



# **MULTI-YEAR ADVANCED RESIDENTIAL BUILDING SYSTEMS RESEARCH**

**Subcontract Number: AXL-9-99208-01**

**Final Expert Meeting Report:  
*The QMS Path to Building Highly  
Profitable, High Performance Homes***

**Deliverable Number 4.1.3.3**

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## I. BA Quality Expert Meeting Summary

**The top five challenges** to achieving the targeted performance and quality of high performance homes were identified by the Experts Meeting participants as follows:

1. Lack of culture of quality and high performance home specifications
2. Lack of tools to incrementally implement quality and high performance home specifications
3. Lack of definition of quality, high performance, and green
4. Lack of addressing design for high performance home quality management systems
5. Lack of effective training for trades, builders, and code officials

Details of these and other challenges facing the industry are provided in Section IV below.

**The top five solutions** to the industry challenges were identified by the Experts Meeting participants as follows:

1. Quality leadership in both individual company and industry
2. Incremental approach to quality improvements
3. High performance home “Brand recognition” in consumer marketplace
4. Address design in a high performance home quality management system
5. Improved and consistent industry training at all levels

Details of these and other solutions to the goal of achieving the targeted performance and quality of high performance homes are provided in Section V below.

## II. Background of BA High Performance Homes & Quality

Current building science, construction materials, and technologies provide builders with knowledge, tools, and materials to construct homes that use less energy and are more durable and comfortable than homes of the past. A “high performance home” (HPH) may be defined as one that achieves superior energy efficiency, durability, and comfort in a cost-effective and environmentally responsible manner. One possible approach to realizing the industry goal of large-scale production of HPHs is through the use of a whole-house system engineering design approach, careful attention to details during construction, and testing to verify performance.

The Building America program goal is high performance homes leading to 50% more efficient than a similar home employing standard design and construction features. Such a home would be more cost-effective to operate and maintain than a conventional home. The ultimate goal in high performance home building is to integrate onsite renewable power systems leading to net zero-energy homes, meaning that homes produce as much energy as they consume annually.

While newer construction materials and technologies allow builders the technical capability to construct significantly more energy efficient homes than standard, code-minimum homes, it often is difficult for builders to successfully incorporate these approaches in a whole-house system without changes in the design and construction of these homes. The implementation of a systematic, quality

assurance program is one way to ease and expedite the process of incorporating new high performance technical practices and aid in achieving continuous energy efficiency improvements. By establishing a formal company process for setting standards, communicating these standards to onsite personnel and trade contractors, and verifying that the company standards were in fact met, a builder can more easily move from building simply code-minimum homes to high performance homes. The company impact of implementing a quality management system is particularly significant when builders must overhaul the design and construction specifications in order to address building science and achieve increasingly high energy-efficiency thresholds. A final and critical step in this process is then conveying the added value of these homes to the customer.

Builders, whether participating in the Building America Program, the Builders Challenge, or without formal participation in these programs, need support through a large-scale effort to provide high performance home quality management tools as well as industry best practices. The goal of the effort is to combine building science with high performance home construction specifications and details. The result is an advanced QMS enabling large-scale production of HPHs. In order to meet the challenge of building HPHs with the recommended building science technical specifications, experts from across the industry were brought together for a one-day meeting.

### III. BA Quality Expert Meeting Description

The NAHB Research Center outlined their 2009 expert meeting on quality management in deliverables 4.1.3.1 Proposed Expert Meeting Plans and 4.1.3.2 Final Expert Meeting Plans. Based on these deliverables the expert meeting topic, objectives, background, and format are further detailed below.

**Expert Meeting Topic:** The QMS Path to Building Profitable, High Performance Homes

**Expert Meeting Objectives:** The objectives of the BA quality management expert meeting include the following:

1. To examine the barriers to the effective design and construction of high performance homes (HPH) and the role for HPH quality management system to build these homes.
2. To identify resources or solutions to address these barriers to the effective design and construction of HPHs.

**Expert Meeting Background:** The NAHB Research Center organized and held an Expert Meeting on the above topic on July 15<sup>th</sup>, 2009 in Upper Marlboro, MD. A group of approximately 35 building professionals with interest and experience in implementing a quality business management system as well as incorporating technical practices that improve the energy performance of homes was convened. Attendees included builders, trade contractors, Building America Teams, HPH and quality management consultants, and government representatives. (See Appendix for a complete list of attendees). The quality expert meeting was the second Building America expert meeting hosted by the NAHB Research Center on quality management. Building on the previous expert meeting on quality management systems as well as the current status of the home building industry, the resulting information from the meeting will be useful in shaping future research and educational efforts regarding the use of a quality assurance system to facilitate construction of high performance homes.

There are two significant changes in the residential construction market since the first Quality expert meeting took place in April, 2007. First, there has been an increase in the amount of interest in “high performance” and “green” homes both within the homebuilding industry as well as by the home-buying public at large. Concurrent with this spike in interest has been the proliferation of green/HPH programs and certifications. The second difference is as obvious as it is important; the homebuilding industry of July 2009 is smaller compared to early 2007 in terms of production volume and new home prices are lower. The annual single family housing production was 1,045,900 in 2007, compared to a total single family production of 622,000 in 2008, and now to an NAHB projected total of 429,000 (NAHB Oct 16, 2009) single family starts in 2009. These conditions were clearly at the forefront of attendees’ minds during this expert meeting, and this is reflected throughout this report.

**Expert Meeting Attendees:** Attendees of the meeting included representatives of home building companies which had both a formal quality management system and experience with building homes that are considered to be “high performance.” With respect to the latter, the builders’ current practices ranged from meeting ENERGY STAR® standards to achieving the more stringent energy performance goals of the Building America program to striving for ‘net-zero’ energy use in a cost effective manner. Several companies also went beyond energy efficiency and included green building practices in their definition of high performance. In addition, a variety of builder types were represented from small builders to large production builders. A comprehensive list of attendees is included in Appendix A.

**Expert Meeting Format:** The meeting began with an introduction from the NAHB Research Center experts Jeff Taggart and Don Carr who also moderated the session. Following introductions, there were three hour-long presentations by experts experienced in both homebuilding and in quality management systems. The first presentation by Denis Leonard of Business Excellence Consulting addressed the financial costs and benefits of implementing a quality management system from an overall research perspective, then from a general industry perspective, and finally, with a specific review of quality management systems and their cost/benefit impacts in the home building industry. The second speaker, Gary Zajicek from Veridian Homes addressed the challenges and successes of implementing a quality management system that his company has experienced as a quality-focused production builder in a single location. The third speaker, Dean Potter of K. Hovnanian Homes, offered the national production builder perspective of the multitude of challenges that face any national builder when attempting to implement a quality management system on such a scale.

The three speakers each made their presentation, followed by a facilitated dialogue to address and expand on the many issues that were presented by the speakers. The Meeting Agenda is attached to this report in Appendix B. Appendix C includes the PowerPoint presentations that were delivered by the featured presenters. The dialogue included first identifying the barriers to building a high performance home and the effective use of a quality management system and then identifying solutions. The meeting results are detailed in the following sections.

#### **IV. Expert Meeting Results: Key HPH & Quality Challenges**

Following the presentations, the attendees participated in a moderated discussion. This section summarizes the discussion regarding the barriers to building a high performance home (HPH) and

the effective use of a quality management system to facilitate this process. The input from the participants was diverse and covered a broad range of topics. The most important points from the meeting have been organized by theme into the categories below. While not every point discussed in the meeting is included, all major discussion points have been included. In addition, barriers addressed during the three formal presentations made during the morning session are included as well.

### Cultural Shift and Leadership Barriers

The lack of a culture of quality within the home building industry was reported by many as a major barrier to successfully building high performance homes and to doing so through an effective quality management system. In fact, one builder stated that “during this current recession it is hard to get the market involved in stretching beyond minimally affordable home purchases” to the purchase of very efficient homes that might be in the range of 50-70% better than code minimum. Builders stated that there is significant resistance to change from many players in the homebuilding process. Because formal quality management processes represents significant change for the industry, they are not readily adopted by many builders and their trade contractors. This resistance to change is common with the trade contractors who often respond to requests for quality process improvements by saying “I know what I’m doing so why do you want me to change?”

Builders are also reluctant to change their approach to designing homes from simple purchasing decisions and accompanying product substitutions, to a wholesale cultural shift to designing the house as a system using quality management processes to involve all relevant parties in the process. National and regional production builders have additional challenges because of the decentralized nature of the industry and the variety of management goals of these larger companies. Also, multiple participants noted that there was a need to find champions for quality within the industry. In addition to a lack of industry champions for quality, one builder noted that change is typically forced through mandates without giving builders the “how to” information needed for efficient and comprehensive process improvement.

### Incremental Steps and Tools

Several participants observed that the industry still has quality and energy efficiency issues with correctly building code complying homes let alone building a HPH. Given that building a HPH requires a significantly higher level of accuracy in both design and installation to meet higher performance criteria, one builder reported that building a HPH can seem daunting to builders. Furthermore, he explained that implementing a complex, comprehensive HPH quality management system could add to builders feeling overwhelmed because it would make the already complex industry process of home building even more complex. While participants in the meeting shared the perspective that quality management systems can be very beneficial to builders and trade contractors, one participant noted that none of these quality management systems is incremental in the steps to implement a quality management system.

### Building Technology

An additional challenge for builders is the complexity of the evolving building science techniques and new products that are being developed to build HPHs. This new technology is challenging enough for a builder to implement in one community, in one climate zone. However, for national builders this

challenge is more difficult since HPHs are engineered and need ALL of the details to come together successfully, and this must be done across multiple climate zones for a national builder.

Another barrier that must be addressed is that individual manufacturers each have their own company goals, (understandably), so there is not a holistic industry approach to collectively designing and manufacturing products that work well with other products in a whole-house system.

#### Quality Management Tools

There is a lack of sufficient quality management tools to use to effectively produce a high volume of high performance homes. While a handful of individual models do exist, there are not enough examples available of successful production building companies building HPHs to guide those companies that want to improve. There is no single quality management system that will work for all builders and trade contractors across the country because each company has its own unique organization and culture, and any quality management system must be customized to effectively function in a particular organization. Furthermore, builders noted that the industry needs scope of work reviews and guides that can be used by companies to upgrade their internal contracting processes.

#### High Performance Home (HPH) Definition

During the meeting, a significant barrier to the development of effective approaches to building high performance homes is that there is a very fragmented market due to competing energy efficiency, green, sustainable, and performance standards, certifications, and programs. Examples include Builders Challenge, Energy-Star, LEED, National Green Building Certification, Environments for Efficient Living, and others.

The lack of a definition is not only confusing for those buying houses, it further contributes to the complexity in the design and construction of homes as requirements such as designs, features, products, and standards differ between the various programs. This variety of energy and green programs requires a builder and their installers to understand and properly install increasing numbers of complex technologies that are dependent not only on the specific builder, but also the particular program.

#### Market and Homebuyer Confusion

Another factor that makes it more difficult for builders to effectively construct high performance homes along with the necessary quality management systems required to do so successfully, is that customers are not clear about what they are or are not willing to pay for. Furthermore, there is market confusion about energy efficient, "green," and quality homes. In addition, there is minimal market differentiation in either mortgages or appraisals between energy efficient/non-energy efficient, green/non-green, and quality/non-quality homes. This could be in the form of lower mortgage rates or higher appraised values. Without this market differentiation there is less of an incentive for builders to construct high performance homes and make the investments required to do so, including expanding quality systems to make HPH design and construction successful.

#### Home and Building Design

The design of high performance homes may require significant changes from a builder's current practices. Existing residential quality management systems have primarily focused on successful

implementation of current designs and products, with much less focus on the quality process needed to efficiently develop new home designs. There is a need to expand the scope of residential quality management systems to include the design process so that homes are designed to function as a system. Part of this expanded scope also includes collaboration between team members, including the architects, during the design process.

#### New Building Product Use, Installation, and Training

Builders at the meeting almost uniformly expressed concerns over new products as a significant barrier to the rapid adoption of HPH construction due to the inherent high risk with new products. Among the concerns expressed were how well new products were tested before being made available for use, as well as under what conditions the new products were tested prior to being made available to builders and trades. Were these products tested in a lab, or in the field? Were they tested in an integrated system with other building products, or alone. Were the tests conducted to effectively study their durability?

Aside from testing, participants were also concerned about training the industry to install new products. Whom do manufacturers train, and how do they conduct the training? How is this training communicated to all of the relevant parties that actually handle, install, and service new products? Are building inspectors trained as well on the proper installation requirements for new products? Furthermore, how can builders be confident that trades, so accustomed to installing traditional products will not continue to use those traditional installation practices that are not appropriate with new products? This is of special concern where there are conflicting installation instructions on a generic product or material from different manufacturers or a manufacturer and a trade association. How does the builder or trade contractor know which instructions to follow? This lack of clarity creates significant risk for the builder and trade contractor, and this risk slows the adoption of new products and new technologies within the industry.

#### Construction Schedule

A significant challenge facing builders constructing any type of home, but especially when building a HPH, is meeting their construction schedule. This approach is especially problematic for a builder who is attempting to build a HPH with the more exacting tolerances and specifications than a typical house. Another barrier to initial quality and the effective construction of high performance homes is ignoring quality non-compliance issues, saying, "I'll fix it when I punch it out" and continuing to move ahead without immediately making the correction.

#### Training

Training was also discussed as a major obstacle to the industry being capable of transitioning to HPH construction on a national scale. With the significant demands of designing and building high performance homes, there is a great need for training the residential construction workforce. Lack of effective training is especially problematic because there is a lack of trade partner and builder stability and in an industry with high employee turnover. What will happen when industry activity picks up from its present below capacity condition? Who will train what will be a primarily new workforce? How can the industry make training effective?

In addition, homes are complex systems and require a training process for the multiple overlapping skills and trades needed to build them. How does a builder determine who is trained and competent?

How does a trade company determine who is trained and competent? How is technical information passed in a trade company from the employees that are licensed or certified in a particular product or skill set to the actual installer working in the field? How is information retained throughout the trade company? How much do construction managers need to know? Does a construction manager need to know everything each installer, trade supervisor, or code official knows? Many or most builder's field managers do not have the in-depth technical expertise to inspect all of the trade contractors working on their jobsite, especially the mechanical trades. Finally, the code officials inspecting the homes also need training particularly with new and updated code acceptances as well as proper installation of new products.

### Accountability

Builders discussed the lack of accountability for their trades as a major challenge. A significant part of this challenge is identifying reoccurring issues. Trade partners typically do not understand the impact of the quality of their work on the work of others and on the performance of the final product. Builders and their trade partners can successfully identify deficiencies through documentation. In addition, documentation can also identify reoccurring issues and once identified, the builder and their trades can work to remedy them.

In addition, builders and their trade partners do not measure their quality performance against industry standard performance metrics. There are currently minimal industry metrics to facilitate cross-company quality performance comparisons, and this makes it more difficult for the industry to create accountability and to improve. Therefore, how can a builder and their trade partners do effective job completion inspections? Builders must help and enable trade contractors to take ownership of their own quality performance. This was a concern to the many of the quality experts assembled.

### Standardized Processes

Part of the challenge for stick-built (or site-built) construction is that it does not have the same feedback loops as factory produced housing. In a factory, there are standardized inspection, evaluation, and work procedures. There is no comparable standardized process in stick-built construction. To complicate matters, the costs and challenges of developing HPHs are different based on house type, market area, and climate zone. Therefore, how does the industry as a whole implement change? Can process change occur on existing projects already designed and underway or is process change only to be expected on new, as yet un-designed and un-started ones? These are questions that the industry faces as it begins to implement high performance homes with energy efficiency, green, and quality considerations.

### Insufficient Communication

A common thread in many of the builder challenges discussed at this expert meeting is insufficient communication. The multiple parties required to build a house are frequently not communicating effectively. Builder's trade partners are not in-house, do not attend regular status and coordination meetings, and thus suffer from the silo effect where information is passed up and down a chain of command but not directly between the affected parties. There is a need for structured, regular, documented, effective intra-trade communication.

### Homebuilding is Complex

The building industry has no record of building error free “regular” homes much less error-free HPHs. Construction industry specifications are not sufficiently clear for installers to implement. It will not be possible for builders to design and construct HPHs without detailing the process.

### The Cost of Quality

In general, few within the homebuilding industry truly understand and appreciate how much it costs a builder, trade contractor, or supplier not to do the job right the first time. As a result, quality management systems are seen as costing too much rather than small investments capable of yielding impressive results and cost savings. Too often builders focus on completing a project on time, and in their haste to complete the job, create many imperfections that must later be corrected. Quality research was presented at the expert meeting showing a series of studies clearly demonstrating the value of implementing a quality management system, yet as a whole, the residential construction industry has failed to recognize the value of quality management systems. This is a major impediment to the design and construction of HPHs.

## **V. Expert Meeting Results: HPH & Quality Solutions**

The expert meeting participants offered a significant amount of solutions to many of the obstacles that builders face in trying to build high performance homes (HPHs). Below is a discussion by topic of many of the solutions that were shared at the meeting. Some of the solutions discussed were solutions designed to address more than one of the obstacles listed in the previous section. In addition, in some instances there was much greater feedback in regards to possible solutions than for others. There were also a number of occasions where the discussion of an obstacle itself provided clear direction to solutions to that particular obstacle.

### Quality Leadership Solutions

There was consensus in the meeting that leadership is critical to an effective Quality Management System. One builder said that you need leadership that actually wants to bother to do it and actually has the impetus to say, “We should do this. We should move forward with the strategy.” The Cost of Quality presentation provided the obvious answer to the question of why a builder should consider implementing a quality management system. If builders are provided with solid homebuilding industry research on the impact of improved quality processes on the bottom line, then they will very likely see quality as a necessity for success.

Builders need to see research demonstrating the direct benefits of implementing a quality management system in successful homebuilding companies in order to become champions for quality within their companies.

### Tools and Resource Solutions

Most attending the meeting shared the sentiments of one builder who said “we need better tools for the industry to be able to use to execute high performing homes.” Participants stated a need to simplify the process of implementing a quality management system (QMS). One suggestion was that a QMS needs to be an incremental process, with a simple, step-by-step process. In regards to quality management systems, a participant suggested, “we should consider a range of performance as well. This incremental approach could be a good, better, best approach to quality management systems,” depending on the particular building company’s size and

existing quality management practices. Another participant offered that there is a need for a simple easy to use quality management manual for good builders that want to begin a quality improvement program. He proposed that “the industry needs standardized materials that 80% of the industry can use, and then each individual builder can customize the last 20% to the specific needs of their company.” Another suggestion was to create a simple, but detailed process on how to actually install and to assure proper installation of the key products and systems found in a HPH. There was also input suggesting that with the more complex designs required for HPHs, that more efforts should be focused on the design process to provide tools and models to builders making the transition to building HPHs. Virtually all of the meeting participants indicated that tools and resources were needed by builders and trades in order to transition the industry to high performance homes. Specifically, participants called for a quality management system (QMS) and an approach to quality that would be more accessible to the industry by being incremental, thus allowing builders and trades to avoid being overwhelmed when adopting or expanding their QMS.

### Training Solutions

Participants also discussed the need for training focused on systems integration for high performance homes. One attendee suggested that builders should train their trades because many trade contractors do not have the size or capability to do their own training. Others suggested that either the trade contractor or the supplier should train the trades. A builder stated that the manufacturers of products need to train trades stating “if the trades need help, these manufacturers need to set up a training program.” While there were differences of opinion on who should provide the training, there was strong agreement that there is a heightened need for training when building high performance homes.

In addition, participants agreed that the residential construction would benefit significantly from effective training tools that were accessible to the entire industry. It was determined that for these training tools to be effective, they would have to address all of the relevant parties, namely both the trade contractor installers and trade supervisors, as well as the builder site supervisors and quality assurance personnel. However, while this training would need to reach all of the previously mentioned audiences, it was noted that it would have to be customized to the needs of each audience. In other words, what a builder superintendent would need to know to supervise a trade installation would likely be different from what the installer himself would need to know, and the training would have to reflect those differences.

### Design Solutions

There were significant comments on the importance of having a good design process. “If the goal is company-wide adoption and implementation of a QMS, we need to design better before building,” said one attendee. Builders do not want to be dealing with the quality issues at the construction phase or at customer relations either. One participant stated that “it’s about pushing it [quality] further up the cycle, back to the design and back at the conceptual stages of the process. And we better figure out a way, collectively, to get that more collaborative design process in our industry.” The critical change is thinking about how design is impacted by or affects the performance of a home. It was suggested that builders need to work together and share information. The challenge is to first make the design right and then enforce the design and the specifications through the quality assurance system. The solution is to “roll out quality programs and to enhance these new quality programs for the industry members.” However, builders also need effective design tools as well as

improved trade partnering and communication in order to be able to implement an improved design process that facilitates the design and ultimately the construction of HPHs. The design process and approach needs greater emphasis than current industry practices typically include, and an enhanced QMS for HPHs will need an expanded design process in order to facilitate HPH construction.

#### New Product Use Solutions

Participants discussed the need for products to be more thoroughly field tested as part of an actual home and for long-term durability rather than tested in labs as individual products and not as a part of a complete building system. One suggestion was to test for durability over longer periods of time in addition to simulated long-term durability testing conducted over a short time. Participants also called for a process of product evaluations that can be trusted so each production building company doesn't have to sort it out individually. It was suggested that product liability exposure might be more limited if manufacturers were to be more involved in the risk of introducing new products into the market. Further, participants expressed the need to have greater participation by manufacturers and suppliers in this industry-wide effort to address quality in the context of HPHs. Another solution to the challenge of building high performance homes would be to develop uniform code interpretation and enforcement by code officials, perhaps through training on new products and construction techniques, to facilitate innovation by production builders.

#### Raise Consumer Awareness

The meeting participants almost universally agreed that customer's expectations are not clear and builders do not know what products customers are willing to pay extra for. Furthermore, there is tremendous confusion in the marketplace as to how to define "high performance home," "energy efficient," or "green." Participants suggested that the solution for this confusion would be to make it straightforward where it "wouldn't make any difference what you call the program; everybody would understand, from the consumer, to the builder, the product manufacturer, to the installer, what you were talking about." Another solution offered was to create incentives so that the market drives the product and builders follow the market. This incentive would rely on there being some kind of common definitions.

## **VI. Conclusions and Next Steps**

The industry faces significant barriers to designing and constructing high performance homes, and industry leaders have proposed solutions needed to effectively address many of these challenges. Of course, the industry needs research assistance with the building science challenges of constructing increasingly energy efficient homes. However, it is quite evident that the meeting participants also see the need for a quality management system (QMS) and related quality tools and resources that address the added complexity of the HPH design process. These tools need to be made more accessible to the industry in order to allow builders and trade contractors to use them. These quality tools must also include a greater emphasis on the design process for HPHs due to the increased complexity of the designs and their impact on final construction quality. In addition, an incremental approach to quality will allow builders to adopt and utilize the most useful tools and resources to them based on their individual existing quality practices and needs.

Another solution for constructing high performance homes (HPHs) using quality management systems (QMS) is training. Training needs must be assessed for various industry targets (installers, trade inspectors, builder superintendents, etc), and training materials need to be developed that

effectively address each audience, also utilizing an incremental approach. For these tools to be effectively implemented and for the industry to embrace the construction of HPHs, builders and trade contractors must have a culture of quality and champions for their quality management systems. This will only happen on a widespread scale when industry leaders see the value and financial results that an effective QMS has on companies through clear industry-based research results from successful builders and trade contractors. The residential construction industry also needs to find ways to optimize new product use through improved testing of products and better installation training. In addition, the industry needs more clarity in the market as to the definition of “green”, and one agreed on measurement of “green” and energy efficiency.

In general, industry leaders appear interested in adopting more comprehensive quality management systems, tools and resources to facilitate the more effective design and construction HPHs. However, these quality tools, resources and training materials do not currently exist in an accessible format readily available for industry use. If these tools and resources were developed and then utilized by industry they would significantly reduce the impediments to building HPHs on a production scale. The Building America Program currently has the building science knowledge, access, and experience to integrate quality management systems and tools with advanced building science into the homebuilding industry.



## EXPERT MEETING FINAL AGENDA The QMS Path to Building Highly Profitable, High Performance Homes

**Location:** NAHB Research Center in Upper Marlboro, MD (Near Washington, DC)

**Date:** Wednesday July 15<sup>th</sup>, 2009

**Time:** 8:00am – 3:00pm

- 7:45 – 8:00    **Continental Breakfast**
- 8:00 – 8:30    **Welcome, BAP Quality Initiatives, Agenda and Introductions** (Jeff Taggart, NAHB Research Center)
- 8:30 – 9:00    **The Cost of Quality** (Denis Leonard, Business Excellence Consulting LLC)  
What is the bottom-line impact of quality for home builders? How much can a well-implemented QMS increase profitability, and how?
- 9:00 – 9:30    **Production Builder Perspectives on High Performance Homes** (Dean Potter, K. Hovnanian Homes)  
A national production builder's perspective on the quality management challenges to building high performance homes. What are some of the possible solutions to address these obstacles?
- 9:30 – 10:00    **Success Building High Performance Homes** (Gary Zajicek, Veridian Homes)  
Challenges to building high performance homes: a production builder's success using a QMS to overcome those challenges.
- 10:00 – 10:15    **Break**
- 10:15 – 12:00    **Facilitated Discussion Analysis of Unique Management Obstacles to Building a HPH** (Don Carr, NAHB Research Center)  
Insights into the challenges arise when designing and constructing HPHs on a production scale by analyzing a specific construction element (the building envelope, for example) of a HPH. What are some best practices builders can use to confront these challenges?
- 12:00 – 1:00    **Lunch**
- 1:00 – 2:30    **Facilitated Discussion Analysis of Specific Additions to a QMS Needed to Build a HPH** (Don Carr)  
What do the best practices of HPH builders reveal about the process changes needed to efficiently design and build high performance homes on a production scale? How can these changes and additions be incorporated into existing QMS models by production builders?
- 2:30 – 3:00    **Facilitated Wrap-up Discussion** (Don Carr)  
The group will review the best practices for how to address the challenges of building high performance homes. What additional tools or research could best serve builders of high performance homes?

## Attendees for Expert Meeting July 15<sup>th</sup> 2009

<b>NAME</b>	<b>COMPANY</b>
Alex Lukachko	Building Science Corp
Amber Wood	NAHB Research Center
Ari Rapport	IBACOS
Chip Merlin	K Hovnanian Homes
Clayton Traylor	Centex Homes
Dan Bartlett	Hunt Building Company
Dave Mallay	NAHB Research Center
David Price	EPA
Dean Potter	K Hovnanian Homes, presenter
Denis Leonard	Business Excellence Consulting, presenter
Don Carr	NAHB Research Center, Moderator
Duncan Prah	IBACOS
Ed Caldeira	Caldeira Quality
Frank Alexander	Actus Lend-Lease
Gary Zajicek	Veridian Homes, presenter
Janet McIlvaine	Florida Solar Energy Center
Jay Hall	Jay Hall and Associates.
Jeff Taggart	NAHB RC
Jim Hoffner	K. Hovnanian Homes
Ken Neuhauser	Building Science Corp
Kevin Brozyna	IBACOS
Larry Owen	American Contractors Insurance Group, Inc.
Mark Voetsch	K. Hovnanian Homes
Michael Carver	KB Home
Mike McMichael	Zurich Insurance
Paul Callanan	NAHB Research Center
Randy Melvin	Winchester Homes
Sam Taylor	DOE
Serge Ogranovitch	The Potomac Group
Stan Luhr	Quality Built
Thom Marston	Energy Services Group (Trade)
Tom Brick	Brick By Brick Consulting
Vladimir Kochkin	NAHB Research Center

## The Cost of Quality in the US Home Building Industry

Quality Expert Meeting  
NAHBRC / DOE  
Washington DC July 15<sup>th</sup> 2009

Denis Leonard Ph.D.



## AIMS

- To present a review of the Cost of Quality research/literature and discuss.
- Not to focus here on Quality Management Tools
- Next step detailed research paper on Cost of Quality
- Research study focusing on key mature quality management builders to create home building industry best practice data (evidence of quality tools used and their impact ) including NAHBRC Quality Builder Council
- Include impact of green building
- Create a recommended format of quality tools and cost of quality tools to implement
- Implement with builders and monitor for impact

## THIS PRESENTATION

- Cost of Quality
- The value/impact of Quality
- Impact of Quality in Construction
- Impact of Quality for Home Builders
- The impact of High Performance Homes
- Potential Home Builder Quality Management Tools/Techniques & Cost of Quality Metrics

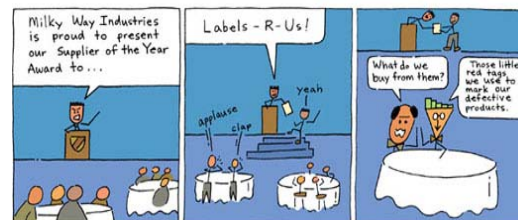
## QUALITY MANAGEMENT & BUILDING AMERICA

- BA provides effective and efficient building methods
- Quality Management provides effective and efficient management methods, tools and techniques to plan, implement and manage while creating consistency and reducing costs in achieving those building methods

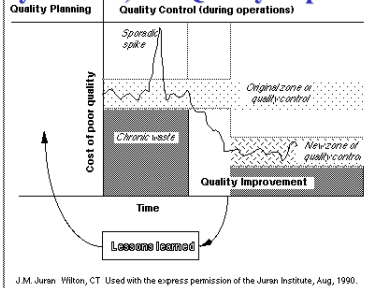
## QUALITY MANAGEMENT & COST OF QUALITY

Mr. Pareto Head

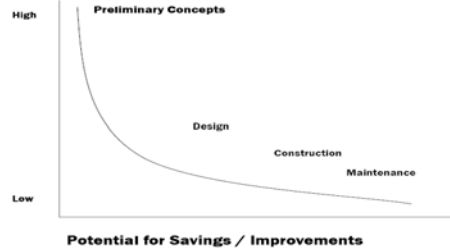
by Mike Crossen



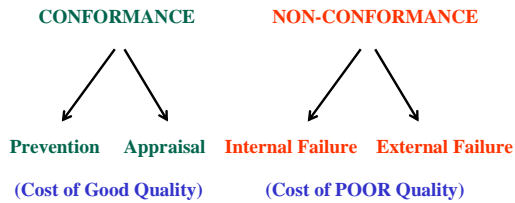
## The Juran Trilogy Diagram: Quality Planning, Quality Control, and Quality Improvement



## Opportunity Curve



## Cost of Quality (Crosby, 1979)



Gary Cokins, Measuring the Cost of Quality For Management, Quality Progress, Sep. 2006, pp 45-51

## P. A. F. (Feigenbaum, 1956)

**Prevention:** Costs of all activities specifically designed to prevent poor quality in products and services.

**Appraisal:** Costs associated with measuring, evaluating, or auditing products or services to assure conformance.

**Internal Failure:** Costs resulting from products or services not conforming to requirements or customer/user needs (which) occur prior to delivery or shipment to the customer.

**External failure:** Costs resulting from products or services not conforming to requirements or customer/user needs (which) occur after delivery or shipment of the product and during or after furnishing of a service to the customer.

(Sower & Quarles, 2003)

## Measuring the Cost of Quality (Cokins, 2006)



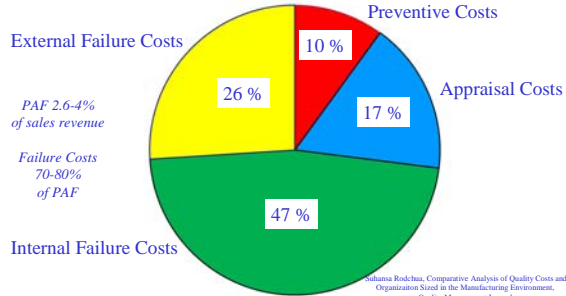
Gary Cokins, Measuring the Cost of Quality For Management, Quality Progress, Sep. 2006, pp 45-51

## THE IMPACT OF QUALITY

## Quality Costs In Manufacturing

Small & Medium Sized Organizations

(Rodchua, 2009)



## Cost of Quality (PAF) Impacts

(Schiffauerava & Thomson, 2006)

- By 25% in 1 year, Hewlett Packard, PC manufacture
- 23.3 to 17.3 in 5 years, United Technologies, telecommunications
- 35.8 to 18.1 in 4 years, Philips, semi conductors
- 65 to 15% in 8 years, Raytheon, Electronics

Andrea Schiffauerava & Vince Thomson A Review of Research on Cost of Quality Models & Best Practices, International Journal of Quality & Reliability Management, Vol 23, No 4, 2006

## BALDRIGE INDEX

- Between 1992 and 2002, the Baldrige Index outperformed the S&P 500 by 6.5 to 1.

### Percent Changes Over Four Year Period\*

Measure	Award Winners	Match Companies
Operating Margin (NI/Sales)	1.13%	-1.71%
Operating Profit margin (EBIT/Sales)	46.77%	2.69%
Return On Assets	10.28%	-5.50%
Return On Equity	18.73%	-5.91%

\* Average change in calculated ratios

Wrostad & Kvaeger "Study Shows that Quality Pays Winners", The Quality Management Forum, Vol. 27 No. 3, Summer 2001, pp. 11 & 14, Table 1 p. 11

## BALDRIGE IMPACTS

### Small Businesses

#### MESA Products Inc

- 93% increase in sales
- 20% increase return on equity

#### PRO TEC

- 3% employee turnover
- 0.12% defect rate

#### Texas Name Plate Co

- Profit increase from 36% in 1998 to 40% in 2004

### Service Businesses

#### Premier Inc

- 90% Customer satisfaction
- 15% increase in operating margin

#### Ritz Carlton

- 99% guest satisfaction, 80% extremely satisfied
- Pre tax return on investment and earnings doubled

#### DynMcDermott Petroleum Operations

- Customer satisfaction increased from 67% in 1999 to 74% in 2004

### Manufacturing

#### Motorola Inc

- 32% increase employee productivity
- 99% customer satisfaction

#### Sunny Fresh Foods

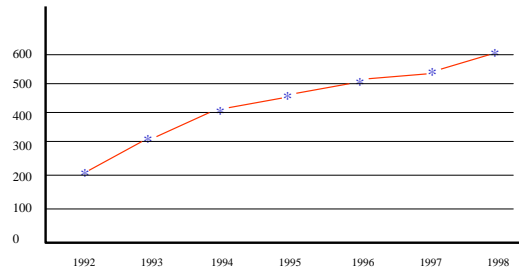
- 93% revenue increase
- Market share increased while competition decreased by 10%

#### Boeing's Airlift and Tanker Program

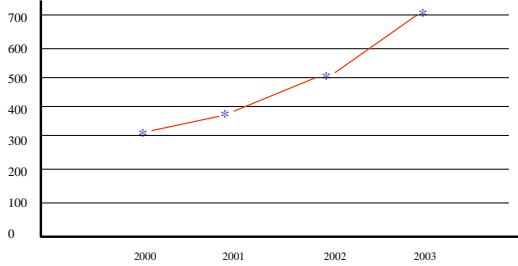
- Avoided loss of 10,000 jobs
- 60% productivity increase

Densley, B., Leonard, D., Longmire, L. & Montgomery, M (IN REVIEW)  
America at the Crossroads: How the Baldrige Criteria can Fix Business, Education and Healthcare and Renew the Spirit that Once Made us Great. Quality Progress

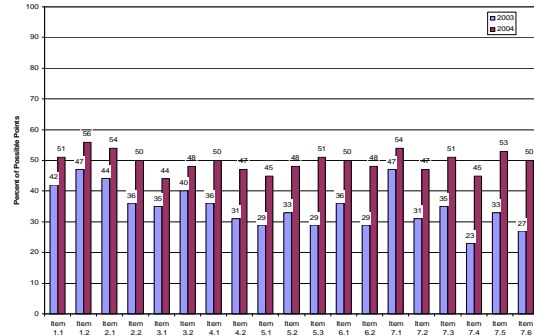
## Boeing Airlift & Tanker Score Improvements



## Boeing Aerospace Support Score Improvements



## Improvement In Every Item in One Year



## Difference Between Those That Attain Desired Results & Those That Don't

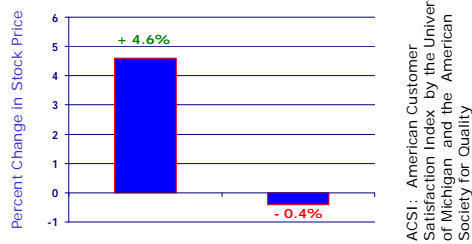


## Employee Satisfaction Impacts Customer Satisfaction

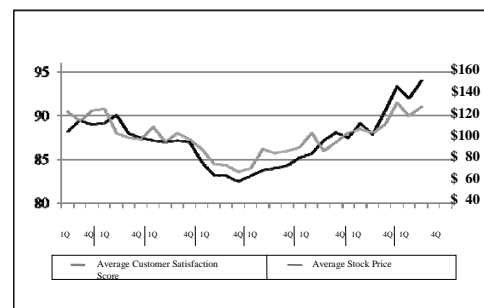
1. A significant relationship between customer and employee satisfaction
2. It is statistically and substantively significant
3. Up to a 4% increase in profitability

1. Bertrahh, K. L., Donahub, N. & Kenneth, P. A. (2000) "A Longitudinal Analysis of Satisfaction and Profitability." *Journal of Business Research*, Vol. 47, Issue 2, 2000, pp. 131-171.  
 2. Brown, S. P. & Lam, S. K. (2008) "A Meta-Analysis of Relationships Linking Employee Satisfaction to Customer Responses". *Journal of Retailing*, In Press, Available Online: 17th July 2008  
 3. Harter, J.K., Schmidt, F.L. & Hayes, T.L. (2002) "Business Unit Level Relationship Between Employee Satisfaction, Employee Engagement and Business Outcomes: A Meta Analysis". *Journal of Applied Psychology*, Vol. 87, No. 2, pp. 268-279

## Stock Price Performance of High Versus Low ACSI Scoring Companies



## Correlation between IBM Customer Satisfaction Scores and Stock Price



Steve Hoisington, Financial Impact of Quality & Customer Satisfaction on an Organization, Wisconsin Forward Award Conference, Madison WI, 2006

## Correlation of Customer Satisfaction (delighted) and Stock Price at JCI



Steve Hosington, Financial Impact of Quality & Customer Satisfaction on an Organization, Wisconsin Forward Award Conference, Madison WI, 2006

## THE IMPACT OF QUALITY IN CONSTRUCTION

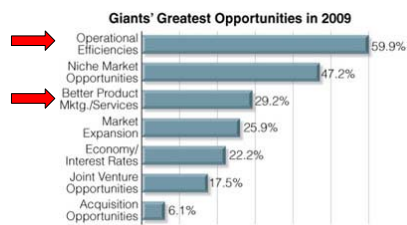
## Construction Quality (Xiao & Proverbs, 2002)

The cost of correcting deviations from stated requirements is in the region of 12 percent of project cost, whereas the cost of providing TQM is between 1-5 percent.

## Construction Quality (Zimak, 2000)

- Long-term investment since:
- Failure costs usually constitute 65–70% of corporation's quality costs
  - Whereas appraisal is normally 20–25% and prevention is 5%.

## The Market for Quality In Home Building



Source: Professional Builder 2009

May 2009

## Defects in Homes

- 15-20% of new homes nationally do not meet reasonable standards.
- This includes roof framing, waterproofing, drainage and weather-tightness.

Disputed Survey Finds Many Flaws in New Homes  
Sacramento Business Journal, 7/25/03

## Defects in Homes

- Data captured by Quality Built field inspectors on 31,995 completed homes and condominiums across 27 U.S. states for the 12-month period ending October 1, 2005.
- Single-family homes averaged \$5,398 in corrected defects per home in 2005
- Multi-family homes and mixed commercial use construction averaged \$4,556 in corrected defects.

Nation's Leading Risk Management Company Releases Top Builder Defect Data for Construction Industry  
Quality Built® Data Shows Builder Top Risk Issues Are Preventable Media Kit: Orlando, Fla., Jan. 11, 2006 — (International Builders' Show)

## Kaizen Impacts

Modular homebuilding company study

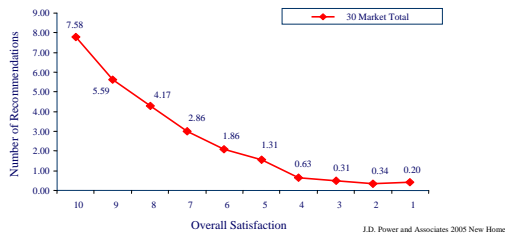
- As a result of the study/implementation of Kaizen
  - 59% labor productivity gain
  - 22% cycle time reduction

US DOE Building America  
Industrialized Housing Partnership  
Manufacturing /Construction Productivity  
2005

## Higher Customer Satisfaction

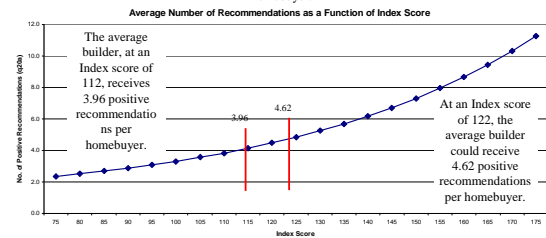
### = More Referrals

MEAN NUMBER OF RECOMMENDATIONS  
GIVEN BY OVERALL SATISFACTION



## As Overall Satisfaction Scores Increase, So Do the Number of Positive Recommendations per Homebuyer

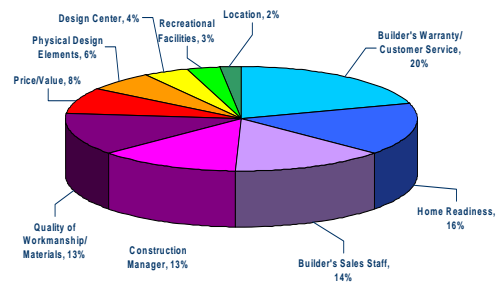
A 10-point increase in a builder's Index score can yield **0.66** extra recommendations per homebuyer.

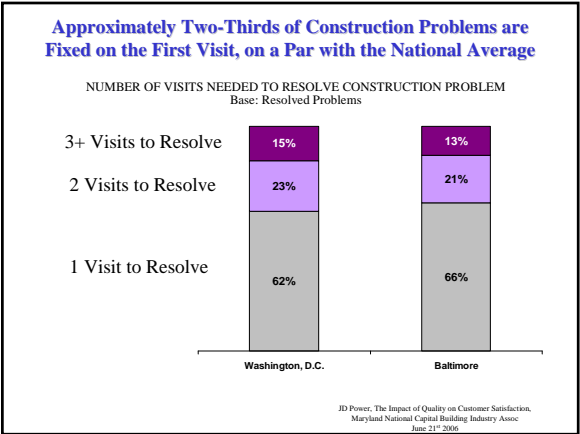
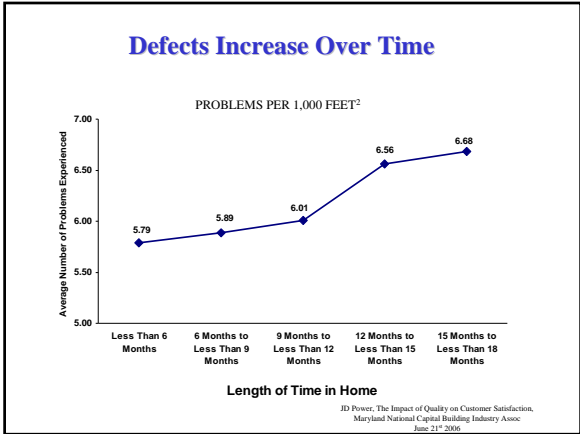


$$\begin{array}{rcl}
 0.66 \text{ Additional Recommendation per Buyer} & \times & 128 \\
 \text{Average Number of Returned Questionnaires per Builder} & = & 84 \\
 & & \times 15\% \text{ Convert to Sales} \\
 & & = 12 \text{ Additional Home Sales} \\
 & & \times \$292,000 \text{ Average Sale Price} \\
 & & = \$3,504,000 \text{ Revenue} \\
 & & \times 5\% \text{ Average Profit Margin} \\
 & & = \text{\$175,000 Additional profit from additional recommendations}
 \end{array}$$

J.D. Power, The Impact of Quality on Customer Satisfaction, Maryland National Capital Building Industry Assoc, June 21<sup>st</sup> 2006

## % Contribution to Overall Experience With New-Home Builder





## NHQ Certification IMPACTS

Survey of NHQ Certified trade contractors revealed that:

- 80 % of NHQ Certified trade contractors reported a reduction in callbacks
- 79 % improved relationships with builders
- 65 % improved their bottom line.

NAHB Research Centre, NHQ Program Achieving Positive Results for Certified Builders and Trade, 2007 Media Releases and Alert

## NHQA IMPACTS

This study cites builders:

- Average net income before taxes of 5.1% gross margin of 18.5%
- Whereas the NHQA builders achieved an average net income of 11.2% and gross margin of 25.5%.

NAHB Business Management Committee's 1997 Cost of Doing Business Study (RC ToolBase, The Bottomline on Quality)

## SPECIFIC EXAMPLES

## NHQA IMPACTS

- Grayson Homes, MD, 98% homes zero defects at closing, net profit increased 9%
- Pringle Homes, FL, reduced cycle time by 15%
- Estes Homes, WA, 95% of trades list them as the best builder to work for.
- TS Lewis, AZ, 33% of homebuyer referral rate. (Homeowner direct recommendation resulted in a homesale).

Professional Builder Magazine, 2009, NHQA Website

## NHQ Certification IMPACTS

- Tim Lewis, President of Tim Lewis Communities said, “Due to our quality check process...defects during construction have dropped by nearly 50 percent.”
- 70 % of NHQ Certified builders improved their bottom line
- 75 % reported a reduction in callbacks and improved relationships with trades.

NAHB Research Center,  
NHQ Program Achieving Positive Results for  
Certified Builders and Trade,  
2007 Media Releases and Alert

## NHQA IMPACTS

- Communication and effectiveness of any new and/or improved process has improved dramatically. We have seen a 20% reduction in our defect rate at our final inspection process.

Kevin Estes, President  
Estes Builders

NAHB Research Center, NHQ Certified Builder Website 2009

## WARRANTY COST NAHBRC QUALITY BUILDER COUNCIL

- 0.26 – 0.35 % of sales including staff costs

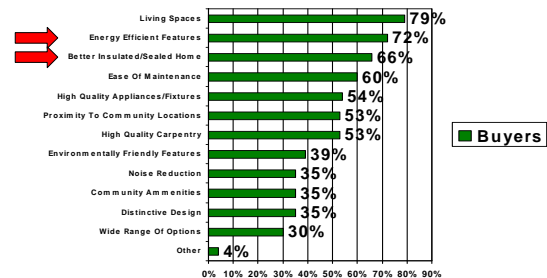
## HIGH PERFORMANCE HOMES (GREEN & ENERGY EFFICIENT)

## Buyers of Green Homes Show High Degree of Satisfaction

- 63% of green home buyers are motivated by lower operating and maintenance costs that come with energy and resource efficient homes.
- 85% say they are more satisfied with their new green homes that with their previous traditionally built homes.

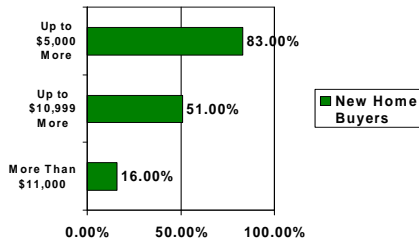
Survey Examines Green Home Buyer Sentiment  
HousingZone April 10<sup>th</sup> 2007  
Research by NAHB and McGraw-Hill Construction

## What Do Homeowners Want?



2007 NAHB Consumer Preference Survey

## New Home Buyers Spending for Utility Savings?



2007 NAHB Consumer Preference Survey

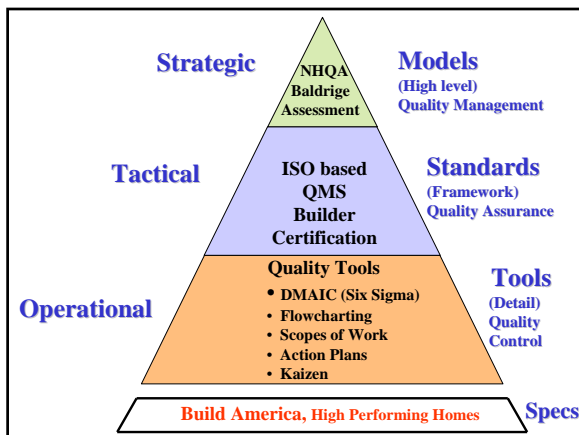
## CONCLUSION

## NEXT STEPS

- Include impact of green building
  - Customer satisfaction
  - Research on increased customer satisfaction based on green/energy efficient homes vs code homes
  - Reduced energy costs
  - Data on increased durability and healthy homes
  - Reduced Liability Insurance due to reduced risk of i.e. mold, mildew etc
- Create a recommended format of quality tools and cost of quality metrics (and tools) to implement
- Suggested approach provided in following slides for discussion

## THANK YOU !

## QUESTIONS ?



## Cost of Quality Metrics (PAF)

- Customer Satisfaction
- Construction Manager Customer Rating
- Warranty Customer Rating
- Employee Satisfaction
- Trade/Supplier Satisfaction
- Warranty Costs
- Inspection Costs
- On Time Delivery
- Number of Warranty Calls
- Time to Complete Warranty Calls
- Walk Through Pre Punch Defects
- Customer Walk Through Defects

## **Cost of Quality Metrics (PAF)**

- HERS
- Air Change Rates
- Referral Rates
- Units Built per Employee/Trade
- Sales per Employee
- Gross Margin
- Net Margin

## **Construction Cycle Times**

Working Days

- Contract signing to closing
- Frame start to certificate of occupancy
  - Contract signing to dig
  - Excavation foundation
  - Excavation back fill
  - Weather days
  - Framing
  - Rough mechanical
  - Drywall
  - Trim
  - Pre-punch to closing

## **CONTACT INFORMATION**

Denis Leonard  
(406) 451-9124

[DenisLeonard@BusinessExcellenceConsulting.net](mailto:DenisLeonard@BusinessExcellenceConsulting.net)



## High Production Perspectives on Designing/Constructing HPHs

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Dean Potter

- VP Home Production and Quality Processes, K. Hovnanian Homes
- Former Director of Quality, NAHB Research Center
- Former Custom Home Builder

## Real world challenges in delivering high performance homes

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- Design
  - Design professionals that are overly "conservative"? Unwilling to consider new ideas
  - Design processes that are segregated i.e. structural completed and then handed off to Mechanicals
  - Working with current design to "fix" it can meet efficiency requirements, not willing to commit to redesign process

## Products- newly developed and introduced = risk?

---

- We approve a new product and it may be installed in thousands of homes in a short period of time
- How well have these products been tested/evaluated
- Have these products been tested within the building system they are to be used in
- How will they perform over time
- How and who do they train trade partners, builders, building inspector?

## Construction management

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- How much do they have to know: As much as a trade? Building inspector?
- For production builders the schedule can be king
- Do not want to change how they have done work- I have been doing this way for 30 years

## Construction management

---

- Allow trades to justify non compliance by stating they will catch it on punch-out
- New products they are not familiar with

## Trade Partners

---

- Who is trained/competent- the owner/crew leader
- Lack of Self evaluation/inspection
- How is the new guy trained- By the Best?
- New products are not understood so installed the same way they have always installed their work

### Trade Partners

---

- Quality levels that have always been acceptable are not and they do not understand what the big deal is
- They do not document their defects- they really do not understand what their issues are
- They have been doing things the same way for years and know their trade who are we or any one else to tell them how to do it

### What to Do

---

- Establish a documented quality management system that will address many of the issues
- Educate, educate, educate
  - Our internal associates
  - Our trades
  - Our vendors

### What to Do

---

- Prove what we know to be true and show it to people- the difference between good and bad insulation practices
- Work diligently with our trades to help them learn what needs to be done but be willing to change trades when you can not get them to "get it"

## The Quality Management System in Building Quality, High Performing Homes

Quality Expert Meeting  
NAHBRC  
July 15, 2009

Gary Zajicek  
VP Construction & Customer Relations  
Veridian Homes  
Madison, WI



## Veridian Homes

- Formed in 2003
- Merger of Don Simon Homes & Midland Builders
- Two family owned and operated companies
- Both founded 50 years ago
- Ranks among top 200 builders nationwide



Projected Sales in 2009  
of \$63 Million

Over 225 Projected Home  
Closings



## 18 Neighborhoods in and around Dane County



## Vision

WE BUILD HOMES THAT ENRICH  
LIVES AND REALIZE DREAMS -  
ONE CUSTOMER AT A TIME ONE  
HOME AT A TIME

WE ACHIEVE THIS THROUGH  
PRIDE, PASSION, INNOVATION &  
INTEGRITY



## Mission

WE BUILD GREAT HOMES BY  
NEVER LOSING SIGHT OF WHAT  
IS IMPORTANT: OUR  
CUSTOMERS, OUR EMPLOYEES,  
OUR COMMUNITIES AND THE  
ENVIRONMENT IN WHICH WE  
LIVE.



## Building on Quality

- 2004 & 2005 Energy Star Partner of the Year
- 2004 Certified Quality Builder QEHS
- 2005 National Housing Quality Silver Award
- 2005 National Design Studio Award
- 2006 National Housing Quality Gold Award
- 2006 Green Tier & Clear Lakes Charter
- 2006 WasteCap Partner of the Year
- 2006 Governor's Environmental Award
- 2006 Waste Recycling Partnership Award
- 2006 & 2007 Energy Star Sustaining Partner Award
- 2007 Innovative Housing Technology Award
- 2007 CIO Awards
- 2007 Builder of the Year, Energy Value Housing Award
- 2008 Builder of the Year, Professional Builder
- 2008 Gold Award, Energy Value Housing Award
- 2008 SAFE Award, Professional Builder
- 2008 Waste Cap Wisconsin Big Diverter Award



## What is a Quality Management System?

It is a documented corporate management system that obtains consistent, documented desired results, by focusing on continuous improvement on all processes and takes immediate and corrective action to prevent future failures.



"This plan will be much easier not to implement than the last plan we didn't implement."



## Builder Certification and the Quality, Environmental, Health & Safety (QEHS) Management System at Veridian Homes



## Baldrige Criteria Framework (PLAN)



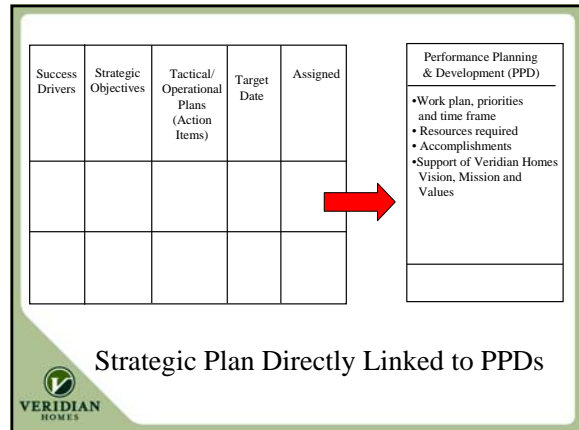
## BUILDER CERTIFICATION

- Based on ISO9000 & ISO14000 & OHSAS18000 series, focused on:

### Continual Improvement

- Corrective Action
- Preventive Action





### Why Incorporate a Quality Management System

### Customer Satisfaction

- Each satisfied customer will tell 6 others about your great product.
- But will tell 48 others about your poor product/service!
- 68% of customer defection due to customers feel poorly treated.
- 44% of new home buyers after 2 years are satisfied with customer service

### ROI & Impact

- ROI estimated in under 12 months, achieved in under 6 months
- Estimated annual savings \$100K
- Improvements in individual trade partners exceeding over 400% in some cases
- Substantial increase to Quality awareness not only internally but with the trades who now track their own performance as well
- Customer satisfaction scores of 95.6%

## ROI & Impact

Construction has increased out building capacity by 33 units per year with the quality management tools we have implemented.

- In real terms given a \$280,000 average sell price that represents potential increased revenue of with no staff increase.
  - 6.5%
  - \$9.2 Million
- Ultimately though, the clear winner is our customer as satisfaction levels soar and product quality continuously improves.

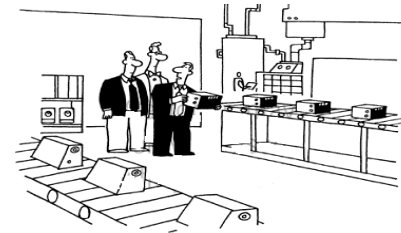


## Challenges In Creating A Quality Management System That Consistently Builds High Performing Homes

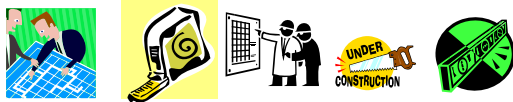
- Learning what a high performing home is
- Learning what systems if any need to be developed/updated to build the High Performing Home
- Obtaining Feedback from verifiers
- Process Mapping
- Identify cost/benefit to possible improvements
- Securing trade contractor buy in to improvement
- Testing the Homes
- Update the S/W
- Train the trades to the S/W
- Learning the defects
- Tracking the defects
- Educating the trades on their defects
- Communication/Feedback (To Way)



## How Does a Quality Management System Work In Building Quality, High Performing Homes



"This is where we pick up each unit and shake out the quality defects."



**Define Measure Analyze Improve Control**

**D. M. A. I. C.**



## Quality Management Review System At Veridian Homes (DO)

- Annual Quality System & Customer Satisfaction Review
- Quarterly Quality Committee Review of Overall System
- Bi-Annual QEHS Operation Review
- Bi-Annual Construction Operations Review
- Bi-Annual Land Development Review
- Bi-Annual Sales Operation Review
- Bi-Annual Design Studio Consultant Operations Review
- Bi-Annual Estimating Operation Review
- Bi-Annual Warranty Operation Review
- Bi-Annual Purchasing Operation Review



# The Operational Role of a Quality Management System To Build Quality, High Performing Homes



NHQ  
VERIDIAN  
VERIDIAN  
VERIDIAN

Veridian Homes  
NABERS Certified Builder  
QEHS Manual

process can start. The Site Readiness form instructs the trade partner not to proceed without the approval of the job construction manager. This is recorded on a daily basis by the CM. As they are required to inspect each room of every home every day as defined in the O&M job description. The findings of the job ready report will be recorded to Veridian Homes at the trade partner to weekly Even/5am meeting. The construction managers will focus on the root cause of the job 'not ready' scenarios at this meeting. Job ready criteria included in the quality system of Veridian Homes certified trade partners are utilized to meet the requirements of this section.

6.2.2 In-Process Inspections or Reviews  
Activities and work done in the Construction operation help in providing inspection or reviews to ensure that the quality plan is being followed. These are organized prior to the covering or concealment of any trade's completed work and depend on the area where specific building components, construction activities, equipment management and/or customer feedback requirements. Weekly project quality checklists to record site status are distributed to the Department of Regional Resources and other relevant organizations. (Refer the documents that get laid inspection only and site disturbance evaluation are conducted by land development.)

Periodic safety inspections shall be made after completion of all job sites. Trade contractors not in compliance will be notified immediately.

Inspections include:


- Action Plan 2.1 Encroachment
- Excavation Trade Partner Clean Sweep Sign Off Log
- Footing inspection
- Foundation walls Trade Partner Clean Sweep Sign Off Log
- Anchor Bolts/Concrete Stud
- Block of Trade Partner Clean Sweep Sign Off Log
- Anchor Plates/3 Ringing
- Forming Inspection
- Frame Trade Partner Clean Sweep Sign Off Log
- Concrete, slab-on, Strip, Concrete Floor, Trade Partner Clean Sweep Sign Off Log
- Height Mechanical Inspection
- Insulation Walkthrough
- Roofing, Decking, Patio Concrete Floor, Trade Partner Clean Sweep Sign Off Log
- Insulation Walkthrough
- CH Log
- Leak/Seal Walkthrough
- Insulation Inspection
- Mechanical Final Inspection
- Final Building Inspection

VERIDIAN HOMES

# Construction QEHS (CHECK)

JOB SITE REGISTRATION AND CHECKLIST

Item	Yes	No	NA	Comments
1. Verify all work is completed as per the contract documents.				
2. Verify all work is completed as per the contract documents.				
3. Verify all work is completed as per the contract documents.				
4. Verify all work is completed as per the contract documents.				
5. Verify all work is completed as per the contract documents.				
6. Verify all work is completed as per the contract documents.				
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# Improvement Tools

- Action Plans
- Facilitation
- Flowcharts
- Customer Focus Groups
- Value Engineering
- Data Tracking
- Sync from field reports and photos
- Weekly trade partner meetings
- Constant Training
- LEADERSHIP



# TOOLS

- Hotspots inspection forms
- Frame inspection forms
- Consultant: Rough Mechanical/Insulation/Blower Door Verification/Certification/Feedback
- Pre Walk inspection forms
- Home Tracker Defect Construction and Warranty Reports
- BUILD Meetings - Weekly Break Out Sessions with Trades
- Kaizen Reviews

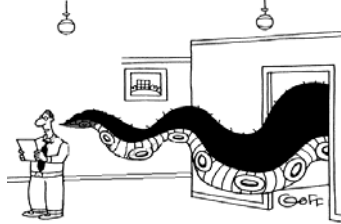


# Weekly BUILD Meetings

- Meeting with Trade contractors
- Victories and Accomplishments
- Safety Tool Box Talk
- Global OFIs for Veridian and Trades
- Breakout Sessions by Trade Type:
- Review Trade Hot Spots
- Review SF/Defect at Pre Walk, Home Orientation
- Review 1<sup>st</sup> Time Service – Post Construction
- Review common defects (Construction and Warranty)
- Create OFI and follow up monthly with Trade
- Create OFI and follow up monthly with Construction, Estimating and /or Drafting
- Scope of Work Reviews



## Free Discussion of O.F.I.'s Is the KEY !



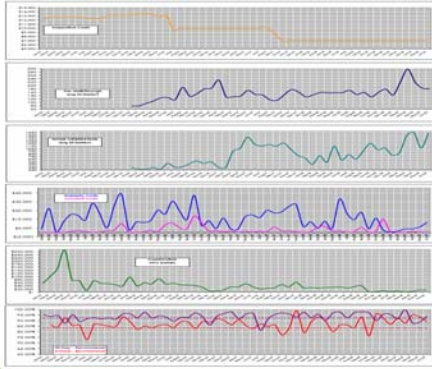
"How's that teensy problem  
in the R&D lab going?"



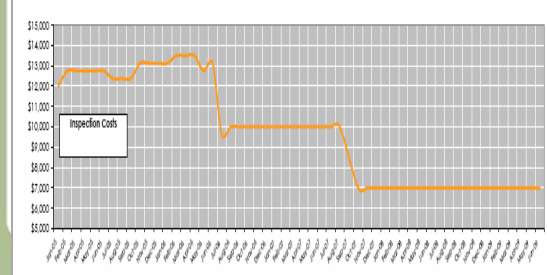
## RESULTS!



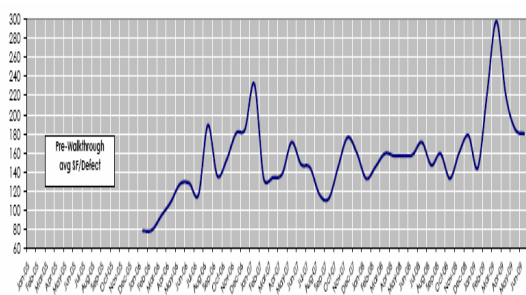
Performance Metrics 2005 - 2009



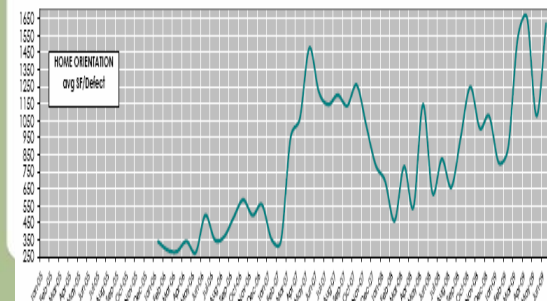
Inspection Costs: 2005 - 2009

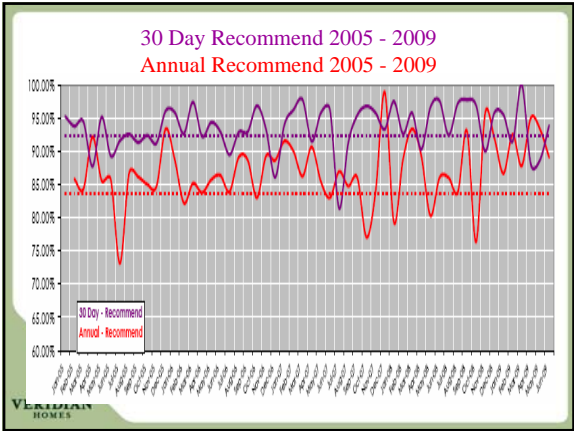
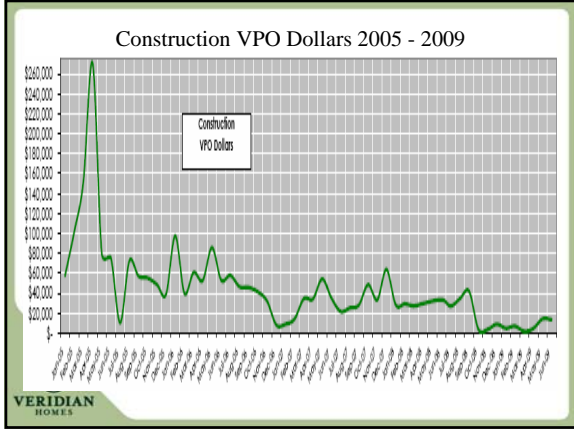
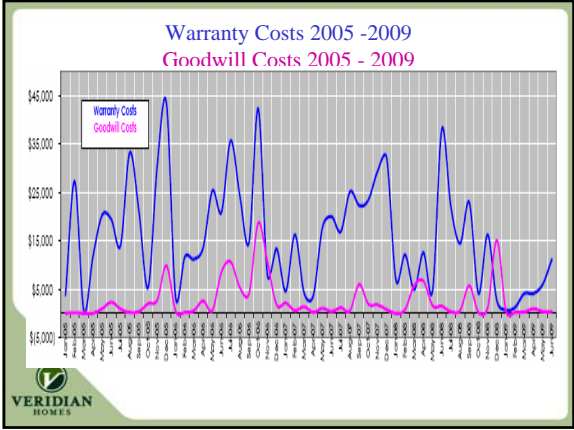


Pre Walk Through: SF/ Defect 2006 - 2009



Home Orientation: SF/Defect 2006 - 2009





**Thank You**

For further information please feel free to contact

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