Quality management practices in the US homebuilding industry

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Abstract
Purpose – Limited research has been conducted on quality management practices in the US homebuilding industry. The purpose of this paper is to establish which practices are actually applied, to what extent and to discuss how quality management can be best advanced in the industry.

Design/methodology/approach – A literature review is conducted on the application of quality in the construction and US homebuilding industry, followed by the analysis of 22 case studies of US homebuilders to provide details of quality implementation.

Findings – While quality management continues to expand and be adopted by industries globally, its application in the homebuilding industry is limited and immature. While quality management systems and quality award criteria are making an impact, the key focus is still being heavily placed on inspection processes, with limited use of structured and advanced quality approaches. Senior managers still see quality as a peripheral issue and are not convinced of its value. There is a need for leaders in the industry to embrace quality and to adopt consistent company-wide systematic and strategic-based approaches.

Originality/value – Limited research has been conducted into the application of quality management in the homebuilding industry. This study of 22 leading homebuilders provides insights into the actual practices of quality management. Recommendations are provided as a guide for future direction for quality in the industry.

Keywords Quality management, Construction industry, United States of America

Paper type Literature review

Quality in construction
As quality management, lean and Six Sigma continue to expand globally in manufacturing and other industries these techniques have gradually made their way into the construction industry (Dahlgaard and Dahlgaard-Park, 2006; Aberdeen Group, 2005; Salem et al., 2005; Abdul-Aziz, 2002; Mathews et al., 2000). Quality has been adopted in the construction industry mainly because as in any other industry, “it is critical that client satisfaction is achieved if an organization is to succeed, or indeed survive” (Barratt, 2000, p. 378). Understanding and meeting client requirements is a key element in the construction industry due to its complex and personal nature. Quality management offers specific methods to help meet these requirements (Xiao and Proverbs, 2002; Low, 2001; Faulkner et al., 2000; Abdul-Rahman et al., 1999).

While the construction industry is attempting to improve quality, this has been slow and fragmented. Mainly due to the fact that historically the industry has been reluctant to embrace change (Low and Hong, 2005; Haupt and Whiteman, 2003). It is also an industry that is characterized by a “confrontational and adversarial atmosphere with time and money being the prime concerns” (Abdul-Aziz, 2002, p. 88). This preoccupation with time and money creates a focus on accepting the lowest bids, tight scheduling, and a short-term focus on cost savings. This continues despite the fact that “poor quality performance results in increased rework, which has significant
cost and schedule implications” (Xiao and Proverbs, 2002, p. 673). As a result while the industry is focusing on quality it is still at the point of using traditional methods, namely to build in multiple inspection processes (Haupt and Whiteman, 2003; Abdul-Rahman et al., 1999). This reliance on inspecting quality into a product, which is misdirection, has significantly slowed the use of advanced quality techniques. In addition, where quality is used the principles are not applied beyond management levels (Haupt and Whiteman, 2003, p. 166).

Also there is a view within the industry that it is different to all others, therefore, the way things have always been done, is the only way to continue. Certainly, the industry has unique aspects, as Low and Tan (1996) point out, “the construction industry is characterized by activities which are discontinuous, dispersed, diverse and distinct in nature” (Low and Tan, 1996, p. 42). The application of quality management in the industry has been proven to work in the industry (Bayfield and Roberts, 2005). Indeed, with the cost of correcting defects “in the region of 12 percent of project cost, whereas the cost of providing TQM is between 1 to 5 percent” (Xiao and Proverbs, 2002, p. 681) its value is evident.

Another problem is that when companies are able to implement quality in their management operations, few successfully transfer this to field operations (Haupt and Whiteman, 2003). This is made more difficult since 90-100 percent of work undertaken is by sub-contractors, the issue then becomes ensuring that sub-contractors are implementing quality (Abdul-Aziz, 2002). There is no doubt that client satisfaction and contractor performance are “positively and strongly associated with their relationships with sub-contractors” (Xiao and Proverbs, 2003, p. 329). Therefore, the best way to improve relationships and quality with sub-contractors is to focus on building partnerships (Mathews et al., 2000). This partnering involves establishing collaboration on resource efficiency, financial issues and combined goals (Bayfield and Roberts, 2005). A combination of “sound formal systems and strong relationships is essential to achieve high quality in the project environment of construction” (Barratt, 2000, p. 391).

The real issue is that “quality tends to suffer from attitudinal rather than technological problems, there is a need to create a culture of quality” (Xiao and David Proverbs, 2002, p. 679). This requires behavioral changes and so “the commitment of the top management for the implementation of these tools may prove to be the most important factor in successful implementation” (Salem et al., 2005, p. 19). It is only a mind shift by senior management that will lead to the industry fully embracing quality management (Low and Hong, 2005; Haupt and Whiteman, 2003).

**Quality programs for the US homebuilding industry**

A key driver of quality management in the US homebuilding industry, is the National Association of Home Builders Research Center (NAHBRC) and their National Housing Quality program. This program consists of three key national programs. The National Housing Quality Award (NHQA), which is based on the Malcolm Baldrige National Quality Award (MBNQA), the Builder Certification program and the Trade Contractor Certification program (NAHBRC, 2007).

The NHQA is open to homebuilders, remodelers, and sub (trade) contractors. Just as with the MBNQA, self-assessment can be conducted. The application process involves addressing each of the criteria by means of a detailed report. A team of judges reviews
the report and if approved then a site visit is conducted which may last several days. In either case the applicant receives a detailed report to provide actionable feedback to continue improvement. The NHQA has three levels of recognition, honorable mention, silver, and gold. Since the start of the NHQA in 1993 through 2007, 64 builders have received recognition, of which seven builders have earned awards multiple times. These organizations range from small family owned to large national builders, building single and multi-family homes of a wide price range.

The Builder Certification program is based on ISO9001, but includes elements of a safety program in addition to the quality management system. Since its inception in 2004 through 2008 the program has certified over 45 builders. Finally, the Trade Contractor Certification program, based on the Builder program has less-stringent requirements. This includes those contractors providing installation services, manufacturing and prefabrication. Since its inception in 1995, the program through to 2008 has certified over 450 trade contractors (NAHBRC, 2007).

Research methodology
Case studies were conducted throughout 2007 with 22 home building companies across the USA. These builders had between ten and 1,000 employees and ranged from ten- to 60-years old. The number of homes built were 15-4,000 homes per year, 11 of the 22 built over 100 homes per year. The 22 builders had $27-900 million in gross revenues. The price range of the homes was $80,000-1.7 million. The homes include both single and multi-family type and of both production and custom design.

The companies were identified as having been involved in the NHQA or builder certification programs. Many had presented at the International Builder show or Benchmark conferences and were promoting their quality practices and were offering to explain their quality journeys.

The case studies were based on in person and telephone interviews that lasted from two to four hours and were semi-structured in nature. The interviews were conducted with the highest manager responsible for quality in each company. This was either a vice-president, or director, or manager of quality. Of these interviewees, 50 percent focused on quality 100 percent of the time, the remainder were also responsible for other key roles such as production or customer relationship management (CRM)/warranty. Structured questions were used and focused on key background data such as the number of employees, gross revenue, and the number of homes built per year. Others were closed-ended questions focusing on the type of quality tools and techniques used by the company. Other questions were open-ended and related to why quality was adopted, how it was introduced, the attitude of employees and other more subjective topics.

Research findings
Getting involved in quality
All the homebuilders studied became involved in quality management due to their owners/chief executive officers (CEOs) being exposed to promotions, training and seminars. The majority were exposed to these through the NAHBRC in particular at the annual NAHB's International Builder show and Professional Builder Magazines' annual Benchmark Conference. At these conferences, certified builders and winners of the NHQA share their best practices in presentations, usually given by the company
This senior level peer to peer sharing of knowledge has had a significant impact on bringing more companies onboard the quality movement. The key influence has been improved efficiency in production, reduced defects, reduced warranty costs, improved customer satisfaction and increased customer referrals. Time and money being the key concern (Abdul-Aziz, 2002). These practices are often singular ideas or concepts that worked for individual builders or were gleaned from popular best selling business books and are not distinct quality tools, techniques, or management systems. There is also a lack of integration of these ideas into a quality program with which they would create synergy and focus (Barratt, 2000). Many of the ideas shared within the industry are isolated ideas to wow the customer. This may be in the form of gifts and surprises aimed at exceeding customer expectations. However, this is not built on the Kano model concept of exceeding expectations but rather, ironically, of creating increasing levels of non-value added processes, while being distracted from ensuring that customer expectations are assured. This added to the fact that only two of the builders focused on using value stream mapping reflect the lack of structure to the quality programs of the builders.

The tools and techniques of builder certification and NHQA which are also heavily promoted at such conferences have been seen by the owner/CEO’s as methods to help implement and achieve quality, essentially as stepping stones to help build a program.

Leadership and senior management influence
Quality is driven in these organizations by strong singular leadership usually the owner of the business or the CEO. These leaders all show high levels of charismatic leadership and use this charisma and genuine passion and belief in quality management to drive its implementation. By embracing quality enthusiastically and personally in this top down approach, employees have in return been inspired and embraced quality. The quality tools, techniques and approaches used throughout the organizations were implemented at the direction and energy of the leader and driven in all cases by one individual or champion in the organization. This champion works either full or part time in the role of quality director or manager, working directly under the owner/CEO. It is interesting to note that while the owner/CEO’s focus on quality held significant sway over their organizations, it is the senior management level, those most close to the owner/CEO that remain unconvinced by quality. Even with incontrovertible proof of the impact of quality provided over time by each company quality leader in regard to, reduced defects, warranty costs, customer and trade partner satisfaction, the senior managers still perceived quality as unnecessary and a peripheral aspect of work (Bayfield and Roberts, 2005). It is seen as primarily a sales and marketing differentiator, which if eliminated would save on overhead costs. Their support is limited and only given as long as the owner/CEO demands it. Therefore, the foundation of quality is weak and will be quickly eroded. Without a mind shift by senior managers quality will not be advanced in the industry (Pheng and Hong, 2005; Haupt and Whiteman, 2003; Xiao and Proverbs, 2002).

Certification and NHQA: providing structures and systems
All 22 of the builders had applied for the NHQA and 11 had received levels of recognition ranging from honorable mention to silver and gold. It is interesting to note however, that only four of 22 used the NHQA as a self-assessment tool. Only this small
number recognized the value of the criteria to drive improvement or as a strategic or coordinating tool for quality improvement efforts. The majority perceived the criteria as simply an award to apply for and win. While of course, all of those applying received feedback, which created a stepping stone of improvement, it was this lack of understanding of the wider value of the criteria that meant that quality tended to fade into the background after any level of recognition. Those builders that won and returned to apply several years later, found that in the interim quality had faded. A one or two year effort was needed to “build” up to applying again, to ensure the company could win once again. Of the four builders that did use the self-assessment technique, only one conducted this consistently and incorporated it into strategic planning process, making the NHQA concept and approaches part of the business functioning. This builder also used the criteria as a model to coordinate and integrate its other quality efforts and initiatives including safety and environmental programs.

In each case, the NHQA did provide the builder with a broader view of the potential of quality and each found the application process more challenging than they had expected. The site visits and feedback reports were considered revealing and insightful and were key in driving the company to implement the recommendations and to apply again.

Builder certification had been gained by 13 of the 22 builders, and each builder had three to four departments involved in the process. One of the builders had also integrated an environmental management system based on ISO14001 into the builder certification system. Both large and small builders used builder certification; highlighting the fact that implementation of a quality system was not dictated by cost or organizational infrastructure. Six of the builders provided training for their trade partners to disseminate quality tools and in particular the trade certification program. These builders had achieved between ten and 50 certified trade partners.

While builder certification includes the use of process maps and action plans (or procedure documents) only nine of the 13 certified builders used either extensively. Two of the builders used significant numbers of action plans and process maps and saw these as basic elements of their quality programs. They also each used value stream mapping; this provided an element of lean for these organizations however it was not used extensively. This reflects the fact that in many cases the most basic of quality techniques were not understood or implemented.

The incorporation of other structured continuous improvement programs
Green/environmental programs have been seen in the industry as creating high performing products. Nine of the builders were certified to the Energy Star program, five were involved in a Green Building program and two were building to the Leadership in Energy and Environmental Design (LEED) program standards. LEED is a third party certification program and benchmark for design, construction and the operation of high performing buildings. One was involved in the National Green Building program launched in February 2008 by the NAHB. Only two of the builders had waste recycling programs, one of which recycled over 50 percent of its site waste.

Only two of the builders saw these environmental best practice programs as being part of a business improvement effort or linked to quality programs in any way. Only one had these directly linked by means of an integrated quality, safety, and environmental management program.
The strategic application of quality
In regard to strategic planning, 14 builders have a strong structured strategic process. These include annual, bi-annual or quarterly strategic planning sessions. In many cases, these sessions are conducted as retreats, however, only three builders devoted more than a half-day to each strategic planning event. Only two builders had a strong roll out plan to implement and disseminate the strategic plan throughout the organization and only five had detailed scorecards to aid in aligning policy deployment. For eight of the builders there was no structured approach to the planning process at all. The senior management team and in some cases the entire management team met to brainstorm and discuss the past year and opportunities for the upcoming year. The majority of the builders used market analysis reports from third party organizations and some used an external and internal strengths, weaknesses, opportunities, and threats analysis. Interestingly, the approach used did not depend on company size.

Surveys and evaluations of performance
It was found that all of the builders conducted customer satisfaction surveys. Indeed, all but two were conducted by independent third party organizations. However, few used these results in a focused manner to address areas for improvement. For example, the one to two areas selected for improvement were chosen by the senior leaders in a subjective manner. Only two builders used correlation or regression analysis to focus improvement. Only three used teams to evaluate the reasons for dissatisfaction and to determine the most effective and efficient method of action. In other words, there is a significant level of time and cost put into ill directed and mismanaged customer improvement efforts.

Seven of the builders expanded upon the customer surveys by conducting customer focus groups to further investigate the issues raised by the surveys or other areas of import. However, even in these cases three of the seven conducted these programs on an irregular basis with their focus varying each time they were conducted. This lack of consistency resulted in a constantly fluctuating level of customer satisfaction. The customer satisfaction levels ranged from 80 to 92 percent in this sample.

As for other external evaluations, trade partner satisfaction surveys were conducted by 16 of the 22 builders. Once again, only three builders actively addressed the issues raised in these surveys to drive improvement. In the majority of cases the survey results were reviewed, praise or frustration was expressed and in the case of frustration the senior management team decided which areas were to be focused on for improvement. Once again improvements in all but two cases were ill-defined and vague in nature.

In regard to internal performance, employee satisfaction surveys were conducted by 16 of the builders, however, only six were conducted by a third party organization. This fact may have had a significant impact on their feeling of confidentiality and so may have had an impact of the validity of the results. Again, areas for improvement did not have specific goals, timelines, or responsibilities assigned to ensure that they could be effectively addressed.

Finally, only six builders conducted leadership evaluations and only four of these used a 360° format. There is limited and peripheral evidence of action taken to address the results of any of these leadership performance surveys. This potentially creates a
significant undermining of employee attitude if they perceive no action to be taken. This of course, is also perhaps one of the most critical areas for improvement and development in an organization.

*Quality tools and techniques*

Quality techniques were primarily focused on the construction and customer relations/warranty departments. This limited application of quality further supports the traditional focus on the actual building process and product itself, limiting the application of quality in other disciplines and so restricting a mature understanding of quality itself (Abdul-Rahman *et al.*, 1999).

Only eight builders had structured CRM systems and only two had detailed software packages to support their CRM. Only two others had strong structured formal approaches. This resulted in constant fire fighting. What in most cases would be a low level of customer dissatisfaction created due to poor management structures, led to increasing levels of frustration and dissatisfaction. This included the time to resolve complaints being excessive, defects taking multiple times to complete or inconsistent answers being provided. This reflected a disconnect between understanding quality management concepts and actually implementing them in practice within CRM.

All of the builders used detailed and multiple inspection points throughout the building process. This was the key pattern of quality throughout the sample. Interestingly, few builders had inspection processes outside the actual building process itself for example in upstream processes such as in design. All builders used extensive construction checklists, however, only four had developed objective checklists; the majority were of a very subjective nature. Also only these two builders had checklists directly connected to palm pilots/tablets or laptops in the field through which results could be directly inputted and then automatically downloaded to the companies database to produce instant data analysis. In both these cases the information was then focused on directly by improvement teams resulting in up to 50 percent of defects being reduced by this approach of identifying root cause analysis and a structured approach to their resolution. This inspection-based mindset was prevalent even with the most advanced builders.

While nine of the builders actively analyses the data only seven did this in any sophisticated way. Only one of the builders further used this data to conduct statistical process control charts. However, two did use correlation and regression analysis to focus on root cause analysis and to prioritize efforts. Most builders gathered and stored data and were overwhelmed by the quantity and so it went unused. Only one builder had a fully integrated database allowing real time data analysis and the synthesis of data into executive dashboards to provide a more tactical and strategic use of quality.

Of the builders, 15 use teams to drive improvement; however six of these used teams on a limited basis and were unstructured in regard to format, approach or project management. One builder had 75 percent of employees involved in improvement projects resulting in 40-80 percent construction defect and warranty cost reduction. This builder used the define, measure, analyze, improve, and control, approach from Six Sigma to structure and manage the team’s efforts. One builder used teams in business process reengineering and used flowcharting as a key element. Only two builders had training programs to support team members. Two builders used a Kaizen Blitz to create a focused and dedicated event to create improvement. One of the builders
estimated that their Kaizen Blitz event (a short intense improvement project) focusing on new home plans reduced up to 20 key defects from reaching the building process. Few builders were able to apply quality management in driving improvements through teams and so limited potential impacts.

In regard to employee training 12 builders had structured training programs, five of which had detailed formal approaches of progressive training that were well planned. Ten of the builders host quality conferences for their companies and trade partners, six of who had regular annual events, one with over 150 attending. However, with the obvious critical involvement of employees and the importance of teams in driving quality this lack of planned training is a key element undermining the future of quality.

A total of 14 of the builders’ conduct benchmarking within the industry through informal meetings, site visits and the formation of small groups of non-competing builders. Five of these builders were part of the NAHB’s Builder 20 groups, which share confidential financial and non-financial information. Only four of the builders conducted benchmarking outside the industry, this reflects the viewpoint in the industry that there is nothing to be learned from outside the industry. Five of the remaining builders conducted no benchmarking at all. This creates an insular culture with limited knowledge of the impacts quality has had in other industries.

In regard to the actual building production process itself, six of the builders use the production scheduling approach referred to in the industry as Evenflow. This represents a form of lean production. In Evenflow, the key steps in production are laid out on a timeframe that does not change, regardless of home size or weather conditions. This production flow creates “slots” for each step in production. Each complete flow represents one home. There may be as many flows per day as resources and production can support.

In regard to other tools and techniques, only one builder used Six Sigma, the lean 5S tool (sort, straighten, sweep, standardize, and sustain) and the theory of inventive problem solving. Two others used failure mode and effects analysis a tool for risk management, three fishbone charts and three value-engineering concepts. Surprisingly, only eight of the 22 builders used the plan-do-check-act cycle perhaps the most basic element in quality. This reflects the lack of maturity in the industry. The success of these few builders using these tools, provides the hope that their promotion will encourage other builders to participate.

Results from quality
Strong results came from the quality programs and included ten builders with impacts on reducing defects and warranty costs by 50-70 percent, nine improving construction cycle time significantly and six improving customer satisfaction. One had improvement on trade partner satisfaction, one on employee satisfaction and another on increased revenue.

Conclusions
Quality management practices are being used in the US homebuilding industry with particular support being provided by the NAHBRC. But, the total number of builders involved is relatively small. It is critical that homebuilders broaden their participation beyond the award application process and the minimum requirement of certification to all aspects of the organization and not on production and warranty alone. The wide
range of tools and techniques offered by quality management is largely ignored. There is a need to focus on structured, systems-based, long-term quality to go beyond the short-term fad and inspection processes.

While the industry has been exposed to quality concepts, attitudes have not changed. The perception remains that quality is a peripheral issue. The majority of the industry has yet to be convinced of its value despite significant evidence. It is the senior managers that need to be convinced. They are the key to changing the industry culture since they are the organizational leaders of the future. For these leaders, quality is still a marketing tool and at best about inspecting quality into the product.

Benchmarking outside the industry is essential. This would open the industry up to a new range of tools and techniques and aid in moving the industry beyond the inspection concept. The cross-promotion of quality, safety, and environmental/green building programs perhaps offers the greatest potential.

For quality management to be advanced, the industry needs to focus on and invest in information technology. All builders use extensive inspection and audit processes gathering large amounts of data, however, this data are either ignored or in the case of a few analyzed in a very rudimentary manner. Without accurate, objective, real-time data, analyzed effectively, root cause analysis cannot be conducted to drive out defects let alone provide data for wider tactical or strategic value.

The current downturn in the US homebuilding market offers an ideal time for a focus on quality management, to drive efficiency and effectiveness and to prepare for the upturn in the market. Unfortunately, many are canceling training and re-certification to save on costs. In many cases, the advances made in quality have been reversed. Once again, this reflects the short-term view of the industry.

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