# Why Housing is Long Overdue for Disruption www.phrc.psu.edu PennState College of Engineering RESEARCH CENTER PennState RESEARCH CENTER PENNSYLVANIA HOUSING RESEARCH CENTER PENNSYLVANIA HOUSING RESEARCH CENTER

#### Description

Virtually every major industry has experienced, or is in the process of experiencing, massive disruption. Think retail, personal transportation, automobiles, computing, music, photography, media, and the list goes on. The current pandemic is only an accelerant for further disruption. Housing in the U.S. has been able to sit on the sidelines with its first-cost dominated business model and uniquely fragmented industry...but not for much longer. That's because there is an historic convergence of five housing crises driving four disruptions that will finally transform an industry resistant to change. And ultra-high-performance home advocates will have to successfully navigate this larger disruption context. Will you be ready?

#### Description

- Learn how 'health' is a critical part of a new customer experience imperative.
- Learn how safer and more resilient homes will have to be integrated with four major housing disruptions.
- Learn how the welfare of all homeowners will be immensely improved with four major housing disruptions.
- Learn how a comprehensive housing optimization framework including high-performance results in \$100,000 to \$250,000 of cost savings and/or added value per home.





#### Retooling Journey...





#### Disruption Happens



#### Disruption Usually Happens from Outside Industry







Fifth Ave. Easter Parade, NYC - 1903

Fifth Ave. Easter Parade, NYC - 1913

Disrupter	World's Largest	Ownership	
Uber	Taxi Company	No Vehicles	
Facebook	Media Company	No Content	
Alibaba	Retailer	No Inventory	
Airbnb	Accommodation Provider	No Real Estate	
TBD in ~3 Years	Housing Company	No Construction	

Housing Disruption is About to Happen to Housing



Why: 5 Crises

How: 4 Disruptions

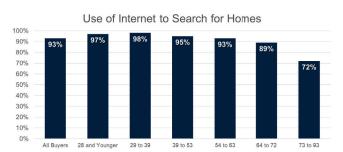
**5 Housing Crises** 

#### Five Housing Crises



#### Informed Homebuyer Readiness Housing Crises Informed Buyers Affordability Trades Productivity Innovation

- Informed Buyer Readiness
- · Affordability
- Trades
- Productivity
- Innovation

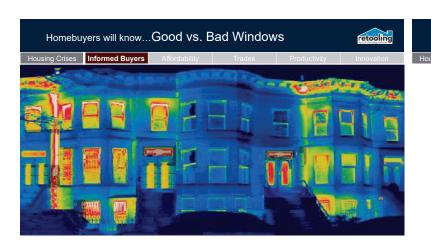


Source: 2019 Home Buyers and Sellers Generational Trends Report, NAR Research Group, April 2019





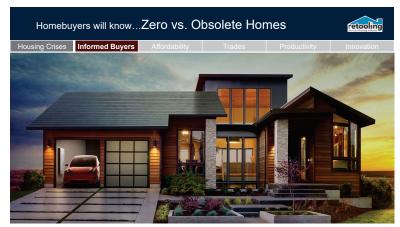






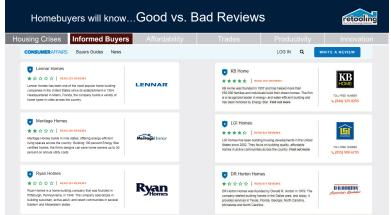














11 Megapolitans contain 70% of U.S. Population in less than 20% of land area in 2008

#### Where We Live in the U.S. is Unaffordable















Millennials: Huge Debt



Housing Crises

formed Buyer

Affordabi

Trade

Productivity

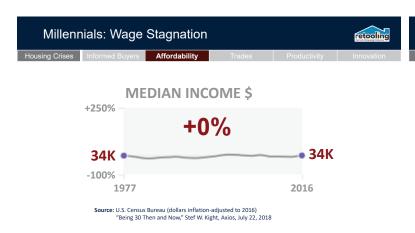
Innovati

- · Huge Debt
- · Wage Stagnation
- · Experiences vs. Savings
- · Job Volatility
- · Inflated Home Prices

#### • \$1.48 Trillion Student Loans

- 44.2 Million Americans
- 11.2% Student Loan Delinquency Rate
- \$351 Average Monthly Loan Payment (for borrower aged 20 to 30 years)

Source: "A Look at the Shocking Student Loan Statistics for 2018," Student Loan Hero, May 1, 2018. https://studentloanhero.com/student-loan-debt-statistics/









Millenials: Job Volatility



THE WALL STREET JOURNAL.

Millennials Want to Buy Homes but Aren't Saving for Down Payments

Nearly 70% have saved less than \$1,000 for a down payment

About 40% aren't saving anything on a monthly basis

8 and 20+ years is time it would take to purchase a home in NYC and LA/San Jose respectively

The New York Times

Steady Jobs, With Pay and Hours That Are Anything But

By Patricia Cohen

May 31, 2017

This volatility helps unravel a persistent puzzle: why a below-average jobless rate - 4.4 percent in April - is still producing an aboveaverage level of economic anxiety. Turbulence has replaced the traditional American narrative of steady financial progress over a

Millenials: Job Volatility retooling

> "Looking to the future, 65% of children at school today will work in jobs that do not yet exist."

Source: U.S. Department of Labor, 2013





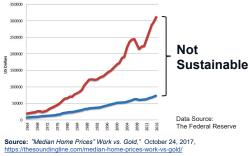


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#### Bottom Line: Affordability Trend **NOT** Sustainable



#### Median US Home Prices and Median Family Income



Productivity

Availability

Quality

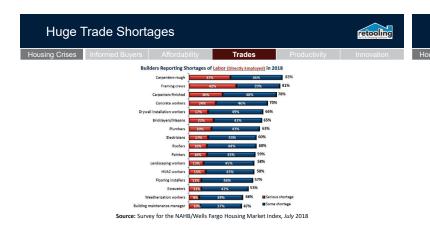
Trade Partner Issues

Housing Crises

Training

Cost

Waste







Of the 1,312 survey respondents in the 2019 Construction Hiring and Business Outlook,

#### 78% report they are having a hard time filling salaried and hourly craft positions.

In fact, worker shortages are the foremost concern of contractors this year, the report found.

Source: 'Three Labor Shortage Solutions Construction Should Adopt,' Don Neff, Building Forward, June 21, 2019



#### Housing Industry Productivity Lagging

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Productivity

**Labor Productivity Index** 180% All Non-Farm Industries +76% 140% **3X** 100% **Construction Industry -28%** 60% 1984 2000

Source: U.S. Bureau of Labor Statistics, U.S. Dept. of Commerce

#### U.S. construction industry is suffering from a \$200 billion labor productivity gap

that could be closed by adopting 21st-century manufacturing methods such as prefabrication, robotic automation, and additive manufacturing.

Source: "Reinventing Construction: A Route to Higher Productivity", McKinsey & Company, February 2017

#### Auto Industry Productivity Innovation: Visible



#### Housing Industry Productivity Innovation: Not Visible





Individual Auto Assembly 1903



Ford Model T Assembly Line 1913



Ford Edge **Robotics Line** 2017



1877

Source: Wood frame house on a Omaha Reservation in Nebraska (Photo by William Henry Jackson: The National Archives, Smithsonian Institution)



2019

Source: Wall Street Journal, Construction Workers 'Left the Business and They Didn't Come Back', Oct. 13, 2015

#### Housing Innovation Outcome: Painfully Slow



**Innovation Drivers** 

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"Despite the importance of the housing industry to the national economy,

there is very little investment in residential technologies...

#### it can take 10 to 25 years

for a new housing technology to achieve full market penetration."

**Source:** 'The Diffusion of Innovation in the Residential Building Industry,' Center for Housing Research Virginia Tech & NAHB Research Center, Jan. 2004

- · Software; and
- Technology

· Data:

That Deliver a Better Consumer Experience





Digital 3D Modeling: Barely Used in Housing



Housing Crise:

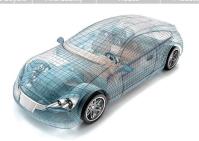
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Affordability

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Innovation



Source: Demo Smart CMS More Smart News, 'Automotive Battery Sensor Market Growing Demand and Trends 2019 to 2028,' Doris Rubenstein, April 11, 2019

#### **Digital Benefits:**

- Speed
- Quality
- Accuracy
- Efficiency
- Waste Reduction
- System Integration
- Machine Learning





**Connecting the Dots: 4 Housing Disruptions** 

#### Housing Crisis Driven Disruption



- 1. Homebuyer Experience Optimization
- 2. Mass-Customization
- 3. SaaS Aggregator
- 4. Offsite Construction

Housing Disruption #1:

### Homebuyer Experience Optimization

#### A Word About Customer Experience Business Model



"If you keep your eye on the profit, you're going to skimp on the product. But if you focus on making really great products, [with great customer experiences]

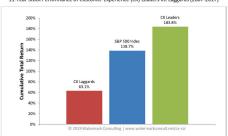
then the profits will follow."

Steve Jobs

#### A Word About Customer Experience Leaders







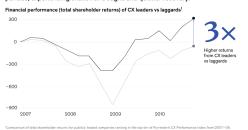
#### A Word About Customer Experience Leaders



#### Customer Reviews Will be Disruptive for Builders



Customer experience (CX) leaders are more resilient during recessionary periods, experiencing shallower troughs and quicker recovery.



Source: 'Adapting to the next normal in retail: The customer experience imperative,' Holly Briedis, Anne Kronschnabi, Alex Rodriguez, and Kelly Ungerman, McKinsey & Company, May 14, 2020.
https://www.mckinsey.com/industries/retail/our-insights/adapting-to-the-next-normal-in-retail-the-customer-experience-imperative?cid=other-eml-alt-mip-mck&hikid=ar\_4etalaer\_be45etab3\_067afee55f486&hctky=114228098\_hdpid=0527be20-6a41-4af1-8aef-ea79c.56706.



#### Benchmarking Customer Experience: Housing



#### Benchmarking Customer Experience: Housing







#### Benchmarking Customer Experience: Housing



#### Preparing for Optimized Homebuyer Experience







#### Housing 2.0 Experience Optimization Framework





#### Housing 2.0 Experience Optimization Framework







#### Homebuyer Experience Optimization: Actual Savings



#### **Save Cost:**

- Optimize Materials
- Optimize Space
- Optimize Integration
- Optimize Quality
- · Optimize Choice
- Optimize Satisfaction
- Optimize Cycle Time
- Optimize Productivity

#### Add Value:

- Optimize Lots
- · Optimize Site
- Optimize Nature
- Optimize Function
- Optimize Performance
- Optimize Quality
- · Optimize Protection
- · Optimize Experts



 $\textbf{Source: } \textit{Exploring a Path Towards Cost-Efficient, Energy Efficient Affordable Housing,'} \ \ \textbf{Mike Steffen, } \\ 23^{rd} \ \ \textbf{Annual Westford Symposium on Building Science, August 5-7, 2019}$ 

#### Homebuyer Experience Optimization Business Case



#### Housing Disruption #1: Housing X Optimization



Homebuyer Experience Optimization				
What	How	Why		
Shift Focus from 1 <sup>st</sup> Cost to Product	Optimize Five Homebuyer Experiences	25% – 60% Cost Savings/Added Value per Home		

Housing	Housing Crises				
Disruptions	Informed Buyers	Affordability	Innovation	Productivity	Trades
Homebuyer Experience Optimization	Community Design Performance Quality Sales	Optimization Framework			



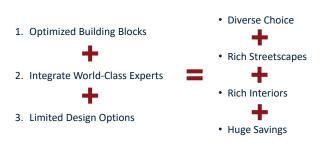


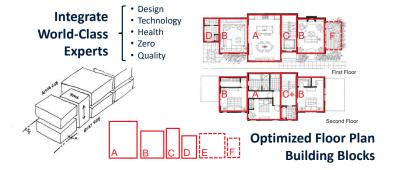
#### Mass Customization: 3 Concepts



#### Optimized Floor Plan Expert Building Blocks







#### Limited Options = Diverse Choice + Rich Streetscapes















#### 2-3 Options:

- Stories
- Roof Trusses
- Pop-Out Windows
- Front Porches
- Siding/Trim
- Color Packages



#### Housing Disruption #2: Mass Customization



Housing	Housing Crises				
Disruption	Informed Buyers	Affordability	Innovation	Productivity	Trades
Mass Customization	Community Design Performance Quality Sales World-Class Experts	Optimization Framework Standard Building Blocks and Cores			

#### Mass Customization Business Case



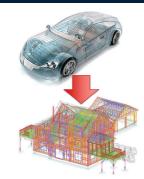
Mass Customization				
What	How	Why		
Diverse Exterior and Interior with Limited Choices for Key Design Features	Standardized Building Blocks: Exterior Bathrooms Kitchens	25 – 33% Cost Savings/Added Value per Home		

#### SaaS Aggregator: Goal



Housing Disruption #3:

## Software as a Service (SaaS) Aggregator



Building the Home Twice, Virtual Before Actual, Allows Greater:

- Speed
- Quality
- Accuracy
- Efficiency
- Waste Reduction
- System Integration
- Machine Learning

#### SaaS Aggregator: 3 Concepts







- 1. Integrate World-Class Expert Solutions
- 2. Digitize BIM Worthy Designs
- 3. Continuously Improve with Big Data



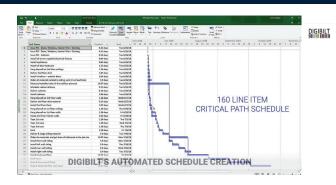
#### SaaS Aggregator: Digitize Bill of Materials



#### SaaS Aggregator: Digitize Critical Path Schedule







#### SaaS Concept: Digital Informed Construction



#### SaaS Aggregator: Business Model









#### **Like Uber but Different:**

- Like: Leverages technology, data, and software for a better consumer experience
- Different: Leverages existing builder supply chain rather than displace it
- Result: Builders embraces change rather than fights it!

SaaS Aggregator				
What	How	Why		
Leverage Technology and Data for a Better Product at Lower Cost	Digitize and Scale BIM-Worthy Mass-Customized Designs	10 – 20% Cost Savings/Added Value per Home		

#### Housing Disruption #3: SaaS Aggregator



retooling

Housing	Housing Crises				
Disruption	Informed Buyers	Affordability	Innovation	Productivity	Trades
SaaS Aggregator	Community Design Performance Quality Sales World-Class Experts	Optimization Framework Standard Building Blocks and Cores	Digitized Homes Machine Learning	Assembly Instructions Big Data	

Housing Disruption #4:
Offsite Construction

# VISIBLY POOR FIELD FABRICATION \*\*\*PRODUCTS SERVICES TRAINING & SUPPORT COMPANY CONTACT COMPANY CONTACT COMPANY \*\*\*MEET HYPORT SOLUTIONS\*\* Hyphen is a forward-finishing company that partners with its clients to produce the most innovative scheduling and supply chain efficiency subdrains walkfalls Our referrations, who rely on Hyphen to provide a region score afficiency subdrains walkfalls Our referrations, who rely on Hyphen to provide a region score afficiency subdrains walkfalls Our referrations (upon 15 of the top 20 homelulations) and installation processes.







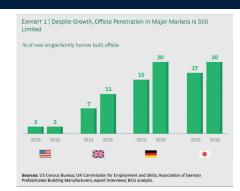
#### Offsite Construction Business Case



#### Offsite Construction Growing Faster Abroad



- Eliminate Waste
- Improve Quality
- Reduce Cycle Time
- Reduce Trades
- Reduce Rework
- Lower Cost (at scale)



#### Offsite Construction Options



#### Offsite Construction: Framing Kit



- 1. Kits
- 2. Panels (finished or rough)
  - Framed
  - SIPs
  - ICPs
  - Precast Concrete
- 3. Hybrids (e.g. Panels plus Kitchen/Bath Cores)
- 4. Modular
- 5. 3D Printing





BMC Ready Frame

#### Offsite Construction: Framing Kit





BMC Ready Frame







#### Offsite Construction - Panelization: Framed Walls+



#### Offsite Construction - Panelization: SIPs







#### Offsite Construction - Panelization: SIPs









#### Offsite Construction - Panelization: Insulated Concrete













#### Offsite Construction: Precast Concrete Walls





#### Offsite Construction – Hybrid: Panels + Core Modules



# Offsite Construction – Modular: Reduced Cycle Time Seeking Schedule Efficiency OI. Site Built Construction Schedule O2. Modular Construction Schedule O3. Modular Construction Schedule O3. Modular Construction Schedule O4. Modular Construction Schedule O5. Modular Construction Schedule O6. Modular Construction Site Development & Building Construction Restoration O6. SITE DEVELOPMENT & FOUNDATION STRUCTION RESTORATION TIME SAVINGS TIME SAVINGS TIME SAVINGS

Source: Special Report: Modular Construction and Design Demand Evolved Business Models, Joe Bousquin, Building Forward, January 22, 2019







#### Offsite Production: 3D Printing



#### Offsite Construction: 3D Printing





Chinese Company Builds Houses Quickly With 3D Printing



## Offsite Construction: 3D Printing

#### Offsite Construction Business Case



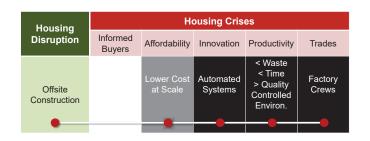
	Offsite Construction				
Wh	at	How	Why		
Faster, B Cheaper with Mi Fiel Constru	Homes nimal d	Advance Building Construction: Kits Panels Modules 3D Printing	<b>0 – 20%</b> Cost Savings/Added Value per Home		

#### Housing Disruption #4: Offsite Construction



#### Housing Disruption: Connecting the Dots Summary







Housing Disruption Recommendations



Thank You and Questions



#### **Integrate Housing Research with Disruptions:**

- Homebuyer Experience Optimization
- Mass Customization
- SaaS Aggregator
- · Offsite Construction



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