VALUE-ADDED CUSTOMER SERVICE THROUGH MASS CUSTOMIZATION AND DESIGN FOR MANUFACTURING IN U.S. PRODUCTION HOMEBUILDING

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ABSTRACT

The US production homebuilding industry is a demand driven industry using cosmetic mass customization and life stage demographics to create product variability marketed through product portfolios and physical models. Transformation from product supplier to value-added service provider is the next logical step. A value-added collaborative design strategy linking a customer driven decoupled design with a flexible component/module manufacturing network using certified field assemblers operating under a national housing code is proposed. Jurisdictional codes, subcontractor crafts culture, builder/consumer sophistication, and corporate shareholders are identified as constraints and opportunities that influence transformation.

Key words: Mass customization, Residential customer service, Homebuilding.
Housing as a Product

Within the industry new housing is commonly referred to as ‘product.’ This is not to say that customer service is ignored. Although volume builders may disagree, they are in the homebuilding product delivery business. Customer service and satisfaction is classically an after sale necessity. The concept of referring to a single-family home (SFH) as ‘product’ is a two-edged sword. On one hand is the turn-key solution offered to economically satisfy varying customer needs and market demands through the builder’s extensive product portfolio. On the other, product portfolio delivery becomes a limiting device that seldom satisfies all the customer’s design considerations and requires trade-offs in product selection. For the past decade, considerable discussion and interest has been generated by the opportunities available to mass-customization the housing industry. This customer-centric concept proposes to allow improved customization of customer designed housing solutions by incorporating many current product delivery strategies, e.g., standard chassis designs, interchangeable components, modularity, just-in-time delivery, parametric modelling, and electronic information management from manufacturing.

The author’s believe 1) US homebuilders have been mass-customizing their products for decades and have offered a diverse portfolio of products that satisfies significantly large segments of the home buying public, and 2) if US homebuilders are to remain competitive there are strategic shifts, including MC/DFM that must be played out of the next several decades. Foremost among these strategic shifts is that of homebuilding away from a portfolio product delivery focus to one delivering customer-centric services that addresses product delivery in lots of one. This fundamental transformation by US homebuilders is essential if they are to remain competitive in their goals to provide a product/service that satisfies an increasingly sophisticated customer base within a shrinking global marketplace. One only need be aware of General Motors major loses in the US automotive market or better yet, Toyota’s US rise to the #1 automobile of choice. Secondly, a shift from a demand driven industry to a supply driven enterprise is a necessary enabler for customer-centric product delivery. This position paper focuses on this transformation possibility by delineating, 1) the character of US homebuilding industry, 2) what constitutes a home builder service provider, 3) why transformation is essential, 4) what obstacles to transformation exist, and 4) how this transformation may ultimately manifest itself.

Nature of the US New Home Industry

The US production homebuilding industry has its roots in post World War II production building exemplified by the building of Levittown, NY from 1947 to 1951. As noted below these simple and are still used homebuilding concepts expanded upon from wartime factory based production line concepts are:

1. secure, subdivide and plat lots a large tract of land,
2. arrange for craft work crews,
3. put in the infrastructure,
4. offer a limited range of housing products constructed on a common foundation type,
5. factory pre-cut and ship framing lumber to the site, and
6. complete the work by moving work crews from one lot to the next in an assembly line manner.

**US Housing Product**

In 2005 there were over 1.6 million new single family home (SFH) starts in the US (US Census 2007). Not withstanding variations in foundations and exterior closure systems there is significant commonality in the basic components and features of new US SFH’s. Evidenced by Table 1 is that 83% of these homes are speculatively built for sale and that 96% are site-built. Although mass-customization already exists within the US housing industry the expected homogenised deliverable is clearly evident. From Table 1 the ‘normative’ 2005 newly constructed US home is speculative site-built, in excess of 2200 SF; costs over $240,000; is air conditioned; with 2 or more car garages, 2 or more bathrooms; 3 or more bedrooms, and is reasonably split between single and multi-story.

<table>
<thead>
<tr>
<th>TABLE 1 - 2005 New US Home Construction Character</th>
<th>%</th>
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<tbody>
<tr>
<td>New home starts (000)</td>
<td>100%</td>
<td>1,636</td>
</tr>
<tr>
<td>Built for sale (000)</td>
<td>83%</td>
<td>1,358</td>
</tr>
<tr>
<td>Site built (000)</td>
<td>96%</td>
<td>1,571</td>
</tr>
<tr>
<td>w/ central air conditioning (000)</td>
<td>89%</td>
<td>1,456</td>
</tr>
<tr>
<td>w/ 2 or more baths (000)</td>
<td>96%</td>
<td>1,571</td>
</tr>
<tr>
<td>w/ 3 or more bedrooms (000)</td>
<td>88%</td>
<td>1,440</td>
</tr>
<tr>
<td>w/ 2 or more garages (000)</td>
<td>84%</td>
<td>1,374</td>
</tr>
<tr>
<td>2 or more stories (000)</td>
<td>55%</td>
<td>900</td>
</tr>
<tr>
<td>Median square footage</td>
<td></td>
<td>2,227 SF</td>
</tr>
<tr>
<td>Median price (US$ excludes lot)</td>
<td></td>
<td>$240,900</td>
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</table>


**Product Diversity**

Although the US homebuilding industry still follows the Levittown model, what has changed is the variety and diversity of housing products (designs) available to potential buyers. This is done without making the product selection overly saturated or increasing the buyer’s sense of product uncertainty. Product diversity is promoted and sustained in an economical manner based on builder customization strategies of: 1) communities (land linked market segmentation through price-points and life stage demographics), 2) ‘model homes’ (product portfolios), 3) product elevation diversity,
4) model options, and 5) personal cosmetic mass-customization in finish materials and product selections.

This strategy is reinforced by municipalities through the use of ‘housing product submittals’ and ‘product diversity portfolios.’ The builder secures a ‘model’ home permit for the all models prior to the need for a permit. Any subsequent structural modification becomes a new model. Once a model home permit is approved it becomes a standard that allows a builder to secure a permit for a home on a particular lot by referencing and linking the model home permit to the lot address. This eliminated the need for repetitive code checking on each new permitted house. Diversity of ‘product shopping’ has been eased considerably with the advent of the Internet. All large US production homebuilders have sophisticated websites that allow prospective purchasers to locate any community and review the entire product portfolio. Table 2 shows the results of a web search of three top four US homebuilders within a major US metropolitan area.

<table>
<thead>
<tr>
<th>TABLE 2 - Partial New Home Product Summary - Atlanta, GA</th>
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<tbody>
<tr>
<td>Total # of new home communities</td>
</tr>
<tr>
<td># of SFH detached communities</td>
</tr>
<tr>
<td>Unique detached SFH product models</td>
</tr>
<tr>
<td># of alternative elevations per model</td>
</tr>
<tr>
<td>Bedroom availability</td>
</tr>
<tr>
<td>Bathrooms</td>
</tr>
<tr>
<td>Detached SFH base model price range</td>
</tr>
<tr>
<td>Detached SFH base area (SF)</td>
</tr>
<tr>
<td>Additional room options</td>
</tr>
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</table>

Extracted from: (www.drhorton.com; www.pulte.com; www.centexhomes.com; 6-1-2007)

Another major feature, of the US homebuilding industry that has potential to be addressed in the transformation from a demand to supply driven customer served industry is the industry’s boom-bust cyclic nature. This cycle is intimately tied to the mortgage lending interest rate. Due to a product portfolio demand-driven approach the US homebuilding industry is unable to rapidly respond to a shift in lending rates and its subsequent impact on product uptake. Unlike the auto industry homes are considered assets and not consumer products. This inability to rapidly respond to downward market shifts leaves large volume homebuilders holding product inventory on costly land acquisitions. This inability to respond to market shifts and the resultant excess inventory dominoes into product price drops to off-load inventory coupled with in-house staffing and downstream subcontractor cutbacks. One obvious response is to reduce choice through a contraction in model diversity. Another not quite obvious response is to provide customer service that meets individual demand through customer-centric customization in ‘lots of one.’
Product Portfolios (Model Homes) Considerations

In order to satisfy public demand and maintain a viable financial return on production homebuilding it is necessary that the industry respond to its consumer demands. In general, this includes developing a stratified marketing approach that segments the market into customer life stage demographics and associated economic capacity, i.e., product price-points. Nelson (2006) has identified these life stage demographics per Table 3. Homebuilders respond accordingly with corresponding life stage ready product.

<table>
<thead>
<tr>
<th>Life Stage</th>
<th>Desired Type of Housing</th>
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<tbody>
<tr>
<td>Single young</td>
<td>adult apartments, other rental, owner-attached</td>
</tr>
<tr>
<td>Young couples</td>
<td>apartment, other rental, owner-attached</td>
</tr>
<tr>
<td>Families with young children</td>
<td>small owner-detached</td>
</tr>
<tr>
<td>Families with adolescents</td>
<td>large owner-detached</td>
</tr>
<tr>
<td>Launching children and moving on</td>
<td>move from large detached to small detached</td>
</tr>
<tr>
<td>Families in later life</td>
<td>small owner-detached or owner-attached</td>
</tr>
</tbody>
</table>

Source: (Nelson 2006)

Therefore the MC approach undertaken by US homebuilders responds to this demographic when developing speculative product. According to a designer for one major homebuilder the keys to portfolio product development are for the division developers to understand the buyer and the buyer’s programmatic needs, understand the product economics of model choices, and comprehend the sales cost to market. Depending on the size and nature of each community the builder will offer between 3-6 product models. Each product model will be associated with 3-5 alternative elevations, 3-5 paint schemes, and a left or right handed site placement option. Additionally on many models there are room option add-ons, alternative basement designs, and the addition of a 3rd car garage. Consistently across the board most US production homes front the 2-car garage to the street. This is a lot size response based on maximizing financial returns on the land linked to the house sale. Thus design placement and MC of garage placement would typically be a lot size constraint.

Thus a typical US new home community of between 100-300 more or less speculatively built homes will consist of four to six distinct models, each with three to five alternative elevations, and as many as five different paint schemes targeted to a particular market segment, e.g., empty nesters, growing families, move up buyers, affluent buyers, downsizers, age restricted communities, etc. Therefore, by a reasoned study of new home production over the past decade, including smaller ‘custom’ builders that sell from physical models and stock plans, the authors conservatively estimate that US homebuilders have sold over 10 million detached SFH, since 1997, using cosmetic and transparent MC strategies.
Model Development

It takes a production homebuilder approximately four months to complete a new product model design. This includes the physical development of product model mock-ups, full scale layouts of each floor plan. The typical lifespan of a new model is 5-7 years with some exceptions (Griffins 2007). This does not take into consideration minor elevation tweaks that will occur and may be done on an annual basis for cosmetic updates. Any structural changes to an existing model constitute a new model. Initiating a new model requires first and foremost that the development arm of the builder understands the buyer and buyer’s needs. From that point forward the design team can proceed to new product model development. Table 4 shows the primary (non-hierarchical) issues and considerations that require integration into successful new model development.

**TABLE 4 - Primary design considerations for new model home development**

<table>
<thead>
<tr>
<th>- Lot issues</th>
<th>- Architectural review considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Buyer program needs</td>
<td>- Jurisdiction codes</td>
</tr>
<tr>
<td>- Ground floor internal travel</td>
<td>- Jurisdiction appearance requirement</td>
</tr>
<tr>
<td>- Land opportunity w/ curb appeal</td>
<td>- Land economics</td>
</tr>
</tbody>
</table>

Source: (Griffins 2007)

In a move toward MC/DFM and implementing a value-added customer service DFM approach that focuses on ‘lots of one’ the items identified in Table 4 must be considered. In addition the obvious emphasis must be given to customer-centric design solutions or ‘buyer program needs.’ This is a front-end value-added customer service that requires a different sales strategy and expertise than currently exists.

Integrating a consistency in jurisdictional codes is paramount to the success of any homebuilding MC/DFM strategy. Local codes are administered and interpreted by the local jurisdiction and at times are considerably different. In metropolitan Washington, D.C. production builders are working within ten separate municipalities, located in two separate states and the District of Columbia, all separated by less than a 20 minute drive. Ozaki (2003) explores some of these constraints as opportunities for systematic changes to standard industry regulatory relationships as added value to the customer. Even municipalities have customers. It is conceivable that the model home permitting process as exists in the US could be modified to accommodate and promote MC/DFM approaches.

Customer Satisfaction

US homebuilder customer satisfaction is typically measured and reported by JD Power and Associates, an ‘independent and unbiased’ surveying agency. The results of the 2006 survey indicate that a major portion (49%) of a new home buyer’s
Homebuilding satisfaction is a result of post construction considerations, i.e., 20% builder's warranty/customer service, 16% home readiness, and 13% quality of workmanship and materials. Yet only 6% are concerned with physical design elements (J.D. Power & Associates 2006). Thus one can infer that 87% of new home buyers trust that quality of workmanship is acceptable, and 94% of the home buying public is similarly satisfied with the physical design elements. A similar degree of new home buyer satisfaction is also reported in the custom design approach offered by the Japanese prefabricated housing industry. Noguchi (2003) reports that custom design opportunity accounts for only 5% of the reason for purchasing Japanese prefabricated housing while 49% purchase for perceived higher quality.

These results are particularly interesting in any move to transform US homebuilding from a site-based demand-driven product supplier toward a customer-focused value-added service provider. If 95% of customers are satisfied with the product design, what are the future customer satisfaction concerns that can build a competitive edge for US homebuilders?

Transforming the Industry to a Services Provider

It is essential that US production homebuilders become increasing cognizant of the need for transformation. The authors consider the two major factors influencing the need for transformation. First, the US skilled labour force is shrinking. Without the significant Hispanic labour pool it would be impossible to keep pace with US housing demand, even considering the current slowdown that the industry is experiencing. Secondly, a global economy exists and international competitiveness can overtake housing much like it did the automobile industry. The Japanese and the Europeans are perfecting MC/DFM in homebuilding and international free trade regulations will ultimately trump local jurisdictional issues opening up International markets. The key to success is through increased customer satisfaction.

The homebuilding industry has embarked upon a customer satisfaction strategy that seeks to deliver an ‘exceptional customer experience’ that is intended to perpetuate a client for life. This concept is aimed at capturing the customer’s heart and begs addressing at the front end of the home buying process, i.e., shopping for a product. It is here that product design crosses sales and provides opportunity for homebuilders to transition to service providers by offering integrating MC/DFM/DfD solutions that offer lifetime custom design opportunities, e.g., different size rooms, alternative room layouts, extra or less room spaces, and even future room spaces.

Gilmore and Pine (2000) identify the ‘four faces’ or distinct approaches to MC as collaborative, adaptive, cosmetic, and transparent. The authors’ position is that US homebuilding is very adept at adding value through cosmetic and transparent MC, i.e., marketing the same product in slightly different packages and life-stage targeted products but is weak in collaborative and adaptive MC. To transition into value-added
service providers providing exceptional customer experiences requires US homebuilders to establish operational processes incorporating collaborative and adaptive MC. MC coupled with DFM principles adds value to the product delivery process and to customer satisfaction by meeting the customer’s life housing needs.

Some may consider collaborative MC that features custom design the domain of niche builders. The authors’ conclude that custom design is at the inception of altering the US homebuilding demand driven boom/bust cycle and excess inventory issues. This is accomplished through valued added customer service that supplies housing in ‘lots of one.’ MC/DFM is not an enormous hurdle to overcome. According to Gann (1996) design engineering time for a typical custom designed from a standard module component inventory of a Japanese Sekisui Heim house is 70 minutes.

**Opportunity and Constraint for MC/DFM in US Homebuilding**

The next step in value added MC and customer service is implementing a collaborative MC approach through an engaged dialog at the design/sales level and sustained through a flexible manufacturing network, hence DFM. Ball (1999) suggests that it is culture of profit-maximizing and inter-firm competition that constrains the UK homebuilding transformation away from innovation. This land-linked sales approach, using flexible crafts subcontractors, and targeting market segmentation is much like the prudent US homebuilder industry, if it isn’t broken, don’t fix it.

The authors’ believe constraints are opportunities waiting to be discovered and will touch upon just several. Among constraints that can be transformed into opportunities are jurisdictional codes, craft based subcontracting, consumer sophistication, and corporate shareholders. Obvious opportunities are that additional construction can be generated as homes require systems modifications and spin-off companies can evolve that market sustainable life stage housing that changes as needs change, e.g., the fourth bedroom that is currently needed could be coupled/decoupled at future dates and returned for rehabilitation, resale, and reinstallation elsewhere as customer needs change. This could also manifest itself in modular components becoming leased modules that are temporarily associated with a new home and as needs change returned to the leasing company for refurbishment. Thus innovative opportunities exist for valued added services including custom design solutions, flexible manufacturing supply chains, spin-off companies, and possibly the super-subcontractor as observed by Iwashita (2001).

**Jurisdictional Codes**

Production homebuilders are quite wary the obstacles that code jurisdictions present. The advent of a common US residential building code, the International Building Code (IBC), has added a measure of commonality across municipalities. The concept
of nationally pre-approved building permits from local municipalities based on previously submitted model homes can be expanded upon by the application of the national manufactured-housing code, i.e., the ‘HUD code’ to supplier’s components and modules. This can include permits for previously approved components, e.g., a third garage, a bonus room addition, or a porch addition, etc. Thus when the builder wishes to start construction a building permit for a particular builder’s/manufacturer’s product (components/modules) linked to a specific lot can be activated.

The authors’ believe that as builders migrate toward a service provider business model that jurisdictions will adapt manufactured housing codes to craft new regulations that encourage the development of value added homebuilding services. This judicial supply chain simplification can enable permitting for base models, components, and associated options, stable product pricing, and smooth builder/subcontractor/municipality interaction.

**Subcontractor Crafts Based Culture**

The current US homebuilding labour force is a flexible, low cost, adaptable, and largely immigrant labour force. Many of the current homebuilding tasks are low technology and can be performed by on-site semi-skilled workers. The US has exported much of its manufacturing expertise and culture abroad and reliance on new plant development seems a remote opportunity. Currently US SFH production builders subcontract, via purchase order, with 20-25 separate craft contractors for each home. What must change is the concept of site build wood platform framing on built in place foundations.

**Corporate Shareholders**

Successful profitability of US homebuilding is integrally linked with the land and life-stage demographics. There is little if any industry sponsored residential R&D funding in the US homebuilding industry. Individual production builders will be unsuccessful if they embark upon singular efforts to MC/DFM as a corporate business strategy. What is required are steady state product manufacturing suppliers and a corporate reengineering to a strategy of capturing a customer for life through an extended life-stage customer service approach. The current subcontracting industry is insufficiently capitalized and is significantly risk adverse to undertake this process alone. Shareholders are reluctant to risk a ‘go for broke’ reengineering of a successful business model. Only a cultural change that partner manufacturer and builder together in a collaborative product development process will achieve success.

**Consumer and Builder Sophistication**

The premise of this paper is that US production homebuilders can fill a void in customer service expectations through value added design services. The backward
moving consideration in this arena is that 95% of the homeowners of newly constructed homes appear satisfied with current design solutions. Thus if an unsophisticated buyer makes design decisions from physical models how will the builder be able to offer value added front-end design services? Although buyers may lack sophistication in design visualization they do have particular preferences in room location, placement, and size. It will become the responsibility of a builder’s sales design force to add value by becoming proficient in product design and use that skill to guide the buyer to an appropriate customized product decision.

Integration Approaches

Technical Transformations

What mechanisms and techniques will eventually guide US homebuilders toward a culture of operating as supply driven MC/DFM housing service providers? There is literature available particularly in the UK, Holland, and Japan, and some within the US that addresses technical solutions for the MC/DFM homebuilding (Barlow et al. 2003; Gann, D. M. 1996; Hofman et al. 2007; Iwashita 2001; O'Brien et al. 2000; Roy et al. 2003; Roy & Cochrane 1999). Common among many of these technical strategies is a focus on product decomposition followed by custom recombination. Decomposition strategies typically separate out foundations, shell, core, and interiors to identify commonality of opportunity for product standardization, interchangeable parts, interface design, and customizable product components, e.g., a standardized platform that interfaces between the structural shell and the foundation with independent interior partitioning, or a ‘chassis’ that functions as a foundation upon which customer focused designs are assembled.

A combination of approaches involving varying permutations of supply chain dynamics is essential in understanding and producing an ‘assemble to stock’ strategy that is cost effective and decouples a supply chain with a lot size exceeding hundreds into lots of one (Barlow et al. 2003). Thus the industry’s customer service future is of integrating a decoupled design that links land development strategy with customer driven designs assisted by a knowledgeable design/sales staff tied to a flexible component/module manufacturing network working within a national housing code using certified field assemblers.

The uncoupling of the product from its classical delivery process and the reconstitution into a far more diverse product as proposed by MC/DFM requires that homebuilders invest in the design of new products and processes and find or create the manufacturing and service network to support this approach. This requires an organizational shift and quite possibly a ‘go for broke’ corporate strategy to be successful. Backing up or retreating to on-site stick build construction is regressive to the point it will stifle any transformation.
Cultural Transformations

The literature regarding a cultural shift necessary to formulate a homebuilder customer-centric supply side delivery model is focused on the UK although the concepts and ideas are applicable to the US (Ball 1999; Barlow & Ozaki 2003; Gann, D.M. & Salter 2000). There appears to be several interlinked cultural transformations necessary to enable a MC/DFM homebuilding strategy. First is an understanding of the historical role of the builder. US production homebuilding is a speculative build process based on groupings of customer life-stages, i.e., design and produce for demographic groups not individuals. Second is the concern that the customer doesn’t know what they want, strongly basing design decisions on what ‘feels’ or doesn’t feel good in review of physical models. Coupled with the buyer’s lack of design sophistication is the builder’s position as a product supplier not a service provider.

Hofman, et al. (2007), has proposed shifting the homebuilder into the role of value added customer service provider by characterising the homebuilder as a ‘systems architect’ that engages in collaborative design and MC. They have proposed and tried a decoupled modular design that allows ‘systems architect’/homebuilder to recombine a palate of alternative product modules and project systems within a hierarchy of design rules into unique customer focused solutions. This approach requires a collaborative dialogue with the customer and a sales architect with product design knowledge and parametric design tools. Additionally MC/DFM predicates the development of a restructured supply chain that produces a steady supply of product modules on both a standard and customized basis. Spiegel (1999) outlines a third consideration. He makes a strong argument that new US home construction is financially driven and that new home economics are land economics. Based on his argument that builders derive a significantly greater financial return on land appreciation than product appreciation economic detachment of product from land is a constraint that links to the shareholder culture of profitability.

Conclusion

The paper has described the current operational activity of the US production homebuilding industry and proposes that the industry shift from predominately a product supplier to a value added service provider that continues to deliver products to sustaining clients. The US homebuilding industry is good at what it does providing high quality products with sufficient cosmetic MC, to reap financial rewards and high praise. It is a conservative speculative business model with over 60 years of success.

Organizations in a competitive world must continually improve or they die. Post construction quality satisfaction in new home construction is generally meeting customer expectations yet the business model necessitates change to provide better customer value and service. An industry wide transformation to a customer service provider is the next logical step in production homebuilding. Opportunities and
constraints involving building codes, subcontractor cultures, actor sophistication, corporate shareholders and cultural entrenchment have been presented. The threats of international housing industrialization, free markets, and national labour shortages will be the pressure that moves the US homebuilding industry to change their business model. The change to a customer service business model engaging in MC and DFM will encourage a supply driven homebuilding enterprise able to create custom housing in lots of one through a flexible manufacturing network for steady state lifetime housing solutions.

References


