



research works

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Lean Production Techniques May Advance Factory-Built Housing



Lean production techniques, which first proved successful in streamlining the automotive industry, promise to have far-reaching benefits for both the factory-built housing industry and the consumers it serves. The overall goal of lean production is to build the best product at the lowest price in the shortest possible time — all while maintaining customer satisfaction. For many manufacturers, adopting lean production methods means making a significant departure from traditional mass production procedures to those which support a continuous customer-driven workflow, foster ongoing improvements, empower employees, and eliminate waste. The industry-wide adoption of lean production techniques is one of the top research priorities suggested by business, industry, and government leaders for manufactured housing. [See *Factory-Built Housing Roadmap*

Manufacturers can improve their production capacity with minimal additional expense by applying lean production techniques to manufactured and modular home construction.

(Including Recommendations for Energy Research) at www.huduser.org/publications/destech/roadmapping.html.]

The Manufactured Housing Research Alliance (MHRA) recently conducted a study for HUD's Office of Policy Development and Research and the Partnership for Advancing Technology in Housing (PATH) that established a baseline for measuring the impact of lean production strategies on factory-built housing plants. Researchers then looked at how a home manufacturer might implement lean production methods.

Benchmarking Survey

MHRA surveyed 141 factory-built housing plants in 27 states and Canada to develop a baseline for determining the effect of lean production techniques on home manufacturing. A report of the key findings, *Getting Lean: Assessing the Benefits of Lean Production in Factory-Built Housing*, describes the highs, lows, and national averages for 11 basic plant metrics and 11 productivity and quality measures. Researchers found wide variations in performance within the factory-built housing industry, which could be attributed to such factors as geographic location

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and differences in product lines. These performance variations make it difficult to draw industry-wide conclusions from the survey, but researchers concluded that ample opportunities for improving operational performance within the industry do exist.

Applying Lean Techniques

The Capsys Corporation, a modular housing manufacturer based in Brooklyn, New York, was selected as the site where researchers would test the applicability of lean production methods. Capsys' product targets first-time homebuyers seeking affordable housing in urban areas. The company uses a steel-based building system to produce townhome modules that are sold to developers and general contractors. Projects run from 70 to several hundred units in size. The plant works on one project at a time, retools for each job, and delivers its units to the building site, where the company also installs them.

A case study team consisting of industrial engineers, a structural engineer, energy-efficiency specialists, and Capsys managers used a concurrent engineering approach to find ways to apply lean production techniques to the product design and manufacturing operations. The industrial and structural engineers looked to maximize plant performance while using as few resources as possible, whereas the energy analysts' goal was to optimize efficiency through low-cost design changes.


Combining what was learned from the benchmarking survey with detailed observations of the plant's activities, the case study team established performance baselines, identified inefficiencies, and suggested

alternatives based on lean production principles. Their recommendations focused on incremental changes to existing practices that had a high rate of return and low cost, required no major capital investment, and were applicable to most Capsys products. The chart below lists the team's top 10 recommendations, provides an estimate of the relative implementation cost, and projects the potential savings to Capsys.

These and other recommendations suggest that Capsys has a significant opportunity to improve production and capacity for only a small amount of additional capital. Still, another kind of investment *is* necessary, in that making the changes will "demand time and dedication from management and a substantial cultural and operating change."

What's Next?

The plans for the next phase of lean production research have already been drafted. The benchmarking survey and analysis of the Capsys operation have yielded data that suggest expanding the pilot program to six or eight factory-built housing plants is merited. By increasing the number and variety of factory housing manufacturers, the second phase of research activities promises to benefit the entire industry. If the result is higher-quality, more energy-efficient, and more affordable homes, efforts to institutionalize lean production techniques among factory-built housing plants throughout North America are worth pursuing.

Getting Lean: Assessing the Benefits of Lean Production in Factory Built Housing can be downloaded free of charge at www.huduser.org/publications/manufhsg/leanprod.html. 

Top 10 Recommendations for Lean Production Improvements		
Recommendations	Cost	Savings
1. Expedite electrical processes	Low	Medium-High
2. Spread line activity by moving work upstream	Low-Medium	Medium-High
3. Rationalize material staging and replenishment	Low	Low-Medium
4. Purchase right-sized tools	Low-Medium	Medium
5. Use right tool for the job	Low	Low
6. Create sub-assembly cells	Low-Medium	Low-Medium
7. Use positional guides and jigs	Low-Medium	Low
8. Reduce welding	Medium	High
9. Reengineer roof slope on townhouses	Medium	Medium
10. Order the workplace	Low	Medium

Source: Manufactured Housing Research Alliance, *Getting Lean: Assessing the Benefits of Lean Production in Factory-Built Housing*. U.S. Department of Housing and Urban Development Affordable Housing Research and Technology Division, December 2005, p. 23.

Hispanic homeownership increased at a greater rate than that of non-Hispanic whites during the last decade (11 percent and 6 percent, respectively), yet considerably fewer Hispanics own homes. The homeownership rate for non-Hispanic whites is 76 percent, compared with only 50 percent for Hispanics. What explains the difference in homeownership rates? What barriers do Hispanic families confront when they want to buy a home? Is help available for overcoming these barriers? And what measures would most likely lead to an increase in Hispanic homeownership? A timely set of seven reports from HUD's Office of Policy Development and Research looks at these questions.

At the core of these reports is a review of available research on Hispanic homeownership. The review found that, to understand what fuels the lag in Hispanic homeownership, one must recognize the diversity of the U.S. Hispanic population. Variations in ethnic and socioeconomic background, geographic location, and length of stay in the United States are significant. In-depth case studies of Hispanic communities in Washington, D.C.; Orlando, Florida; and San Antonio, Texas underscore the diversity of the U.S. Hispanic population. The accompanying table presents statistics that reflect a few of the differences in the Hispanic populations of these three communities and the country as a whole.

Each community has a unique demographic profile that influences Hispanic homeownership rates. This research points to an array of significant contributors that include age, income, level of education, net worth, household type, nativity, country of origin, degree of social integration, and place of residence. The authors of these reports recognize that other



A seminar held at HUD in June examined Hispanic homeownership in the United States.

influences, such as discrimination, also shape Hispanic homeownership levels.

Common Barriers to Hispanic Homeownership

Despite variations within the Hispanic population, the research finds common barriers to homeownership that are especially difficult for immigrants. One such barrier is a lack of accurate information about buying a home and the roles that real estate agents and financial agencies play in the process. Limited English skills, a disconnect from mainstream financial institutions, and bad experiences with banks in other countries discourage many from pursuing homeownership or contacting housing counseling agencies.

A disproportionate number of Hispanics have low levels of income and wealth, poor credit histories, unstable employment, and inadequate documentation. This means that many do not have access to housing finance, particularly in high-cost markets where decent, affordable homes are in short supply. According to the case studies, many Hispanics prefer

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Characteristics of Hispanic Households				
Characteristic (%)	Orlando	San Antonio	Washington, D.C.	United States
Proportion of total population	17	45	9	13
Homeownership rate	55	59	44	46
Homeownership gap in relation to non-Hispanic whites	-18	-11	-29	-26
Majority country/region of origin	Puerto Rico (55)	Mexico (72)	Central America (30)	Mexico (54)
Education beyond high school	49	38	45	33
Foreign born	75	22	82	53
U.S. citizens	83	89	51	68
Speak English at least "well"	82	89	73	75

Compiled from: *Efforts to Improve Homeownership Opportunities for Hispanics: Case Studies of Three Market Areas and Improving Homeownership Opportunities for Hispanic Families: Language, Agglomeration, and Hispanic Homeownership*. U.S. Department of Housing and Urban Development, Office of Policy Development and Research, March 2006, pp. 7-14, 37-43, 63-70.

Effective moisture control in the home begins with design and construction decisions that affect the moisture-resistance features of roofs, walls, foundations, and vapor barriers. A well-constructed home makes for a good long-term investment. However, moisture control ultimately depends on the homeowner's understanding of the issues and conscientious management. Not only must the owner recognize moisture problems, but through adequate maintenance, must also prevent them from developing. Too often, homeowners find that they are only minimally prepared for the responsibility of protecting their principal investment.

In June 2005, *The Oregonian* ran a two-day series about moisture-related problems, warning that "... rot and mold are eating away at the structural components inside a small but growing number of today's homes and condos. The result is an ugly—and costly—affront to the American Dream." Within 24 hours, more than 100 readers had contacted the paper, asking how to determine whether their own homes had moisture problems.¹

Recognizing the widespread need for information about preventing moisture damage, HUD and the Partnership for Advancing Technology in Housing (PATH) commissioned a best practices and plan review tool for builders and designers, together with a supplemental guide for homeowners titled *Moisture-Resistant Homes*. The guide combines the latest in technical knowledge with judgment, experience, and a common-sense approach to moisture management. It helps homeowners protect their most valuable investment by looking at the home as an integrated system, illustrating how and where moisture damage occurs, explaining how to recognize moisture damage and, when necessary, how to find the right kind of help.

Your House is Alive!

In many ways, a house is like a living organism, in that it needs a healthy skin, or exterior, to protect its internal structure from the elements. It must be able to breathe—or in this case, to release excess moisture. It also needs a healthy circulatory system; one that can carry water in and out of the house without leaking.

1. Jeff Manning, "Falling Apart," *The Oregonian*, 19 June 2005, p. A01; 21 June 2005, p. B04.



Regular maintenance can help homeowners protect their homes from moisture damage.

Know How and Where Moisture Damage Happens

Moisture damage in the home is frequently traceable to a lack of maintenance or disrepair. The most frequent trouble spots include:

- Roofing or flashings
- Ice dams
- Heating, ventilation, and air conditioning (HVAC) systems
- Plumbing
- Window and door flashings or seals
- Landscape grade changes
- Standing groundwater or rainwater pools
- Gutters and downspouts
- Soffits and fascias
- Weep holes
- Sump pumps
- Condensation
- Natural disasters

Know What to Look for in Each Room

Savvy homeowners routinely check all systems, looking for clues to excess moisture and impending or existing water damage. In the kitchen, look under and around the sink, behind the refrigerator, beneath the dishwasher and stove, and at exhaust fans and filters. In the bathroom, regularly inspect the plumbing, exhaust fan, toilet, windows, showers, tile

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to rent in predominantly Hispanic neighborhoods than to buy a house they could afford elsewhere.

As the case studies emphasize, many Hispanics cannot meet underwriting requirements to qualify for mortgage financing. During the past decade, three of the most common sources of residential mortgages—Fannie Mae, Freddie Mac, and the Federal Housing Administration (FHA)—made changes that standardized mortgage products and helped low- and moderate-income households qualify for mortgages. However, underwriting requirements still present obstacles to many Hispanics. Some of the more common ones include:

- **Requiring borrowers to be legal residents of the United States.** This remains a barrier for millions of undocumented immigrants. Although some lenders are assessing this requirement, it involves issues that remain difficult to resolve.
- **Disallowing cash income.** Some smaller community mortgage lenders now allow a limited portion of a borrower's total income to be earned in cash. Fannie Mae, Freddie Mac, and FHA may follow suit in the future.
- **Requiring homebuyer education and counseling in order to qualify for new flexible mortgage programs,** such as Fannie Mae's MyCommunity Mortgage. This is a relatively new requirement; however, it is one that sometimes impedes Hispanic homeownership when counseling and materials are unavailable in Spanish.

Strained Homeownership Services

To navigate the process, most prospective Hispanic homebuyers need a wide range of information and services. The demand for credit, mortgage, and post-purchase counseling; for assistance in building English proficiency; and for help in establishing legal residency is straining the capacity of providers. Although housing counseling agencies offer the most comprehensive range of services, including group seminars and individual counseling, few offer one-stop centers. As a result, prospective homebuyers must cobble services together for themselves. For example, one agency may offer homeownership counseling but refer clients to a real estate agent to find a house, to another agency for downpayment assistance, and to yet another to find a mortgage. This fragmentation leaves many prospective homebuyers discouraged and vulnerable. A number of agencies also report that limited resources often keep services out of reach for many moderate-income

Hispanics who would make excellent candidates for homeownership. The same can be said for criteria that require clients to earn between 50 and 80 percent of area median income.

These reports will be useful to anyone interested in understanding the barriers that Hispanics face in the housing and mortgage markets, and in learning more about public and private initiatives aimed at increasing Hispanic homeownership. All seven reports and a separate summary can be downloaded from the following websites, or ordered for a nominal fee by calling 800.245.2691 and selecting option 1.

- *Improving Homeownership Opportunities for Hispanic Families: A Review of the Literature* (http://www.huduser.org/publications/HOMEOWN/hisp_homeown1.html).
- *Efforts To Improve Homeownership Opportunities for Hispanics: Case Studies of Three Market Areas* (http://www.huduser.org/publications/HOMEOWN/hisp_homeown2.html).
- *Review of Selected Underwriting Guidelines To Identify Potential Barriers to Hispanic Homeownership* (http://www.huduser.org/publications/HOMEOWN/hisp_homeown3.html).
- *Housing Tenure, Expenditure, and Satisfaction Across Hispanic, African-American, and White Households: Evidence From the American Housing Survey* (http://www.huduser.org/publications/HOMEOWN/hisp_homeown4.html).
- *Mortgage Pricing Differentials Across Hispanic, Black, and White Households: Evidence From the American Housing Survey* (http://www.huduser.org/publications/HOMEOWN/hisp_homeown5.html).
- *Improving Homeownership Opportunities for Hispanic Families: Language, Agglomeration, and Hispanic Homeownership* (http://www.huduser.org/publications/HOMEOWN/hisp_homeown6.html).
- *Homeownership Rate Differences Between Hispanics and Non-Hispanic Whites: Regional Variation at the County Level—Empirical Studies* (http://www.huduser.org/publications/HOMEOWN/hisp_homeown7.html).
- *Summary of HUD Research Series: Examining Barriers to Hispanic Homeownership and Efforts To Address These Barriers* (http://www.huduser.org/publications/homeown/hisp_homeown8.html). **HJ**

According to the American Housing Survey (AHS), first-time buyers make two out of every five home purchases. These buyers must make immediate – and often critical – decisions about the type of structure they want, the neighborhood in which they will live, and the cost burden they will assume. A recent HUD-sponsored study, *The Homeownership Experience of Low-Income and Minority Families: A Review and Synthesis of the Literature*, draws from seven biennial AHS surveys completed from 1991 to 2003 that reflect the choices made by new low-income homeowners (defined as those earning less than 80 percent of the area median income) and minority homeowners.

Type of Housing

Although the choice between manufactured or stick-built housing did not differ by the first-time homebuyers' race or ethnicity, low-income families invested more frequently in manufactured homes. A majority of low-income and minority buyers, however, chose single-family detached homes. The condition of these properties, which are typically smaller and older, was generally similar to that of other owner-occupied residences and far better than what these new owners might have experienced as renters.

Type of Neighborhood

Participants in the 2005 National Association of Realtors Profile of Home Buyers and Sellers Survey ranked neighborhood quality as the most important factor influencing the location of homes. Yet the AHS data show that, compared with higher income homeowners, low-income and minority buyers tend to choose neighborhoods that have more problems with blight and litter and are closer to commercial and industrial zones. Nevertheless, neighborhood conditions for low-income renters were comparatively worse, suggesting that these first-time buyers improved their surroundings through homeownership.

Cost of Owning

Researchers observed a growing tendency among low- and moderate-income groups to assume a large debt burden for housing. Between 1991 and 2003, the proportion of low-income homebuyers who committed less than 30 percent of their income to housing fell, whereas the proportion spending 40 percent or more rose. By comparison, low-income renters paid close to 40 percent of their income for housing throughout the same period. The largest differences in cost burdens



A majority of low-income and minority homebuyers choose single-family homes, according to recent American Housing Surveys.

were among income groups. Minorities, especially Hispanics, also carried heavier housing debt.

The 1991 – 2003 AHS data also reflect decisions regarding interest rates, lenders, loan-to-value (LTV) ratios, and types and lengths of mortgages. In general, researchers found the following:

- The proportion of first-time homebuyers who paid high interest rates rose as household income levels dropped. Minorities were more likely than whites to pay higher interest rates. Average interest rates fell for all groups, but fell more for low-income buyers, suggesting that new affordable mortgage lending products may have made financing more accessible.
- Although low-income buyers were more likely to have high LTV ratios, the average LTV ratio differed little across income groups. Over time, loans with higher LTV ratios increased among all categories of first-time buyers, although minorities held a higher proportion of such loans than did whites.
- The proportion of homeowners with fixed-rate mortgages differed little across income or racial/ethnic groups.
- Low-income buyers tended to use shorter-term financing, possibly because a larger proportion invested in manufactured housing. Minorities used the lengthier 30-year mortgage more often than white buyers did.

The study also explores the long-term effects of a low-income or minority family's decision to buy a home. It identifies both challenges and benefits to consider in determining how policymakers might help more low-income and minority families take part in the American Dream.

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surrounds, and tubs. In addition, the water heater, water softener, heating system, cooling system, and other HVAC systems are all potential sources of moisture damage and mold. Areas to inspect in the attic include roof pass-throughs, attic vents, insulation, ductwork, recessed lights, and the walls that connect the attic to the basement. In the laundry room, check for leaks, clogs, or drips in the washing machine and dryer connections, hoses, filters, sinks, and faucets. Basements, whether finished or unfinished, should be cool, dry, and clean. Crawl spaces also need regular inspection. For all of these areas, *Moisture-Resistant Homes* gives the homeowner specific advice on what to look for and what to do to prevent—and address—problems.


The guide also walks the homeowner through a thorough inspection of the home's exterior, including sidings, wall penetrations, windows and doors, drainage, and the effects of trees. The condition of shingles, flashings, gutters, and roof membranes are all important to the integrity of the home and must be carefully monitored. Although many homeowners cannot safely climb onto the roof, many things can be observed from the ground, from windows, and through binoculars.

Know Who Can Help

Moisture-Resistant Homes concludes with a number of resources that homeowners can use to find more information on moisture control, as well as for advice on hiring a contractor to make needed repairs and improvements.


- Smart Consumer Services (www.smartconsumerservices.org) offers tips for securing a contractor's help.
- The Environmental Protection Agency offers *A Brief Guide to Mold, Moisture, and Your Home* (www.epa.gov/mold/index.html).

- GLE Associates' Mold Site (www.gleassociates.com/mold) offers information about mold for claims professionals, contractors, commercial property owners, and homeowners.
- The Engineered Wood Association (www.apawood.org/bbh_index.cfm) provides construction tips for building moisture-resistant housing.
- *Repairing Your Flooded Home* (www.redcross.org/static/file_cont333_lang0_150.pdf) is offered by the Federal Emergency Management Agency and the American Red Cross.
- The National Center for Healthy Housing and Enterprise issued *Creating a Healthy Home: A Field Guide for Clean-up of Flooded Homes* (www.centerforhealthyhousing.org/FloodCleanupGuide_screen_.pdf), a how-to guide for cleaning flood-damaged homes based on research conducted in New Orleans.
- HUD's Healthy Homes program (<http://170.97.67.13/offices/lead/hhi/consumer.cfm>) links consumers to specific resources on health and safety hazards.
- The *Healthy Housing Reference Manual* (www.cdc.gov/nceh/publications/books/housing/housing.htm) is a resource offered by the Centers for Disease Control and Prevention.

This article is based on chapter 4 of *Moisture-Resistant Homes*, with information from The Institute for Business and Home Safety (www.ibhs.org). The report is available as a free download at www.huduser.org/publications/destech/moisturehomes.html. Printed copies are available for a nominal fee from HUD USER by calling 800.245.2691 and selecting option 1. 

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The Homeownership Experience of Low-Income and Minority Families: A Review and Synthesis of the Literature is available as a free download at www.huduser.org/publications/HOMEOWN/hisp_homeown9.html. Printed copies are available for a small fee by calling HUD USER at 800.245.2691

and selecting option 1. This article highlights research that drew from the AHS, the largest regular source of up-to-date housing statistics in the United States (online at www.huduser.org/datasets/ahs.html). The 2005 AHS national data set is a recent addition to our website. 

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