the design world, and one with a range of definitions. Although modernism stands out as a period of time in architectural history (replaced by post-modernism and a host of new genres), it also represents a rejection of traditional building methods. In reductive terms, modernism can be understood as a non-traditional, architecturally innovative approach to design.

Although prefabrication has been espoused by both modernist and traditional designers over its unfolding history in the U.S., conventional design solutions have dominated the built world. This could be due to the types of designs on the market, the marketing process itself, or a gap between what people actually want and what companies believe they desire. During her work

as editor of Dwell Magazine, Jacobs realized that “there is definitely a market for a modern aesthetic. Perhaps this is not reflective of the majority, but it certainly exists.”<sup>97</sup> She found that the people who subscribed to this modern magazine were not often living the modern dream, but they were interested in learning about modern design, and wanted it to be a part of their lives.

Jacobs found it frustrating that modernism was often considered “too good” for mainstream American consumers. She said that “in lectures, people routinely ask me questions such as ‘Are Americans ready for modernism? Americans don’t really have any taste.’ That annoys me. Taste is something that you learn through experience. If you go to buy a house, you end up buying what you can afford, sort of near where you want to live. But people end up buying what is offered because they need to live someplace, not because it is exactly what they desire.”<sup>98</sup>

IKEA has demonstrated that Americans are eager for a more modern design aesthetic, but this may not be representative of the majority. According to Winston Ledet, Home Depot is “more interested in promoting American design than the modern Scandinavian aesthetic. I think that fundamentally, the middle-income American consumer is not really ready for this modern lifestyle. While the urbanites living in condos have already bought into the contemporary IKEA style, it really hasn’t hit middle America. More and more, people are becoming willing to adopt a modern aesthetic, but I believe it is in the distant future.”<sup>99</sup> However, Ledet continues to grapple with the question of selling modern design, and he recognizes that his company is shifting. “In terms of Home Depot’s design aesthetic, it is undergoing change. We are moving more in the direction of contemporary American design.”<sup>100</sup>

Tapping into the true sense of what people want to buy, or how people want to live, is a slippery

97 Personal Interview with Karrie Jacobs, February 12, 2007.

98 Personal Interview with Karrie Jacobs, February 12, 2007.

99 Personal Interview with Winston Ledet, March 19, 2007.

100 Personal Interview with Winston Ledet, March 19, 2007.

process. Often developers need to do more than just provide different options. There is a sort of learning curve associated with new products, a period over which people change how they feel about a new way of thinking or doing. When Sylvan Nathan Goldman first introduced shopping carts in grocery stores, they were firmly rejected. However, after creative marketing and the by planting models using the carts in stores, they became widespread tools for shoppers.<sup>101</sup>

It may be the market that helps this learning curve to play out. According to Jacobs, “housing developers build what they believe will sell, but they haven’t pushed the design envelope. It is interesting for me to see that as the housing bubble collapses across the country, many standard developers are getting forced to generate more exciting work. Toll Brothers, for instance, has shifted from building standard issue tract houses outside of New York City to modern housing lofts in Williamsburg. The changing market has necessitated this shift.”<sup>102</sup>

#### Opening the Design Process Through Internet Software

Designer Nick Rader describes the difficulties of involving clients in this potentially new exposure to the design process: “there is a great disconnect among the architect/buyer, homebuyer/fabricator, or the fabricator/architect causing a reversion to choice of design rather than customization of design.”<sup>103</sup> He argues that the reintegration of these three parties can be realized through a single piece of parametric software. This program would allow for these three entities to speak the same language, and includes direct input and output at every level. The system itself includes checks and boundaries, as well as the flexibility to imagine truly unique designs.

Design Within Reach has pushed this client feedback loop through its online Design Notes Newsletter. According to DWR founder Rob Forbes, the newsletter’s objective is to “enlarge

101 Bridgman.

102 Personal Interview with Karrie Jacobs February 12, 2007.

103 Rader, 16.

our clients' perception of what design is so they can appreciate design in its many forms."<sup>104</sup> Although interaction with readers isn't perfectly quantifiable, the site does provide feedback loops for customers to post comments. Forbes believes that this kind of education has value for retailing, and the internet is making this interaction possible: "educational and cultural benefits have always been hard to measure. I understand why most organizations don't focus on these. It's hard to connect them to the bottom line, and it's hard to measure them with traditional business metrics."<sup>105</sup>

As companies embrace the internet to educate customers and involve new users in the design process, the accessibility of home design has grown. Novice designers are now capable of making their own plan sets, and while many architects would scoff at the viability of this participation, it seems to be well-received by mainstream Americans. The architectural field has protected the divide between design tools and open access for centuries, and the internet threatens to disrupt this autonomy.<sup>106</sup>

### Change of a Structure Over Time

In some countries, site and services projects have been proposed as a way of providing the foundation for housing without great initial expense. Recipients receive land and service connections, and are then able to build a house for themselves over time. The houses initially are small, often temporary units, and gradually grow into something more permanent and suited to the tenant's needs. These programs provide the bare-bones structure needed for inhabitation, while empowering the tenants to conceive of the space they desire and make that dream a reality.

104 Interview with Rob Forbes, May 17, 2006.

105 Interview with Rob Forbes, May 17, 2006.

106 Whereas people have been designing for themselves forever, until recently, this work never claimed to be "architecture." The power of open design software is that it allows non-designers to participate in a sanctioned or authentic architectural role.

In the U.S., building codes and notions of basic or fundamental housing standards tend to limit this type of open-ended development. However, residences usually grow over time, morphing into new building configurations and adopting the changing needs of tenants.<sup>107</sup> Buildings do change, in terms of finishes, cladding, or even structure over time regardless of building type or construction, but there are some designs that are naturally more conducive to adopting additions.

Just as early American seamstresses would design clothing with triple hems that could be let out as a child grew, designers can build in opportunities for growth at the outset. In the case of clothing, this initial anticipation allowed for efficiency and longevity in use, while incorporating limited movement in direction. However, with thoughtful consideration, these tailors could predict areas for growth and know just how to design the garment to last over time. In the same way that humans tend to follow expected growth patterns, houses grow predictably, and a designer can help to direct that process of growth by creating natural connection points within a structure. The result is that a house grows reliably, in good form, with fewer growing pains and less incurred expense.

Lowes' Katrina Cottages are meant to take advantage of this incremental growth over time. The units are sold as small as 300 square feet, with built-in joints for add-on bedrooms and wings. Because the units were designed to function as post-disaster relief shelters, they handle the most basic functional needs quickly, but maintain the longevity of a traditional house. Unlike the single-use FEMA disaster-relief trailers, the Katrina Cottage is actually designed to serve as a part of the rebuilding effort. Moreover, the Katrina Cottages are simple enough to allow Lowes a low-risk introduction to the manufactured housing industry. "It is possible that whole houses will become more available directly from stores such as Lowes. The Katrina Cottage is a first step- it is a small, manageable project with a limited scope. But it could lead to more advanced project types- we still haven't seen the future for this type of building."<sup>108</sup>

107 Brand, *How Buildings Learn*.

108 Personal Interview with Jarett Smith, March 12, 2007.

In the prefabricated building world, this kind of additive construction means that a homeowner can become a life-long customer of sorts. Building components and assemblies can be designed to interlace such that new rooms can be purchased as lifestyles change, or existing spaces can be upgraded as new technologies and styles arrive on the market.

### Modular Systems

Modular structural systems dictate the set of standards that enable prefabrication efficiencies. According to New York building consultant Steven Winter, “the development and widespread use of modular technology represents one of the most significant recent changes in housing production in the United States.”<sup>109</sup> While in the past, variations in boat sizes and cart dimensions allowed for a more varied breadth of modular sizes, two modern transportation options dictate today’s standard. The widespread use of the shipping container, and its partner flatbed truck, have set the standard for international freight dimensions.

Beyond just arriving to the job site in modular units, prefabricated building solutions rely on a more coherent standard. Like the kit houses of the past, prefabricated buildings consist of components with intricate and often interconnected assemblies. In the case of kit houses, customers chose to either assemble buildings themselves or contract the work out. “Regardless of where the designs came from, the process was the same. Customers selected a plan, ordered a complete set by mail, and either contracted with a local builder to complete the house according to the specifications or, in some cases, built it themselves.”<sup>110</sup>

Today these kit houses continue in a similar form. Architect Rocio Romero’s prefabricated Fish Camp houses “come with pre-drilled holes in all of the panels, just like an IKEA bookcase.”<sup>111</sup> By harnessing the technology that enables simplistic connections, manufactured buildings can allow for unskilled construction. Although building safety codes limit the amount of self-

109 Hanafin, 39.  
110 Randl, 98-99.  
111 Jacobs, 270.



building that goes into an off-the-shelf house, simple, connectable units make for reliable construction budgets, and facilitate additional elements over time.

In a fully mechanized world, one can imagine a system by which the client chooses from options available through web-based design engines, submits an order for it to be built, uses online bidding software to contract out the local labor needs, and has the house components delivered to some site, anywhere. In this scenario, Architect Brett Zamore's fantasy for the future of the design field that entails little more than designing a set of instructions, is not far off the mark.<sup>112</sup>

### Size

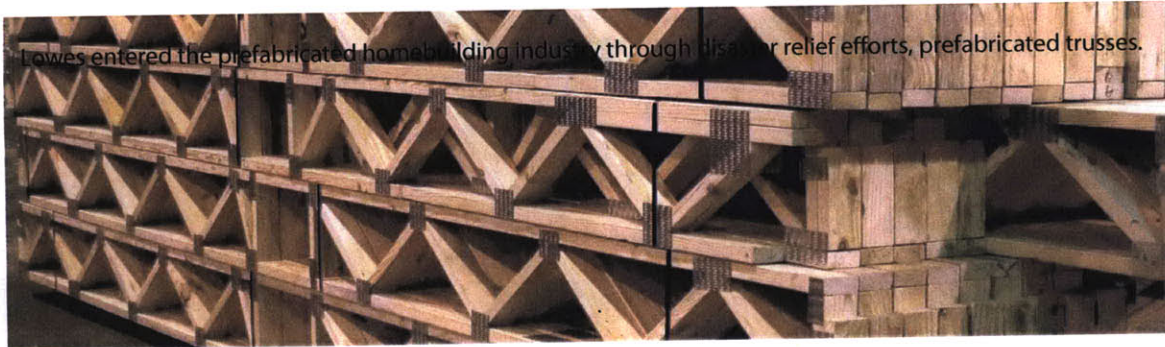
The design of prefabricated houses differs from standard market housing in the number of constraints it must recognize. Because transportation dictates modular unit size, prefabricated houses tend to be some amalgamation of that unit type. Prefabricated house sizes also tend to parallel more traditional dwellings in the homebuilding industry. In 2005, the average house size was 2,200 square feet, up from 1,400 square feet in 1970.<sup>113</sup> "For the affluent, houses have been swelling with no apparent limit. The square footage of new homes increased by 39 percent between 1971 and 1996 to include family rooms, home entertainment rooms, home offices, bedrooms and often a bathroom for each family member."<sup>114</sup>

112 Zamore's vision for homebuilding takes prefabrication to the extreme. The idea that a simple set of directions, like a recipe, could be so streamlined that housing would be a real possibility, is, of course, wholly dependent upon a completely mechanized, computer-driven design to construction process. Jacobs, 199.

113 Jacobs, 10.

114 Ehrenrich, 81.





However, manufactured housing actually supports a range of house sizes. Net-zero energy houses have been prefabricated and marketed at 1,400 square feet, although the volumes are meant to feel more like a 3,000 square foot house.<sup>115</sup> Size should be limited to the bed of a typical semi-truck that could navigate through residential streets, which is 9' by 45'.<sup>116</sup> Because modular units lend themselves to additive construction over time, small houses offer a starting point that is financially within reach, while enabling growth over time.

#### Design/Build.

In recent years, design/build operations have helped to re-knit the age-old rift between the construction industry and architectural firms. DIY magazines and books have reentered the market after a downturn in the 1990's, and homebuilding television programs have become increasingly popular.<sup>117</sup>

The powerful thing about design/build is that it connects the practical building world with the choices of the design world. At the Yestermorrow Design/Build School in Vermont, instructors emphasize the practical benefits of doing all design and construction in-house. Students link their own vision of space with practical realities, such as available materials, sources of labor, skill-sets and nonstandard time frames.

115 Kent Larson's current net-zero energy house project. Personal Interview with Kent Larson, February 26, 2007.

116 Rader, 26.

117 L.C. Williams & Associates.

While design/build and self-building operations restack the control over the building process into the hands of the client, it also poses problems for novice builders. Many building projects occur incrementally and at a pace far below the standard construction speed.<sup>118</sup> While homeowners may avoid the typical loans or excessive start-up expenses, this decision comes with a tradeoff: they often choose to live in a partially finished project or at a job site for longer than usual.

Prefabrication can assist design/build operations by eliminating skilled labor and handling critical safety issues. If plumbing, electrical, and other HVAC components are integrated into assemblies, then builders have less skilled labor to do at the job site. If houses arrive at the site in panels, construction may merely be a matter of connecting those various pieces. Prefabricated house designs have the potential to simplify the building process, thereby opening access to more people.

Although DIY has become a popular pastime for the workforce, this interest doesn't necessarily marry self-built housing and prefabrication: "prefabricated building assemblies and self-built housing should not necessarily be bound together. What will drive the prefabricated building industry is not self-built housing, and in fact, when prefabricated building was self-built in the past, this factor may have kept it limited."<sup>119</sup> The difficulty with self-built initiatives is that building codes and skills vary, and unless the project is tightly controlled for user variation, it becomes a liability: "the difficulty with self-building a home is that no matter how well it is designed, it is never going to be as simple as assembling an IKEA bookcase. Houses are infinitely more complex projects; they require HVAC assemblies and building code compliance. And despite efforts to hybridize services, it will be impossible to make them totally idiot-proof."<sup>120</sup>

118 Jacobs, 150.

119 Personal Interview with Winston Ledet, March 19, 2007.

120 Personal Interview with Winston Ledet, March 19, 2007.

## Bundled Units

In addition to mass-producing individual houses in the factory, developers appreciate considerable economic benefits when they cluster like kinds of housing on singular sites. In the development of suburban neighborhoods, these monotonous housing communities have led to what urbanist Alan Berger has coined the “drosscape:” a landscape supporting fragmented, homogeneous development and under use.<sup>121</sup> Many of these mono-communities consist of replicated manufactured constructs, and threaten the diversity of neighborhoods.<sup>122</sup>

Co-housing developments bundle housing in a different way. Here individual homeowners buy into a common land bank, but retain independent ownership of their own house footprint. Multiple families participate in a highly coordinated design and building process that links the building efficiencies of multiple like units in close proximity. The end result is a blend between replicated units and customized single-family houses, and it is a strategy that offers considerable cost savings. According to Karrie Jacobs, “you need to value engineer, have a lot ready to go, and do buildings in multiple quantities to justify the value of an architect. Otherwise, you can’t get low costs/affordability and still pay the designer.”<sup>123</sup>

In Europe, IKEA has launched the BoKlok housing program, where clusters of six house units are developed on a single plot of land. This relatively standard building approach combines other innovations, including unique financing, marketing, and furnishing options. Although the pilot program could be used in a singular form, the practice of bundled units has thus far proven itself to be more economical for homebuyers.<sup>124</sup>

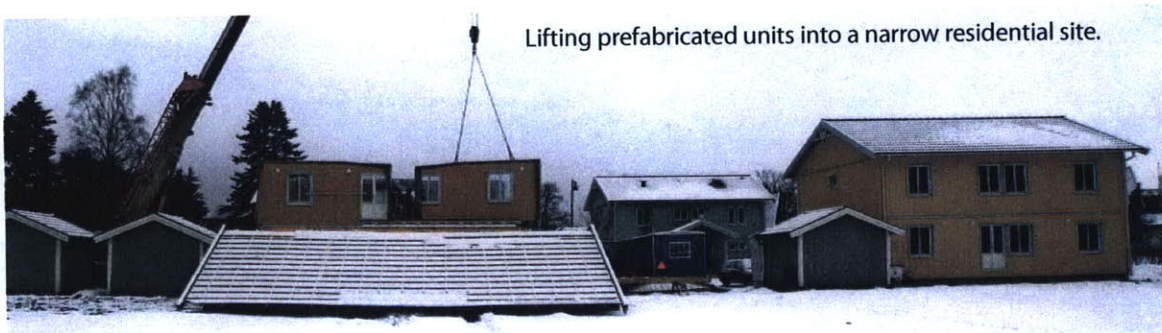
Bundled units on single land parcels lead to logistical challenges regarding land ownership.

121 Berger, 21.

122 Change over time occurs in every neighborhood, especially in owner-occupied housing. Also, it is not clear that the majority of homebuyers actually dislike homogeneous neighborhoods. Witness the popularity of homogeneous gated communities.

123 Jacobs, 104.

124 Interview with Neil Shaefer, IKEA Boklok UK.



While cooperatives and tenant-in-common legal devices exist in the U.S. to facilitate such arrangements, this type of sharing is relatively uncommon.<sup>125</sup> Developers, rather than individual homebuilders, stand to benefit from multi-unit building efforts. Through planned unit developments (PUDs) or other zoning incentives, these large-scale projects work best en masse. For the independent homebuilder, however, streamlining this process in the U.S., or obviating the need to engage in difficult legal logistics altogether, may be necessary to make this type of bundling a reality.

With plots of land growing scarce and commuting becoming a fast reality, self-sufficient communities recognize the need for dense urban housing initiatives. The single-family residences, like those projected in this thesis, may become obsolete as people prioritize dense urban living. According to Architect Trevor Lewis, "if you consider the most economically and environmentally sustainable model for housing, you will find that most would reside in multi-family developments that inherently require the expertise of an architect due to their complexity."<sup>126</sup> Precisely because of this level of complexity, prefabricated multi-family building requires a development team beyond the scope of a major building retailer.

### Simplicity

One of the great advantages of prefabricated building systems is that machines provide skilled labor for complex assemblies. This concentration of skilled labor at the factory frees up the

125 Dreier, 41.

126 Personal Interview with Trevor Lewis, February 20, 2007.

building site for more basic assembly tasks. In order to reap the benefits of this relationship, prefabricated houses must be designed so that the front-end factory work includes all challenging parts, while the tail-end site assembly reduces time, skill and effort.

In the past, some companies included as many of the inclusive options as possible in their kits, as a means of increasing profit, controlling the finished product, and ensuring customer satisfaction. Early A-frame kits, for instance, included pre-cut lumber, windows and doors, interior walls, moldings, bolts, nails, and interior finishes. "In a move driven more by marketing practicality, later versions contained all of the tools needed to assemble the house, such as a hammer, level, plumb bob, wrench, caulk, and caulk gun."<sup>127</sup> This holistic view of the house is even greater when the disparate elements are fabricated on the factory floor. Complete control of the product outcome is retained by the company, and assembly involves merely connecting the unit to the site and systems.

#### Materials.

Poor material quality has often been associated with prefabricated housing, but this doesn't need to be the case. Material quality standards can be regulated in a factory setting much more effectively than those on the job site, and for this reason, quality tolerances can also be pushed to the farthest limits as well. The trick is to use these conditions to improve the quality of the prefabricated work, rather than to develop housing that will just barely stand up to the rigors of use.

Because manufactured housing already carries negative associations with regard to material quality, the market will need to develop aggressive ways of resisting this stigma in the future. IKEA products carry a certain association regarding their quality and craftsmanship, and those same qualities will be extended by their brand to the houses they develop. Home Depot and Lowes appreciate a valued perception of robust material use, and could benefit from those

<sup>127</sup> Randl, 103.



associations when they develop housing. The challenge for these companies will be to push their material limits to take advantage of factory tolerances, improved products, and innovative systems, while retaining a sense of authentic, real and robust housing.

Materials that require advanced industrial processes or skilled machining benefit from construction in a factory environment. As with airplanes, cars and computers, advanced technology applied to material use has the potential to revolutionize an industry. Prefabricated houses could literally be stamped together from a variety of molded shapes, rather than stick-built according to conventional framing practices. By bundling advanced technology and new materials, prefabricated systems will begin to tap into a new marketable image for the housing industry.

### Green Design

One of primary differences between building with standard construction techniques and manufacturing in a factory is the state of the job site. With prefabricated building projects, limited time is spent on the job site, reducing impact on surrounding areas, daily transportation costs, and noise or toxic pollution. Prefabricated buildings can generate zero waste on the job site, meaning that in the factory, the usual waste associated with fabrication gets recycled and monitored. Prefabricated buildings require fewer tools for assembly, and appreciate a lower instance of worker injuries overall.<sup>128</sup>

128 Personal Interview with Kent Larson February 26, 2007.

In terms of green design, prefabrication disseminates new technologies, helping to launch new products. For instance, photovoltaic assemblies are a proven green technology with considerable cost savings. However, the initial cost of the unit is so great that many installations take twenty or more years to recuperate expenses. Although the embedded technology and materials in each unit are expensive, the costs could be reduced considerably simply by producing more units.

Green designers are beginning to conceive of the house as a system, where energy flows, material use, and environmental impact can be designed and monitored. Technology allows for smart systems to interact inside the house, and architects have embraced design as a vehicle for sustainability. Prefabricated housing generates the entire house as a system, verifying and reproducing successful green designs. The development of a net-zero energy use house has become the work of researchers at the PlaceLab at the Massachusetts Institute of Technology, with the intention of using prefabrication as a construction method.

#### Non-homogeneousness

The last decade of housing development has witnessed rampant growth, as subdivisions blanket America with the cookie-cutter homogeneity of single family dwellings. The problem with this uniform community is more of an urban design phenomenon, and it is one that appears to even itself out over time. Levittown now has morphed from an identical subdivision into a more unique environment, through time, additions and the impact of varying lifestyles.

Avoiding repetition and monotony seems to be a good thing for diversity and sustainability, and it is not helped with the standardization and multiplication of prefabricated houses. Open source building techniques address this desire to create different houses on similar foundations, as have numerous builders and designers. For instance, French modernist Jean Prouve tackled this issue by developing a prefabricated housing system that allowed for the linking of design

components into fourteen variations of two design types.<sup>129</sup>

Beyond repetition, prefabricated building solutions suffer from a more tangible component of the building tradition. With factory production and non-traditional building materials, Americans have begun to usher in the erasure of craft, or the removal of human involvement in the building process. Most people will agree that hand-crafted houses are superior to factory-built work, despite evidence that shows better quality control, higher standards, more precise tolerances and verifiable results in manufactured housing. According to Sheppard, “there is no particular virtue in handicraft for its own sake, except to the craftsman, and his work is often too expensive to be widely used- a condition that may well apply in the future to housing constructed on orthodox lines.”<sup>130</sup>

Architecture, like art, is understood to be somehow beyond the realm of the system, the machine, or the factory. It has always been a field that engages the senses, that evokes emotion and tactile experience. Housing, in particular, is considered more firmly human, and thus more intimate, than most other built constructs.

Writer Tom Robbins reflects on this kind of machining of the fast food industry: “that’s the fly in the Egg McMuffin. Rather, the fly is that there never is a fly in an Egg McMuffin. The human spirit requires surprise, variety, and risk in order to enlarge itself. Imagination feeds on novelty. As imagination emaciates, options diminish; the fewer our options, the more bleak our prospects and the greater our susceptibility to controls. The wedding of high technology and food service has produced a robot cuisine, a totalitarian burger, the standardized sustenance of a Brave New World.”<sup>131</sup> This manufactured homogeneity is a product of the industrialized age, although it is one that has kept some distance from the housing industry. With the advent of accessible and advanced prefabricated building solutions, companies and designers will need

129 Arieff, 25.

130 Sheppard, 10.

131 Robbins, 73.



to actively combat this sense of uniformity.

Open source building, or other strategies for mass-customization, could offer a balance between these two camps.<sup>132</sup> However, due to their factory origins, prefabricated houses elude the realm of art. Builders lack the ability to incorporate indigenous materials, case-specific needs, or general quirkiness. As with any homebuilding venture, unusual design work, specifically anything that breaks from convention, costs more money. Prefabrication tends to distill architecture to the status of an object or product, rather than a living, breathing thing. Unless design outlets exist for incorporating varied user needs, mass-production stands to kill house diversity.

132 Personal Interview with Kent Larson, February 28, 2007.

# FINANCE

When the price of a house is described only in terms of dollars per shelter, other ways of allocating costs are disregarded. With creative financing and labor allocation, it is possible to parse the housing dollar in different ways. While not directly connected to the dollar, time, donated labor, and willingness to live in an unfolding dwelling are all substitutes for hard cash. When it comes to making housing accessible to a broad spectrum of budgets, these alternative variables may make homebuilding more reachable.

Sweat equity has the potential to reduce the cost of construction while engaging the client in the building process. This strategy requires that the client invests heavily in their own time, which also inherently necessitates that they undervalue their time. It also requires a modicum of skill, which can affect both time and product quality.

Sweat equity builds a buyers' connection to place, empowers people to improve their dwellings, and values self-sufficiency. It also undercuts the building industry, reduces the speed and efficiency of the building process, requires non-skilled labor, and implements a stiff learning curve. Numerous non-profit affordable housing developers view sweat equity as an important component in their process. Habitat for Humanity, for instance, asserts that the initial investment showcased by owners during the building process verifies their ability to take care of that physical asset after it is built.

Prefabricated housing works to eliminate construction time, thereby reducing the amount of sweat equity that could potentially feed a project. Still, if manufacturers develop house designs

that allow for on-site finish work, buyers could participate in the building process too. While this self-building component is at odds with the inherent strengths of prefabrication, it also allows for the selective customization of individual units.

From a financing perspective, prefabricated building systems sold through major corporate building retailers offer many options for cost reduction. Simple business models show that more unit sales reduce the overall price of each unit, increasing efficiency, and allowing for a higher overall quality of investment in prototypes and development. Despite the high cost of transporting an entire house, non-local commerce doesn't appear to affect the overall cost of a prefabricated house in a significant way.<sup>133</sup>

Because the construction industry differs from the manufacturing industry in terms of productivity and labor cost, prefabricated building techniques optimize cost savings. Construction wages have been shown to exceed manufacturing wages in the U.S., due to the complexity and skill of work expectations, and the risk and effort associated with working on a job site. Despite this wage discrepancy, and because of the vagaries inherent to a job site, construction labor is less productive than manufacturing labor.<sup>134</sup> Thus the prefabricated housing industry stands to benefit from the efficiencies and cheaper salaries of the manufacturing industry.

Despite these obvious cost efficiencies, prefabricated houses marketed in recent years by Dwell and Sunset magazines consistently cost more than their manufactured counterparts.<sup>135</sup> It is therefore possible to develop cheap prefabricated building components, but when it comes to infusing a modern design aesthetic and non-traditional building developers, prices escalate.

133 According to Eli, the shipping costs for a house manufactured in New England and shipped to California are under \$3,000, and the load comprises of one and a half truckloads. Personal Interview with Jhaelen Eli, Empyrean Design Director, March 08, 2007.

134 Turner and Turner, II-8.

135 According to Resolution: 4 Partner, Joseph Tanney, the 2,000 square foot Dwell Glidehouse would cost around \$400,000 in New England, without land, site work, and fees. Daniel, 1.

Some factors can significantly affect the cost of a prefabricated house. As with any homebuilding project, the cost of land is a major investment, and if the site is already owned, it will greatly improve affordability.<sup>136</sup> Many workforce homebuyers have access to land parcels, but lack the ability to navigate the bureaucracy involved in developing that land. The hyper-inflated prices of permitting in some cities make even remodeling ventures cost-prohibitive.<sup>137</sup>

Beyond the cost of the land and permitting, site improvements, utility connections, and foundation work is relatively controlled by external factors. Prefabricated building innovations, then comprise of a smaller sliver of the overall cost of a house, relative to the part that is seen and experienced. By some estimates, the price of constructing a house is less than one half of the total house development.<sup>138</sup>

Still, innovative financing schemes have proven useful in opening accessibility to homeownership for low to moderate income earners. IKEA offers special loans for furniture packages to new homeowners. KB Manufactured Homes allows buyers to order upgrades, including carpet, appliances, and mini-blinds, and then fold these extras into the cost of the house. In a similar vein, the Lowes Katrina Cottage arrives at the job site replete with a stove and a washing machine, in addition to all other construction materials. This scheme allows buyers to shelter independent household products under tax deductions meant for housing.<sup>139</sup> Because a typical mortgage customarily lasts 20-30 years, and appliances might have half that lifespan, buyers theoretically continue to pay off a product in their mortgage well after it must be replaced. Despite these long-term disadvantages, companies have shown that when they get involved in the financing themselves, they attract additional clients, sell more products overall, and obviate some of the obstacles to new homebuilding that banks enforce.

136 The Rural Studio, for instance, works well since their clients own their land, and benefit from free student labor. Jacobs, 209.

137 In San Francisco, homeowner Angela Matt filed more than \$25,000 worth of permits before breaking ground on her house remodel. Personal Interview with Angela Matt, January 29, 2007.

138 Personal Interview with John DeMoncheaux, December 05, 2006.

139 Jacobs, 127.

The efficiencies inherent to prefabricated building systems significantly reduce the overall cost of construction. According to Architect Brett Zamore, who runs his own kit building design firm in Houston, modular construction techniques can reduce building costs by up to 20%.<sup>140</sup> This number was much lower in a Boston-based study, where cost efficiencies derived mainly from the shortened enclosure time on site, and thus a reduction in vandalism. This study, conducted by Cambridge based non-profit, found 3-4% savings through use of prefabricated housing elements. Whether or not significant savings occur, prefabricated building systems purport to lower costs so sharply that they have gained a reputation for becoming too cheap.<sup>141</sup>

Government grant and subsidy programs also offer innovative financing options, especially when they are combined. The City of Houston sponsored sixteen designs for the development of a \$100,000 house, through a local redevelopment competition, and then oversaw the development of some of those structures for affordable housing initiatives.<sup>142</sup> Federal voucher programs have been implemented in the past to subsidize low-cost prefabricated housing.<sup>143</sup>

According to HUD, “manufactured housing systems and components are recognized and accepted as a significant and essential part of the national housing industry. The Federal Housing Administration evaluates housing systems to determine their eligibility for mortgage insurance purposes and issues Structural Engineering Bulletins on acceptable ones.”<sup>144</sup> HUD specifies a host of manufactured housing designs that are pre-approved for HUD funding. These designs are then published to disperse this information: “in the low-rent public housing program, any system illustrated (in their published texts) may be considered by a local housing authority, but the proposed project’s total plan will be subject to HUD approval of complete working drawings and specifications, including electrical and mechanical systems and equipment.”<sup>145</sup> While it may be necessary to get HUD’s approval for prefabricated building systems, this connection may also engender support for modern design initiatives.

140 Jacobs, 176 and 196.

141 Jacobs, 198.

142 Jacobs, 193.

143 Jacobs, 193.

144 US HUD FHA, *Manufactured Housing*, forward.

145 US HUD FHA, *Manufactured Housing Technically Suitable for HUD Housing Programs*, Introduction.

# CHANGING ROLES

The adoption of wide-scale prefabricated homebuilding necessitates a shift in roles for architects, builders, retailers, and customers.

## Architects

Beyond all other responsibilities, architects provide a sense of validity to the projects they represent. They are design and housing experts, with the ability to think about architecture in terms of light, form, art, and function. Architectural critic Karrie Jacobs states that “even though industrial designers know more about machining and reproducing products, they don’t understand light and space in the same way. I really believe that there will always need to be an architect on board.”<sup>146</sup> Without the services of architects, many large-scale single-family house development projects embody a profit-driven design approach that ultimately lacks cohesion.<sup>147</sup>

As early as 1946, Richard Sheppard stated that: “the architect has an important and difficult part to play in prefabrication. His working conditions here are different, since client and builder are fused in the firm that employs him. In the normal relationship he can, as the agent of the employer, dictate questions of technique and form to the contractor. In prefabrication he does not enjoy the same degree of independence and his opinions on form and technique are likely to be valued only in relation to the production and sales side of the industry. It is unfortunately true that the final authority rests not so much with him as with the production engineer. But

146 Personal Interview with Karrie Jacobs, February 12, 2007.

147 Many developers recycle house plans, according to Karrie Jacobs. Personal Interview with Karrie Jacobs, February 12, 2007.

it is at least encouraging that the vast majority of prefabricated schemes of construction have been produced under the control of an architect; his ability in organising and co-ordinating the varying requirements is clearly necessary."<sup>148</sup>

Collaboration between large building supply retailers and architects breaks an age-old alliance between client and architect. Ultimately, this partnership shifts an architect's role from that of a service-provider to that of a product designer.<sup>149</sup> Because AIA standards don't account for this kind of unorthodox relationship, this affects the legality of the architect-client contract.<sup>150</sup> The AIA has established firm boundaries for the type of work that an architect can legally perform, and to alter these responsibilities calls for a new set of guidelines for legal protection.

A shifting design role also supposes that architects are prepared to adopt this change in identity. While architects readily absorb changes in technology, software, and building codes, this radical shift is one that architectural education programs may not have prepared graduates for. In-house architects for corporate retailers will need to learn new ways of operating that don't normally apply to a standard architect/client relationship.

Finally, a move towards prefabricated building and mass-production creates the problem of a potential loss of work for this professional set. The architect makes money for developing a single design, and the more unique designs they can make, the more potential for profit. However, currently architects work with only a thin sliver of the socio-economic spectrum, suggesting that a new market for prefabricated architecture could emerge in addition to the old one. Karrie Jacobs believes that prefabrication offers a new way for architects to market their services, rather than a net loss of work for the architectural profession:<sup>151</sup> "The prefabrication movement has become a vehicle for architects to retail their services. It expands their client

148 Sheppard, 20.

149 Jacobs, 69.

150 An Emeryville IKEA employee said that the company retracted the full gamut of their in-house design services to prevent from unhappy clients from suing. Store visit, February 01, 2007.

151 Jacobs, 269.

base, albeit indirectly. 99% of people who buy or build houses never have any direct connection with the architect. A very small minority of people employ architects and actually get to discuss their own needs. Although some developers employ architects on their staff, to a certain extent they are simply recycling house plans. So ultimately this movement is bringing more people in touch with architectural services.”<sup>152</sup>

In 1929, when Buckminster Fuller was told that prefabrication could make the architect obsolete, he responded that “the architect’s efforts today are spent in the gratification of the individual client, his efforts of tomorrow, like those of the composer, the designer of fabrics, silver, glass, and whatnot may be expanded for the enjoyment of a vast number of unseen clients. Industrial production of raw materials and miscellaneous accessories, calls for more skill and a higher development of the design element, not its cessation.”<sup>153</sup>

One undervalued skill that architects bring to the prefabricated housing industry is their ability to look at design beyond capitalistic motives, incorporating philosophy and sociology. Architects have been trained to consider this breadth of factors in any design project. When housing extends beyond formal attributes to include lifestyle choices, planning policy, environmental stewardship and social advocacy, architects manage those disparate factors. Whether designing a mass-produced house or a custom building, the architect’s role is the same: to manage the variety of factors that affect people’s lifestyles within these designs.

## Builders

Prefabricated construction techniques radically change the nature of the building process. Unlike architects, the vast majority of all building projects employ construction workers. While factory construction implies increased mechanization and a reduction in the overall need for on-site construction workers, the profession may discover ways to innovate. New jobs for

152 Personal Interview with Karrie Jacobs, February 12, 2007.

153 Arieff, 36.



construction workers will emerge in the factory fabrication industry, in the transportation and erection of prefabricated houses, and as finish carpenters. While shifting the traditional roles of the construction industry, prefabricated homebuilding begins to address the uneven labor market, where lines have been drawn over illegal versus legal labor, union versus nonunion workers, and local versus foreign fabrication.<sup>154</sup>

Within the construction industry, disparate services have been increasingly separated and expert-oriented. While plumbing, electrical, and framing elements compose a single wall, these pieces are compartmentalized such that a separate expert is required for each unique service. In prefabricated buildings, these layered services begin to overlap in a more adept way. These interwoven elements must rely on initial coordination efforts, but ultimately reduce the amount of on-site skilled labor required for a new house.

Factory house fabrication changes the nature of the work environment. Controlled interior spaces eliminate the unknowns of weather and daylighting, allowing for additional shifts and more productive working hours. The provision of a single stable space reduces the number of injuries for workers and eliminates daily commutes to an ever-changing job site. Where climate, safety, and tasks are controlled, factories may provide better jobs for people and higher quality of work.

#### Retailers

Conventional homebuilders have already largely streamlined the design process for housing.<sup>155</sup> Standard sizes are well established in the construction industry, accepted building conventions are understood, and permits, codes and workers respond to this set framework. Despite the many efficiencies of standard stick-frame construction techniques, this process represents an outdated and low-tech way of doing: a system meant to address singular houses on a case-by-case basis.

154 Jacobs, 80.

155 Personal Interviews with Winston Ledet (March 19, 2007) and Kent Larson (February 28, 2007.)

Prefabricated housing retailers could take a lesson from the automotive industry. According to Karrie Jacobs, “homebuilders have an interest in making housing that sells, even if it is well behind the trends. Consider the development of the auto industry in the last century. If people aren’t excited by what Detroit has to offer, they buy an import. Look at Toyota’s Hybrids and the Mini Cooper. Eventually Detroit pays attention to these consumers, and begins to transform American options to respond to the market. The auto industry has developed products rapidly, primarily because of the international market.” The homebuilding industry, however, appears to be exempt from this international market pressure. “Maybe it will take an IKEA to start building homes in this country before the homebuilders will start to notice. The homebuilding industry is much more conservative and slow than modern culture accepts.”<sup>156</sup>

Because of these accepted traditions in building, changing this paradigm involves a shift of expectations from consumers, builders and product suppliers. And despite the difficulty of developing new technologies, the building industry is gradually moving towards developing larger products and assemblies. Home Depot’s VP of Strategy suggests that this change has already started to take place: while we haven’t fully invested in whole prefabricated homebuilding, we’ve built a business around prefabricated components. For instance, our flooring assemblies and prefabricated trusses are now the norm in the building world. Ultimately, these prefabricated building products could serve as a precursor to entire prefabricated homes.”<sup>157</sup>

Within the construction industry, advertising and existing marketing supports, such as name recognition, lends validity to an otherwise risky new project-type. Large companies, with well-established branding, use their reputable names to introduce new technologies. These retailers also benefit from deeper reserves in case a product fails, protecting the company through sheer

156 Personal Interview with Karrie Jacobs, February 12, 2007.

157 Personal Interview with Winston Ledet, March 19, 2007.

size.<sup>158</sup> Muji, a household name in Japan and in a growing international market, is a company that has pulled housing into their line of consumer products, which once only ranged from paper clips to bowls.<sup>159</sup> Using the same mechanization and design aesthetic of their industrial object, Muji has launched two prefabricated houses. Arguably, a company with the existing support network of retail stores, in-house designers, relationships with factories and shipping access is best suited to break into a new industry.

Large companies benefit from a business approach that takes advantage of their scale. IKEA has found that as the company continues to grow, product quality has improved and prices actually fall.<sup>160</sup> The consumer benefits from patronizing a large company, believing that the company is reliable, and can take advantage of mass-production efficiencies. IKEA CEO Anders Dahlvig, claims that growth stimulates the company: "our return statistics are improving, and our product-quality reports are also getting better."<sup>161</sup>

Because major building retailers are more willing to risk a new product launch, it could create a profitable tertiary business. Both IKEA and Lowes have taken this step. Home Depot's Winston Ledet suggests that Lowes may be able to reap long-term benefits from their Katrina Cottage: "it hasn't been widely embraced, but it will help them learn how to break into the kit homebuilding industry. It may help them to develop a position in the low-income housing or second home market. That's the opportunity here--- disaster-relief solutions could help them evolve into new markets."<sup>162</sup>

Instead of looking to the established major U.S. manufactured homebuilders to change the

158 Lowes' Katrina Cottage is an example of this type of pilot program: it is a new product type for a major national building retailer.

159 Muji offers two different prefabricated housing kits, with plans, renderings, and photos online: <http://www.muji.net/ie/>

160 "We're also aggressively reducing our prices, by about 17% over the past five years," says IKEA CEO Anders Dahlvig. According to IKEA's North American CEO, Pernille Lopez, the company plans to open 50 new stores in North America by 2010." Murphy, 1 and 2.

161 Murphy, 1.

162 Personal Interview with Winston Ledet, March 19, 2007.

face of prefabricated housing, corporate building retailers may be the best suited to break into this market. These large companies have widespread brand recognition, positive track records in product production, and extensive marketing and development reserves. Unlike their counterparts, these companies benefit from an untarnished reputation in the homebuilding industry, and therefore stand to reinvent the industry as they develop their vision.

### Buyers

PlaceLab's Research Scientist Kent Larson argues that "architecture in its current form is elitist."<sup>163</sup> Because the architectural field so often overlooks workforce housing, it raises this question: would workforce homebuyers actually benefit from the services of an architect? For a population that readily embraces industrial design and has a clear need for housing, prefabricated housing with a modern design aesthetic may actually fit in.

Although most Americans have become divorced from self-building skills in recent years, studies show that people are still interested in self-building efforts.<sup>164</sup> The workforce has more time than money, and many people actually want to establish a connection with their place of living. IKEA has developed a working model that supports this trend at the scale of home furnishings: "we have the sense that people have more time than money. So people are prepared to work so they can save some money."<sup>165</sup> By opening access to the building world, customers grow more engaged in their home development, feel empowered to take control of their space, and have access to a higher quality of life through improved design.

In order to engage customers in the building process, construction must become more inclusive. This could occur by reducing the technical skills necessary to design and build houses, as well as by opening access to information, support, and funds for these products.

Mass-produced prefabricated building components and open source building offer a means

163 Personal Interview with Kent Larson, February 26, 2007.

164 L.C. Williams & Associates.

165 Anders Dahlvig, IKEA CEO, in Murphy, 2.

for this population. Prefabricated housing inherently offers improved access to the workforce, compared to standard homebuilding projects.

The workforce has much to gain from a closer alliance with the building industry. "Insofar as the poor have to work near the dwellings of the rich- as in the case of so many service and retail jobs- they are stuck with lengthy commutes or dauntingly expensive housing."<sup>166</sup> One way to combat this lack of affordable housing is to re-think the way that this group of people interacts with homebuilding. Although new ways of housing won't solve all of the issues of affordable housing, it does increase the options available to this group. It is a starting point in the quest for better, more efficient, reasonably priced housing.

Workforce Americans have long been deprived of the right to build for themselves, and too often feel disempowered to take control over anything in their lives, shelter included. The red tape- codes, permits, fees, licenses, experts' stamps and even technical skills that have made the building process so inaccessible to people without an architect representative- can be understood as a rift along class lines. This portion of the population- the low and medium-income earners- lack access and representation to design services because they can't pay for an architect and they don't qualify for government aid. This disconnect has obviated the development of good new housing stock for this portion of the population, in essence creating a gaping hole in the breadth of the housing market.

American workers without a connection to the building trades- the school teachers and waitresses and police officers- lack the tools necessary to generate their own housing. Many of the people in this group are limited to buying substandard houses because design services haven't trickled down to their income level, yet. Although basic housing needs differ according to regional and cultural expectations, dwellings can be defined according to certain standards.

Substandard housing includes that which incorporates toxic or harmful products, lacks security,

166 Ehrenrich, 199.

or fails to function as a shelter; generally these deficiencies surface in affordable dwellings. A sizable percentage of these people could potentially build for themselves, but are stymied by this dependence on the architectural profession for advice or facilitation. Kit packages have provided an alternative option in the past: "whether finishing a basement rec room or constructing an A-frame, do-it-yourselfers bought with sweat equity the middle-class necessities that they could not otherwise afford."<sup>167</sup> Today, Home Depot, IKEA and Lowes develop advertising campaigns directed towards workforce Americans, focusing on building confidence among potential homebuilders.

Whereas the workforce could, at one time, order a Sears Roebuck catalogue house directly, choosing from a myriad of shapes, styles and sizes, today the process typically entails selection from among a smaller set of options. Low-to-moderate income earners usually are limited to existing, if new, housing stock, and they buy a house that has been envisioned by another person. Prefabricated housing offers this group an opportunity to enlist the IKEAs and Home Depots of the world as the suppliers of building components without involving architects directly. This shift would enable the workforce to buy affordable houses with real design potential- superior to most manufactured housing- yet still well within their budget.

# IMPLEMENTATION

## Marketing

Architecture, from the professional perspective, lies beyond the realm of the consumer object. Instead architecture is considered art, or environment, but certainly more than merely an industrial product. Architects resist the transference of architecture into an object, and this may well be a defining factor in this field's inability to make mass-production a reality.

Large companies such as IKEA, Home Depot and Lowes, on the other hand, have refined and streamlined product marketing and brand recognition. They have the experience, the capital and the resources to launch major advertising campaigns. These companies not only benefit from advanced resources, but to some extent also appreciate a name recognition that lends some sense of validity to new project types.

IKEA, Muji and Lowes have already demonstrated success in pairing existing company identity with new house sales. These large companies have employed innovative marketing schemes tied to brand reputability. The widespread use of the internet as an information portal, the use of existing retail locations to educate potential homebuyers, and the connection of new house product to existing company identity, have helped to fuel their emerging homebuilding campaigns.

Advertising serves as the primary source for reaching prospective buyers. "Articles and plan books had the shared goal of getting consumers to move from thinking about it to doing it,

to buying the lumber and land and building their own piece of the good life."<sup>168</sup> As long as prefabricated houses are sold on a case-by-case basis, selling houses will parallel product sales in terms of marketing.

The prefabrication movement will need to address the current stigma against manufactured housing before garnering the respect of the workforce. Strategies for improving the market share for prefabricated housing involve bolstering a number of factors. Improved marketing will need to address individuals as well as institutions. Prefabricated housing stands to benefit particularly from large-scale housing developments, perhaps initiated by federal disaster relief agencies. To dispel existing negative stigmas, new companies could reinvent the image of prefabrication. Finally, the introduction of flashy design work or a modern aesthetic could serve as the basis for marketing the new identity of prefabricated housing.

Improvements will need to be made to prefabricated housing in terms of both standardization and flexibility. Because this industry is fairly new, and one that could grow with intention, it makes sense to design smart features from the outset. These decisions should leave alternatives open, rather than forcing buyers into a constrained sliver of the building world.

Open source building, or other internet-based selling vehicles, should link retailers with buyers. This type of interface allows for great improvements to mass-customization, as well as built-in feedback mechanisms for consumers. Marketing efforts should consider modeling the reflection-in-practice planning theory at these initial stages.<sup>169</sup>

Finally, marketing needs to capitalize on the simplicity of this new system. Everything from design access to embedded services like intrinsic plumbing and electrical systems improves the overall value of the prefabricated package. Package deals, where transportation, financing,

168 Randl, 99.

169 Donald Schon pioneered this thinking about reflective planning in practice.



design permits and construction are folded into one seamless unit, will produce higher savings for buyers.

### Building After Disaster

Temporary architecture, consisting of quick-built, low-quality, mass-construction is a typical response to the immediate need for dwelling reconstruction after a disaster. By offering more robust housing solutions, the prefabricated housing market has the potential to serve affected communities in a more sustainable way.

Building temporary housing has a number of drawbacks. The process still consumes resources, requires effort, and affects the built environment in the manner of traditional housing. Despite that there is really no justification for doing this, author Richard Sheppard notes that “the fact that such houses are described as temporary has led to an assumption that the period of reconstruction is somehow to be divided into a number of phases of varying urgency, and with special forms of construction adapted to each.”<sup>170</sup> Post-disaster relief efforts are rarely so cut and dried. Moreover, many temporary houses ultimately serve longer terms than they are designed for, resulting in various modes of squatting that is detrimental to the health, safety and longevity of communities.<sup>171</sup>

Mobile housing can still be permanent housing, if designed with the ability to move, morph into new capacities, or serve as an accessory to a future structure. Beyond mobile architecture, manufactured housing using minimalist technologies may solve the need for speedy, deliverable, cheap housing while supporting a more sustainable approach to building after disasters. Either as whole units or as a series of multiple numbered components prepared for on-site assembly, prefabrication incorporates advanced fabrication methods that enable speed.<sup>172</sup> These systems

170 Sheppard, 12.

171 Some disaster-relief efforts specifically call for tent shelters, knowing that they are far less permanent than trailers. These units are purposefully under-designed so that they do not stand up to the rigors of time and use, creating a built-in shelf life for housing that ensures that people will move on with intention.

172 CNC milling machines allow for kits to be quickly produced, and flat-packed to the job site.

allow for structures to be pre-prepared, and then shipped for “just-in-time” delivery.

The design of prefabricated disaster relief structures must incorporate a size and function that provides for immediate needs while supporting future use. In-law units offer a precedent for such development: this small outbuilding is cheap, fast, and complete, while remaining useful even after the primary residence has been restored. Other alternatives involve a modular system whereby individual pods may be erected initially, and could be added to until a full-sized house emerges. Lowes’ Katrina Cottages offer a model for this type of growth over time.

While disaster relief efforts imply major community reconstruction, they rarely require the massive numbers of new house units that could singularly support an industry. New Orleans’ Hurricane Katrina spawned Lowes’ Katrina Cottages, but doesn’t necessarily provide a model for developing prefabricated housing. Winston Ledet notes that “Hurricane Katrina was such an odd thing. Beyond a catastrophic earthquake, it is unlikely to be relived. In most cases, natural disaster is more about repairs than full home replacement. Very rarely do you find entire communities engaging in full demolition and redevelopment. More often, these communities suffer from a lot of wind damage, which leads to small-scale repair work.”<sup>173</sup>

The real potential for prefabricated housing in disaster scenarios may be in securing governmental contracts for building. Jarrett Smith, says that “because the program is just getting started, we have only launched the Katrina Cottages in twenty-nine stores along the gulf coast. Although each of these stores may have sold just a few packages, we have other concurrent outlets for sales. For instance, we are also working on a FEMA project that will build around 500 cottages. Lowes has also donated several cottages in the gulf already, and we have built three models as selling tools.”<sup>174</sup> The real advantage of developing housing for this sector is the potential to help improve a difficult situation, as well as to gain future building contracts.

173 Personal Interview with Winston Ledet, March 19, 2007.

174 Personal Interview with Jarret Smith, March 12, 2007.

### The Mongolian BBQ Approach

In Mongolian barbecue restaurants, customers design their own meal by selecting from a variety of ingredients and presenting that self-served collection to the chef to prepare. This approach yields efficiencies in preparation that relieves the chef of the time-intensive decision-making process while optimizing a more valuable skill-set, preparation. Customers get what they want, engage in efficient communication, and take on the responsibility of owning their decisions.

In the prefabricated housing world, this model could lead to expensive one-off designs that are difficult to get right. But in the age of computer programs that facilitate order and supply chain management, these inefficiencies can be pared down considerably. In this realm, options offer more choices for consumers, and ultimately an opportunity to sell additional goods through add-ons. Major manufactured housing retailers already market houses along these lines: “sellers were able to market the home with an eye-catchingly low initial price and then increase the sale price by including supplemental elements. Like an a la carte menu, the shell could be customized with a variety of options.”<sup>175</sup>

The accessibility and ease with which these options are marketed to the consumer is critical. If a computer program is designed to lead users through a step-by-step process of selection, with smart parametric iterations, these choices can be managed. Moreover, this mass-customization could be highlighted to attract buyers.

Without a clear and effortless system for making decisions, more options could actually reduce the number of sales. Professor Sheena Iyengar’s research found that consumers actually will buy more items when they have fewer product variations to choose from. Author Malcom Gladwell reiterated this point: “if you are given too many choices, if you are forced to consider

175 Randl, 103.

much more than your unconscious is comfortable with, you get paralyzed.”<sup>176</sup>

### Authorship

As long as the architectural field is considered a spatial art form, architects are bound to have problems with issues of authorship and mass-produced design work. While many architects embrace open-access design and enjoy the thought of their work affecting many people, history tells a different story.

Architects have consistently worked for singular patrons with deep pockets. Residential architecture has been especially tied to notions of individual client needs and responsive to their particular resources. The architecture of public buildings, on the other hand, has been cited as an opportunity for poorer people to appreciate architectural environments, as an alternative to paying for architectural services in their own homes. At the McCall Design Group in San Francisco, architects manage design work for the franchise stores that pepper malls across America. By designing interiors for companies like the Gap, Restoration Hardware and Victoria’s Secret, these architects effectively extend their product to a much broader audience, including people who would not normally encounter high-end architectural design.<sup>177</sup>

The architecture of prefabricated buildings may need to operate under different authorship guidelines than more standard projects. For instance, architects could sell their work under copyright, gaining payment from royalties on an individual basis. Designer Marianne Cusato, who has since partnered with Home Depot to develop the Katrina Cottage kits, will sell the plans alone for several hundred dollars. This arrangement seems like a risky alternative to entering a typical contract, in terms of protecting the architect’s work. However, by making their services available to a broader audience, architects benefit both from selling more designs overall, and from seeing their work reach more people.

176 Gladwell, 146.

177 Personal Interview with Angela Matt, January 29, 2007.

## Construction

The construction process has already begun to incorporate new prefabricated elements.<sup>178</sup> According to Winston Ledet, “building components are already transitioning to more intrinsic prefabrication. For instance, packaged fireplaces, as well as entire wall units are becoming the norm. What once took a builder weeks to construct can be dropped into place in half an afternoon. This prefabricated alternative takes out labor and cost, without reducing value.”<sup>179</sup> Beyond these individual building components, production construction techniques, typically employed in large-scale developments, establish factory-like conditions on the job site. As with the construction of prefabricated housing, this method requires a crane on the job site to erect cumbersome modules.<sup>180</sup>

The construction industry already relies heavily upon existing building standards and modules, such as the 4 by 8 sheet of plywood, or the 2 by 4 piece of lumber. In Japan’s post-war housing boom, the preexisting tatami mat and shoji screen modules facilitated a glut of prefabricated homebuilding. Because these standards played such a major role in developing new building types, Architect Michael Franklin Ross suggests that Japanese “traditional architecture is itself a form of open system.”<sup>181</sup> Prefabricated housing retailers must consider these existing standards in their approach to designing housing.

## Incremental Change

Although the U.S. has eagerly embraced a technological revolution that affects nearly all facets of American life, the country has done little to modernize the way houses are designed and built. Architectural designers regularly put forth proposals for innovation in this industry, and yet buildings continue to follow relatively stable trajectories: “remarkably, little has changed since then, despite wave after wave of groundbreaking proposals for prefabrication in the late

178 Jacobs, 247.

179 Personal Interview with Winston Ledet, March 19, 2007.

180 Gietema, 28.

181 Ross, 62.

thirties, again after World War II, and yet again in the late sixties from architects including Le Corbusier, Walter Gropius, Jean Prouve, Albert Frey, Buckminster Fuller, Sir Richard Rogers, and Charles and Ray Eames.”<sup>182</sup>

“Good design isn’t just for the elite,”<sup>183</sup> says critic Karrie Jacobs, and ultimately, the prefabricated housing movement offers a small scale approach to this larger problem. Prefabricated housing is about making small changes to the availability of architectural design on a mass scale. Curitiba’s onetime mayor Jamie Lerner has called this strategy “urban acupuncture,” and suggests that these changes have a widespread rippling effect.

For Lowes, Home Depot, and IKEA, entering the modern prefabricated homebuilding market represents a major departure from their current product offerings. As they design for this shift, incremental steps, involving simple project types and low risk will help to support this transition. Aggressive marketing should be coupled with a more reserved tack in terms of project types. The small-scale Katrina Cottage pilot program has allowed Lowes to break into the prefabricated homebuilding market while limiting the company’s financial risk. Jarrett Smith explains that Lowes has “started selling the cottages in twenty-nine gulf coast stores, and will continue to expand the project as long as there is demand. We may then be able to roll it out nationwide.”<sup>184</sup> This tight geographical area ensures that the houses will meet local building codes and environmental needs while gauging whether the project has popular support.

Regional differences hamper efforts to streamline the building process, and so targeting one specific part of the country also limits Lowes’ initial investment. According to Smith, “many other variables will come into play if we expand our geographical area. Snow loads and seismic issues, for example, will require specific design changes. However, interest in the Katrina Cottages is very strong. We have had inquiries from people in Saudi Arabia to the Bahamas. This type of

182 Arieff, 9.

183 Jacobs, 176.

184 Personal Interview with Jarret Smith, March 12, 2007.

development could fit into our stores nationwide and ultimately, become available globally.”<sup>185</sup>

Incremental change works in terms of the scope of the project design, as well as geographical area. As retailers attempt to gauge whether Americans are ready to embrace modern prefabrication methods, and ultimately as they sell this new idea, small-scale project types may offer a lead-in. Home Depot’s Winston Ledet suggests that the best way to break into this new market will be facilitated by targeting specific user-groups: “I believe that fundamentally, Americans still desire individual house-building,” he says, “the majority of Americans are really not ready to totally launch into prefabricated communities.” However, he suggests two different scenarios that could allow for an easier shift into a more widely-accepted prefabricated building industry: “these two categories are really low-income housing, such as prefabricated buildings as an alternative to a trailer home, and prefabrication used to build second homes. The reason this could work is that in both of these cases people are more likely to accept a home based on function, rather than identity. Other than these two scenarios, I can’t see prefabrication reaching mainstream America anytime soon.”<sup>186</sup>

In their 1972 report on industrialized housing, Turner and Turner advocate an approach towards prefabricated homebuilding that bridges the gap between high and low use of technology, and traditional and highly manufactured housing. This middle ground allows for the housing industry to catch up with technological and mechanical innovation without outstripping the known building norms altogether.<sup>187</sup>

This partial approach towards industrialization may represent a more conservative trajectory than manufacturers are capable of creating, but it eliminates the risk inherent to new development of this nature. Architectural historians argue that the failure of Buckminster Fuller’s spacecraft-like prefabricated houses, and the market success of generic manufactured housing models lies in the rejection or adherence to conventional building norms. Still, advanced technology and

185 Personal Interview with Jarret Smith, March 12, 2007.

186 Personal Interview with Winston Ledet, March 19, 2007.

187 Turner and Turner, IV-2.

manufacturing processes have become the norm in automobile sales and well as the computer industry, and housing may well be braced for this leap.

### Orchestrating Alliances

The success of a modern approach to prefabricated housing depends upon the coordination between different parties. During the design process, this level of communication is paramount: “this won’t happen unless all parties communicate- from the financier, to the supplier who provides the parts, to the home buyer who settles for the gable roof she did not really want.”<sup>188</sup> Coordination between parties becomes more efficient when all parties work under the same roof. When major retailers hire in-house designers, develop relationships with building suppliers, adopt company marketing approaches and refine buyer outreach, they stand to control the entire loop of the homebuilding experience.

Pairing builders with buyers is nothing new for the retail giants that sell building materials. If these companies offered entire prefabricated houses in their stores, they could also profit from orchestrating the connection between certified contractors and potential buyers. Winston Ledet envisioned this process: “if Home Depot ever developed an entire house it could be made available through stores and attached to a series of preferred builders. This way of linking services already has been modeled in history, with the Sears Catalogue houses. What’s more, the kitchen design and remodel divisions of Home Depot already work that way.”<sup>189</sup>

However, major companies assume responsibility for these connections, and for IKEA and Lowes, this kind of legal vulnerability isn’t worth exposing: “at the moment, Lowes doesn’t get involved with pairing builders and buyers. We don’t work out any of these alliances--- primarily because of liability. The store associate will direct the customer to the local homebuilding association to locate a qualified, certified builder.”<sup>190</sup>

188 Arieff, 10.

189 Personal Interview with Winston Ledet, March 19, 2007.

190 Personal Interview with Jarret Smith, March 12, 2007.



## Other Challenges

Prefabrication has the stigma of low-cost housing. Changing the image of prefabricated housing has already begun through intensive advertising campaigns and in architectural publications. In the house trailer industry, acceptance occurred with a name change, as mobile homes became prefabricated houses. Already, the word prefab has begun to replace prefabricated housing as a hip, modern iteration of this older building genre.

Beyond the initial investment of the prefabricated house or kit, many additional costs accrue: “in addition to finishing the interior, customers were usually responsible for site preparation, constructing the foundation and hooking up to the electrical grid, a water source, and a septic source.”<sup>191</sup> The physical outcome of prefabricated building may only address as little as one third of the overall project cost. Other, less tangible, costs represent the bulk of housing, such as site acquisition, utility connections, insurance, mortgages, and legal fees.

The loss of jobs posed by replacing human workers with machine labor also represents a significant challenge to the construction industry. Some tradespeople are necessary due to the skills they possess. Without the population involved in residential building efforts, America risks losing a cultural and traditional link to the building process.

In his master’s thesis, William Gietema found that market acceptance of prefabricated homebuilding hinged primarily upon building logistics.<sup>192</sup> He cites a number of concerns that homebuyers have about the building process, including the lack of design flexibility in prefabricated panels, a competitive housing market, slim profit margins, reliance on experienced framing teams, and poor adaptability in the production process.

Finally, while major building retailers have the means to disseminate prefabricated houses

191 Randl, 103.

192 Gietema, 5.

throughout the country, the nation is not standardized enough to accept such widespread homogeneity. Unique building codes, weather constraints, and even cultural implications will require varied and region-specific house designs. In preparing the Katrina Cottages for market, Smith said that “getting familiar with the different codes in different geographical locations has been the most difficult challenge to date. We have experienced some hurdles with individual city building codes already, and that is just in the gulf area. However, we are working these problems out as they present themselves.”<sup>193</sup>

193 Personal Interview with Jarret Smith, March 12, 2007.

# CONCLUSION

Architects are over-rated when it comes to housing low and middle income earners in single-family dwellings. However, a host of factors have made the building process inaccessible to people without architect representatives, and this disconnect has resulted in a dearth of well-designed new housing stock geared towards this portion of the population. The workforce lacks architectural representation and access to design services because they can neither pay for an architect nor qualify for government aid.

In the early 20<sup>th</sup> century, Sears Roebuck catalogue houses were delivered directly to cities across the country. Today, a number of slick modern prefabricated housing companies replicate this convenience, at a much greater relative cost. Meanwhile, their counterparts, the companies that make up this country's manufactured housing industry, produce thousands of cheap, iconic and utterly mundane prefabricated units. Architectural critics have made popular the myth that prefabricated architecture can be cheap, or it can be good, but it cannot be both.

The problem of developing successful prefabricated housing, however, might simply be solved by re-packaging the homebuilding experience for the workforce. By employing architects as in-house product designers, companies such as IKEA, Lowes and Home Depot stand to enter the prefabricated housing market with an eye at bridging the gap between affordability and quality. Through the outlet of a recognized retailer, the workforce could afford to buy a house with real design potential while honoring budget constraints.

The propulsion of this idea requires a restructuring of the current housing paradigm. Most

prevalent forms of prefabricated housing lack a connection to a modern design aesthetic. Architectural historian Colin Davies believes that this is a fundamental rift between the architectural field and the mechanization inherent to prefabrication: “modern architecture is unpopular, expensive and divorced from industrial production. This is why whenever it has tried to extend its field to include the territory of the prefabricated house it has failed and been forced to retreat.”<sup>194</sup> As the architectural field broadens its scope to include new ways of building, prefabrication must become a part of this ever-growing identity.

Prefabricated building systems have the potential to transform the way that architecture is conceived, produced, and developed. With the integration of technology, user input, and mass-customization, this building strategy effectively bundles multiple design angles. Prefabricated building streamlines the construction process, producing housing faster and cheaper than conventional methods. It doesn't, however, address the financing, permits, approvals, site work, utilities, and transportation required to generate a turn-key product. Beyond formal design, the bigger challenge revolves around working out these larger logistics.

A single corporate retailer has the ability to manage these logistics as well as in-house design services. These companies are already adept at managing a variety of components and applying factory-like precision to the products they sell. Parent companies could manage the design software, advertising, loans, orders, permits, fees, transportation, certified contractor support, and even the foundation development. By bundling these various services under one single provider, a collection of disparate entities could operate more efficiently and at a greater volume.

Of course, homebuilding differs from product manufacturing in that each site dictates a different solution, and each inhabitant perceives their needs to be slightly different than their neighbor. Housing needs to belong to architecture; beyond existing as an object, it must integrate with the surrounding environment. A more responsible, responsive residential

194 Davies, 8.

architecture is needed for the future of housing in the U.S. This includes embracing green building and technologically smart structures. It includes standardizing building components so that interfaces can communicate across companies and product types. It includes designing structures to grow over time, by building in hem lines that can be let out. It must strike a balance between ushering in a modern design aesthetic and appealing to existing architectural norms.

In terms of the profession, architecture must also make changes in both structure and intent. Architects need to be willing to adopt new roles in a changing construction industry, and to retail their services through non-traditional outlets. Architects will need to champion the prefabrication movement if they want to participate in it, and they will need to consider issues of authorship and architecture as an art form.

Perhaps architects aren't strictly necessary for modern homebuilding in the U.S. Certainly, the impact of architects on residential design has been limited by both scope and innovation. The architectural field stands to benefit from adopting a looser definition of the profession, recognizing and engaging both mass-production and vernacular styles. Prefabricated homebuilding opens new opportunities for an indirect architectural representation, where the marketplace acts as an intermediary.

Prefabricated housing also provides a means of linking architectural services with all people, regardless of their spending power. Through industrial technologies, production efficiencies, and national retailing, architecture may move from a profession of elite culture transmission to one with everyday access. The involvement of designers in this movement relies on the assumption that architects actually do good work, and are valuable resources for individual homebuilding efforts. When paired with industrial prefabrication, corporate retailing strategy, and new production methods, architects have the capacity to improve housing for the workforce.

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