Thinking About Roof System Quality: An Attitude Survey of Industry Stakeholders

James L. Hoff
Firestone Building Products/University of Sarasota

Key Words

Roof system quality. Industry stakeholders. Attitude survey. Customer satisfaction. Quality dimensions. Cluster analysis.

Abstract

This study is based on an attitude survey of industry stakeholders to identify and prioritize the key processes that influence the quality of roof system installations. To establish a baseline of performance and identify areas for future improvement, the study also explores current perceptions regarding the relative contribution of industry stakeholders to the overall attainment of roof system quality.

Author

Jim Hoff (jlhoff@firestonebp.com) has served in a variety of technical and management roles in the construction industry for over twenty-five years. Currently, Mr. Hoff is Vice President of Marketing for Firestone Building Products Company and serves as Chairman of the Board of the Polyisocyanurate Insulation Manufacturers Association. Mr. Hoff received an A.A.S. in architectural technology from Indiana Vocational Technical College, a B.A. in psychology from Indiana University, a M.S. in management from Indiana Wesleyan University, and currently is completing his doctoral dissertation for a D.B.A. in management from the University of Sarasota.

Introduction: The Hidden Dimensions of Quality

The Construction Industry and the Problem of Quality. Although many industries, especially in the manufacturing sector, have embraced new techniques such as Total Quality Management (TQM) to improve quality, the construction industry remains wedded to more traditional quality practices. Although modern quality concepts such as customer-defined requirements, continuous improvement and statistical quality control have dramatically raised quality in many industries, the construction industry typically has rejected such practices in favor of older

approaches that emphasize rigid product standards, fixed contractual relationships and after-the-fact inspection.

Although other industries have come to view quality in broad terms of customer satisfaction, the construction industry appears to cling to a more narrow definition of quality as the "conformance to requirements" (Seymour & Sui-Pheng, 1990). Conformance to requirements defines quality as the satisfaction of a set of specifications rather than the satisfaction of the customer. This definition assumes that specifications will in fact meet customer needs and wants, but as Tobica and Stroh (1999) assert, this paradigm is inadequate:

> "Conformance-to-requirements … assumes that we can get stable and complete requirements; it ignores the potential mismatch between what is specified and what the customer needs or wants. In fact, customers may not know or care how well a constructed facility conforms to specifications; they want their needs and expectations to be met."
> (Tobica and Stroh, p. 316)

The reluctance of construction organizations to embrace modern quality management principles has been documented by Schriener and Angelo (1995), who assert this reluctance is a result of a commonly held industry view that the costs of quality outweigh the benefits. Sommerville (1994) observes that this attitude can be attributed in some part to the legal framework of construction contracts. Almost all such contracts contain provisions for the "making good of defects," and the costly process by which such defects are made good can easily encourage construction organizations to view quality as a cost.

Reluctance toward modern quality practice is also likely a reflection of the general atmosphere of contentiousness and distrust within the construction industry. As evidenced by the high frequency of litigation in construction (Carlisle & Kanji, 1998), it is obvious that disputes are common and frequently resolved only through the courts. Carlisle and Kanji also assert that this contentiousness permeates almost all aspects of the construction process. After conducting in-depth interviews with more than 2000 construction workers and managers in the United States and United Kingdom, they observe, "the typical (construction) site atmosphere is one of divisions, suspicion and a lot of argument" (Carlisle & Kanji, 1998, p. 28).

Quality and the Roofing Industry. Compared to the overall construction industry, the roofing industry in North America has made measurable progress in adopting modern quality practices. In conjunction with Northwestern University, the National Roofing Contractors Association has established a formal TQM program for roofing contractors. To date, more than 200 contractors from across North America have participated in this program and have implemented some TQM practices in their operations (Good, 1995, Puniani, 1997). Roofing

manufacturers have also leveraged modern quality practices to improve roofing quality. In fact, improvements in the performance of roofing products frequently are a direct result of TQM programs originally established in manufacturers' factories (Hoff, 1998). At the same time, though the roofing industry has made positive strides in using some of the tools of modern quality management, many of the problems afflicting the larger construction industry continue to prevail. Roofing-related litigation remains high, the "punch list" to correct defects is still a standard operating procedure and industry standards of quality continue to be based on conformance to requirements rather than customer needs.

The Need for Research. At a research level, little effort has been expended to explore these hidden dimensions of quality, especially those dimensions requiring a deep commitment to customer needs and cooperation among all participants in the roofing process. To expand understanding of roofing quality, research should focus on industry attitudes regarding quality, as well as perceptions regarding the responsibility and effectiveness of all industry participants in achieving quality. As a minimum requirement, such research should include all key industry participants, and the research should strive to identify the key processes that make (or break) quality in roofing. Ultimately, the results of such research could be used to develop a more comprehensive understanding of the relationships and interactions necessary for the roofing industry to achieve levels of quality now common in other sectors of the economy.

Identifying Quality Dimensions in Roofing

Previous research has demonstrated that customer satisfaction is related to specific factors representing product or service attributes. These factors are sometimes referred to as *quality dimensions* (Parasuraman, Zeithaml and Berry, 1985) or *customer requirements* (Hayes, 1998). Although a number of different methodologies can be used to identify performance factors related to customer satisfaction, one widely used approach is the *critical incident technique*, originally developed by Flanagan (1954). A critical incident is a specific example of how, in the words of a customer, a service or product has provided either a positive or negative performance. Hayes (1998, p. 19) identifies that a critical incident should be specific and should describe the service or product in terms of a distinct attribute or activity.

In the spring of 2001, telephone interviews were conducted with 20 authorities in commercial roofing representing all key industry stakeholders, including roofing contractors, roofing manufacturers, building managers, roof system designers and roof consultants. These experts were asked to identify and describe activities they considered to be most important in achieving quality and customer satisfaction in commercial roofing. The activities were then reassessed in a second interview to identify the broadest and most common categories of

processes contributing to roof system quality. As an example, activities such as "apprenticeship programs" and "instructional videos" were combined into the broader category of "installation training." Based on this series of telephone interviews, the following broad but distinct dimensions of quality were identified to be critical to effective roof system installation:

1. Material Selection: The identification and selection of roofing materials for a specific application.

2. Industry Standards: The development of industry-wide standards to promote uniformity in products and processes.

3. Installation Training: Training provided to roofing crews to develop expertise and consistency in roofing application.

4. Roof Monitoring: The observation of a roof *during* installation to assure conformity with design standards.

5. Roof Inspection: The observation of a roof *after* installation to assure conformity with design standards.

One of the five key quality dimensions identified the expert panel was modified for this study. The expert panel originally categorized "material selection" to be part of a larger category of "roof design," but several of the experts were concerned that the concept of "design" could be considered an activity conducted only by licensed professionals, such as Registered Architects and Professional Engineers. To address this concern and to avoid potential confusion among the respondents, this quality dimension was limited to "material selection" for this study.

Identifying Key Industry Stakeholders

For purposes of this study, a stakeholder was defined as an easily identifiable group of individuals or organizations that share a common and frequent role in the roofing process and either contribute to or are affected by roof system performance and quality. Using this definition, the same expert panel was asked to identify these key stakeholder groups. Using the same two-step process of identification and re-assessment, the following key categories of roofing stakeholders were identified:

1. Building Owners and Managers: A building owner or representative of a building owner of a building involved in the management and procurement of roofing assets.

2. Roofing Contractors: Business organizations engaged in the installation of commercial roof systems.

3. Roofing Materials Manufacturers: Business organizations engaged in manufacturing and marketing commercial roofing materials.

4. Roof Consultants: Individuals or organizations engaged by building owners to assess, specify and monitor roofing assets.

In addition to these four primary categories, several other groups were identified but not included in this study. For example, general contractors and construction managers are frequently involved in the roofing process, especially in new construction. However, because almost three-fourths of all commercial roofing work involves reroofing activity, it was not believed that general contractors have a significant impact in this largest segment of commercial roofing. In a similar manner, architects and engineers frequently are involved with specifying roofing systems, but many design professionals who specializing in roofing practice also align themselves with roof consultants. As an example, many members of the Roof Consultants Institute are also registered architects or professional engineers. In view of this apparent overlap, only roof consultants were included in the study.

The 2001 Roofing Quality Survey

Survey Instrument. The survey for this study was conducted via mail. Referring to the definitions of the key quality dimensions developed by the expert panel, the survey form requested each respondent to rate the importance of each quality dimension using a seven-point scale, with 1 being the lowest importance and 7 being the highest importance. In a similar manner, each respondent was asked to rate each of the four key stakeholder groups according to its relative responsibility for each quality dimension, with 1 being the least responsible and 7 being the most responsible. Next, each respondent was asked to rate each of the four key stakeholder groups' relative performance for each quality dimension, with 1 being the worst performance and 7 being the best performance. Finally, respondents were asked to assign themselves to one of the four key stakeholder groups. The respondents returned survey forms anonymously to an independent fulfillment service.

Survey Mailing and Response. Surveys were mailed to a randomly selected sample of representatives of each stakeholder group. The building owner sample consisted of 118 facilities managers or engineers drawn from a database of a large roofing manufacturer. The contractor sample consisted of 162 executives of member companies of the National Roofing Contractors Association, as identified in the 2000-01 NRCA Membership Directory. The consultant sample was sent to 99 professional members of the Roof Consultants

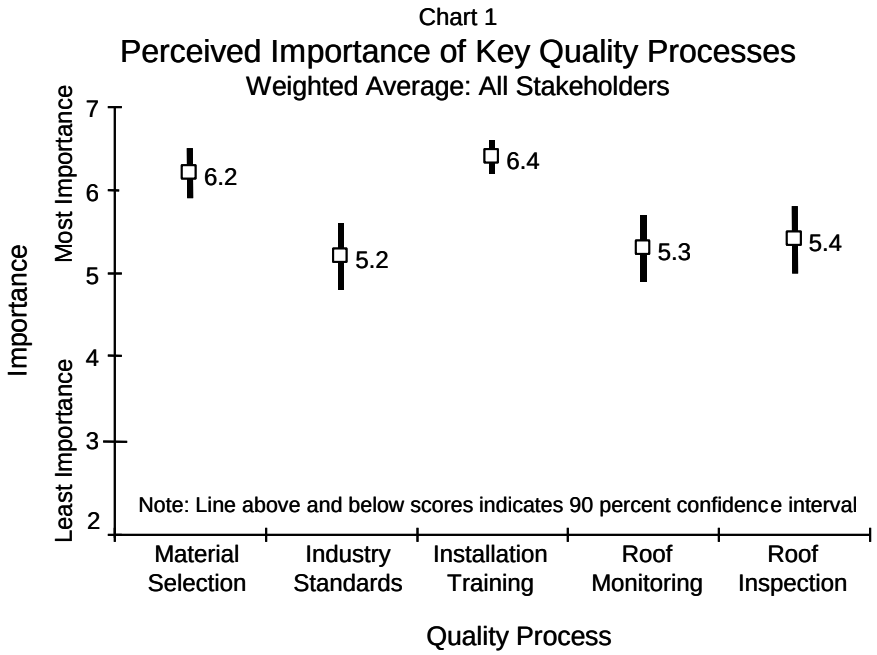
Institute, as identified in the 2000 RCI Membership Directory. The manufacturer sample consisted of 26 executives or managers of roofing materials manufacturers as identified from the directories of several industry trade associations. Because membership in trade associations is a common practice for roofing contractors, roof consultants and roofing manufacturers, samples taken from membership directories were assumed to be reasonably representative of the broader populations of these stakeholder groups. In the case of building owners, however, the sample used in this survey likely represented only the most informed and involved building owners, because many building owners do not formally employ building managers and may not belong to building owner trade associations. This sample, however, will provide significant insight into the attitudes and expectations of the best-informed building owners.

The return rate for the surveys was surprisingly high for all groups, including 23 building owners (19.5 percent), 62 roofing contractors (38.3 percent), 48 roof consultants (48.5 percent), and 15 roofing manufacturers (57.7 percent). Overall, the return rate was 36.5%, which is very high for mail surveys. Not included in this return rate were four survey forms that failed to identify the stakeholder affiliation of the respondent and six surveys with incomplete responses.

The respondent rating scores for each quality dimension were tallied and standard distribution statistics (mean and standard deviation) were calculated for each variable by respondent group. Weighted scores were also calculated for the combined groups using an equal weighting factor for each of the four stakeholder groups. Differences between scores were examined using a series of independent samples t-tests with a 90% confidence interval as the criterion for statistical significance.

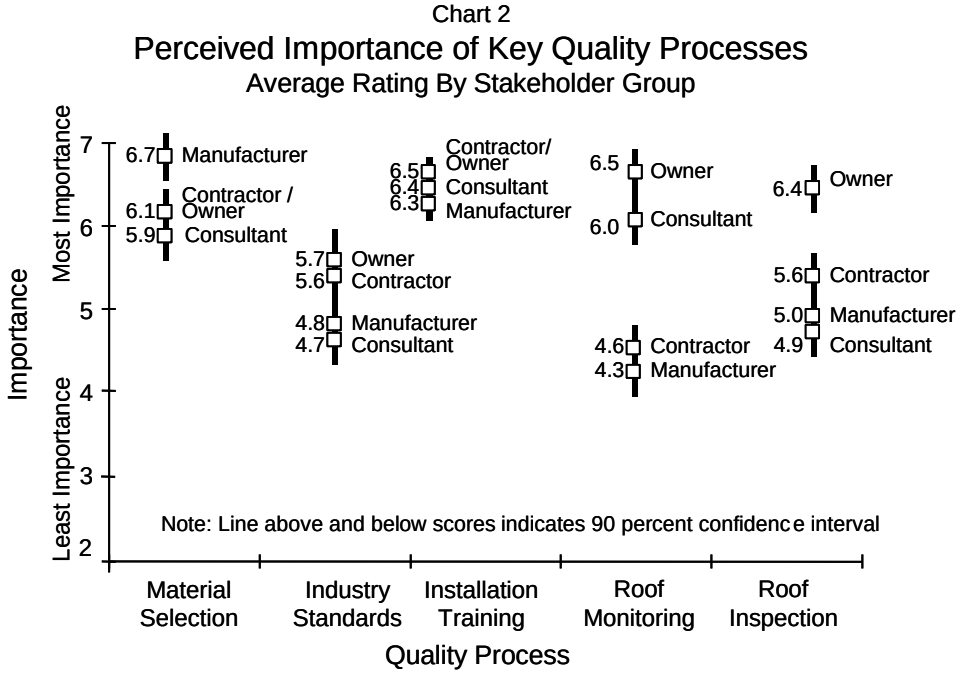
Results: Importance of Key Quality Dimensions

Overall Importance. Using weighted scores, material selection and installation training appear to be considered equal in importance by the combined stakeholder groups and significantly more important than the other three factors at a 90 percent confidence level. As shown in Chart 1, industry standards, roof monitoring and roof inspection also appear to be considered equal in importance but less important than material selection and training.



Differences Among Stakeholders. Comparing the average responses for each stakeholder group, the overall importance of material selection and installation training remained unchanged, but the stakeholder groups differed significantly regarding the importance of roof monitoring and roof inspection. As shown in Chart 2, though roofing contractors and roofing manufacturers considered roof monitoring to be moderate in importance, building owners and roof consultants considered this dimension to be as important as installation training and material selection. In a similar manner, though roofing contractors, roof consultants and roofing manufacturers all agreed that roof inspection was lower in importance, building owners again considered roof inspection to be as important as the highest-rated quality dimensions.

Chart 2



Differences within Stakeholder Groups. Because each stakeholder group in this study was pre-defined, it is important to discern whether these nominally uniform groups actually shared their opinions uniformly. Using the statistical technique of cluster analysis, two distinct subgroups were identified in both the roof consultant and roofing contractor samples. The groups were labeled “stereotypical” and “nonstereotypical” based on the profiles of their attitudes. As a common stereotype in the roofing industry, roof consultants frequently are perceived to be opposed to roof inspection as an effective approach to quality assurance. In a similar manner, roofing contractors are stereotypically considered to be opposed to independent roof monitoring. Although the overall survey results do not support these stereotypes, the cluster analysis reveals a sizeable subgroup among both roofing contractors and roof consultants that clearly hold the stereotypical view. Although the nonstereotypical subgroup of roof consultants regards roof inspection to be fairly important (5.8 points), the stereotypical subgroup assigns an extremely low rating (3.1) for this dimension. In a similar manner, the nonstereotypical subgroup of roofing contractors regard roof monitoring to be fairly important (5.5 points), while the stereotypical subgroup assigns an extremely low rating (2.6) for monitoring. As shown in Charts 3 and 4, the stereotypical roof consultants and roofing contractors also share one common attitude – a low perception of the value of industry standards.

Unlike their stereotypical counterparts, the nonstereotypical subgroups of roof consultants and roofing contractors appear to share a fairly balanced view of the importance of the key quality dimensions. In fact, for both subgroups there is no statistically significant difference in their ratings for any of the five dimensions.

Finally, the nonstereotypical subgroups of roof consultants and roofing contractors also share one other common attribute: both represent the majority for their respective stakeholder groups, with nonstereotypical consultants accounting for 30 of the 48 consultant respondents and nonstereotypical contractors accounting for 41 of the 62 contractor respondents.

Chart 3

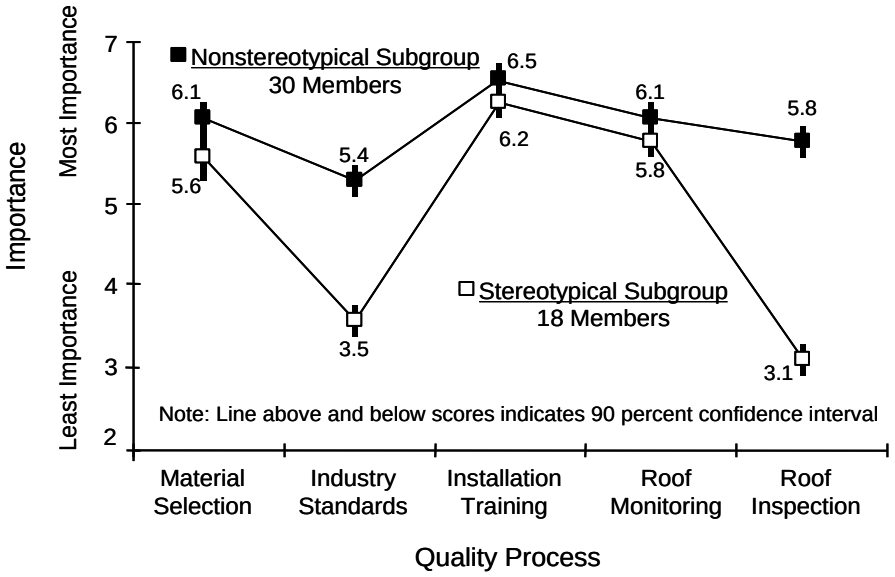
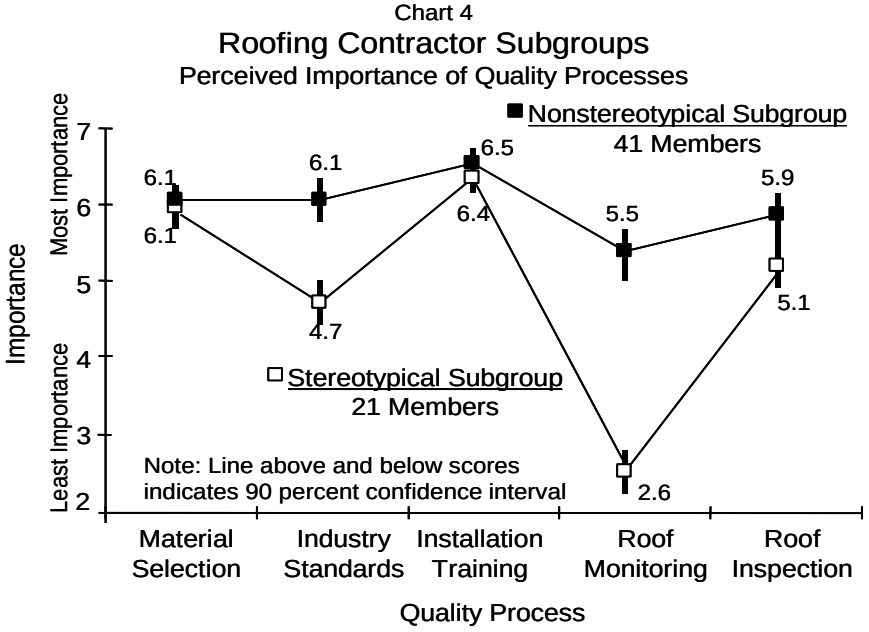


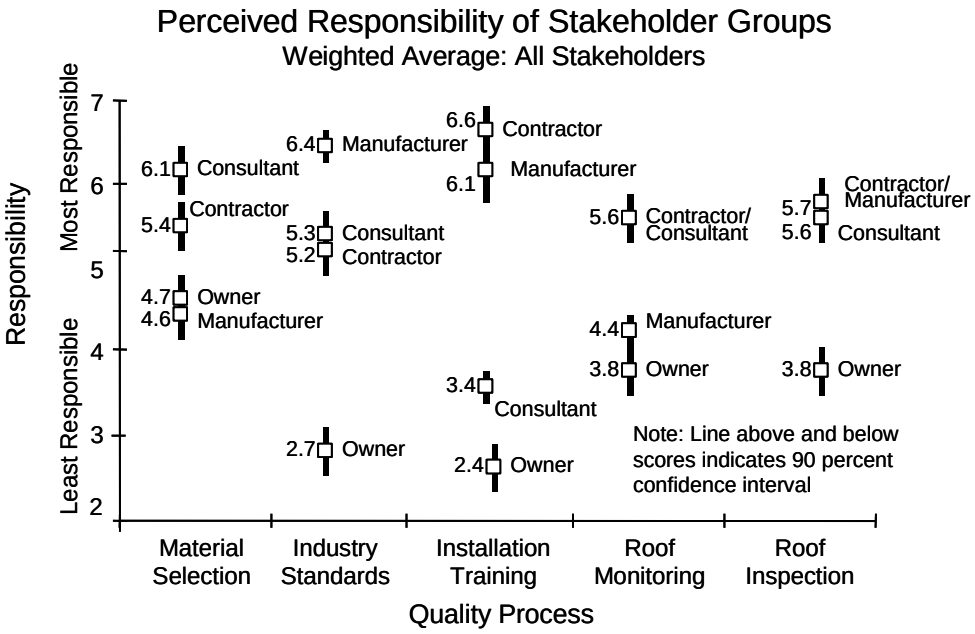
Chart 4



Results: Stakeholder Responsibility and Performance

Responsibility of Stakeholders. Using a weighted average for all stakeholder groups, an overall responsibility rating was obtained for each stakeholder according to the five key quality dimensions. As shown in Chart 5, roof consultants were considered to be the most responsible for material selection, and roofing manufacturers were perceived to be the most responsible for industry standards. Installation training was considered to be the joint responsibility of roofing contractors and roofing manufacturers, while roof monitoring was considered to be the joint responsibility of roof consultants and roofing contractors. In the case of roof inspection, responsibility was equally divided between roof consultants, roofing contractors and roofing manufacturers.

Chart 5



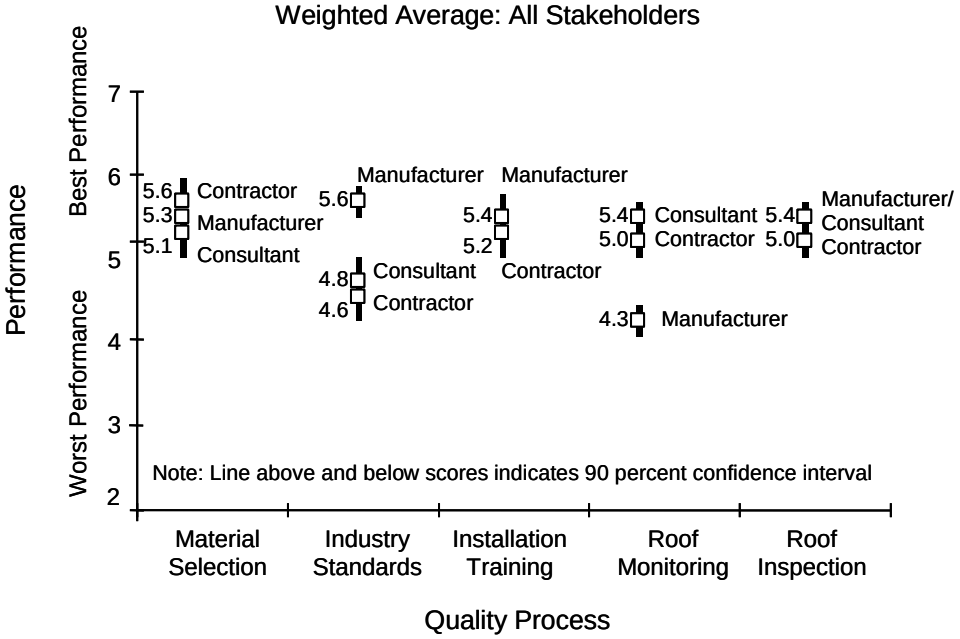
Performance of Stakeholders. Regarding performance, the stakeholder ratings are fairly uniform, but show room for uniform improvement. In customer satisfaction research using a point scale, respondents typically assign excellent performance ratings at or near the top of the scale (Dutka, 1994). Given the seven-point scale used in this study, an excellent performance assessment would typically require a score of at least 6 or more. As shown in Chart 6, however, the average weighted performance rating for almost every stakeholder group runs in a lower range of 5 to 5.6. Although these averages do not indicate any serious problem in stakeholder performance, they do indicate performance could be improved significantly.

It should be noted that some performance scores in Chart 6 have been eliminated for several of the stakeholder groups. Because building owners were perceived to have minimal responsibility for any of the quality dimensions, their performance scores offer little insight. Likewise, the performance score of roof consultants for installation training is omitted, because consultants are perceived to have minimal responsibility for training.

Chart 6

Perceived Performance of Stakeholder Groups

Weighted Average: All Stakeholders



Stakeholder Perceptions: Self versus Others. Charts 7 through 12 compare the self-perceptions of each stakeholder group against the weighted perceptions of all other stakeholders. With few exceptions, roofing contractors appear to significantly overestimate both their responsibilities and performances. In addition, the other industry stakeholders appear to rate roofing contractor performance not only lower than the contractors' own estimate, but also in a range (4.0 to 4.9) lower than the performance range of any other stakeholder. Roof consultants appear to accurately estimate their responsibilities, but some of their self-perceptions of performance (material selection and roof monitoring) exceed the estimates of other stakeholders. Contrasted with roofing contractors and roof consultants, roofing manufacturers appear to accurately estimate both their responsibilities and performances as compared to other stakeholders, even with a tendency towards underestimation.

Chart 7

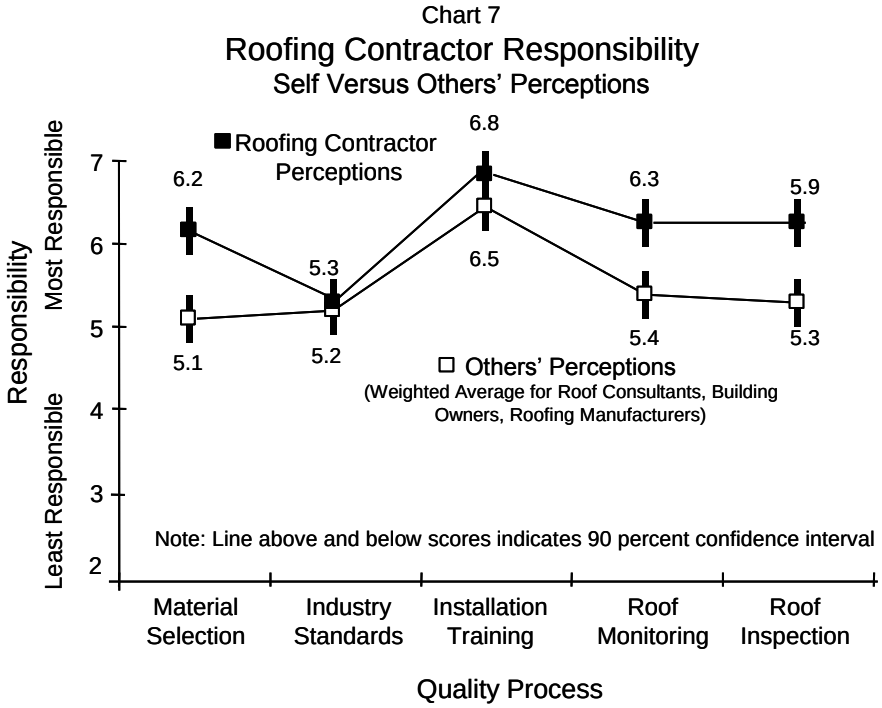


Chart 8

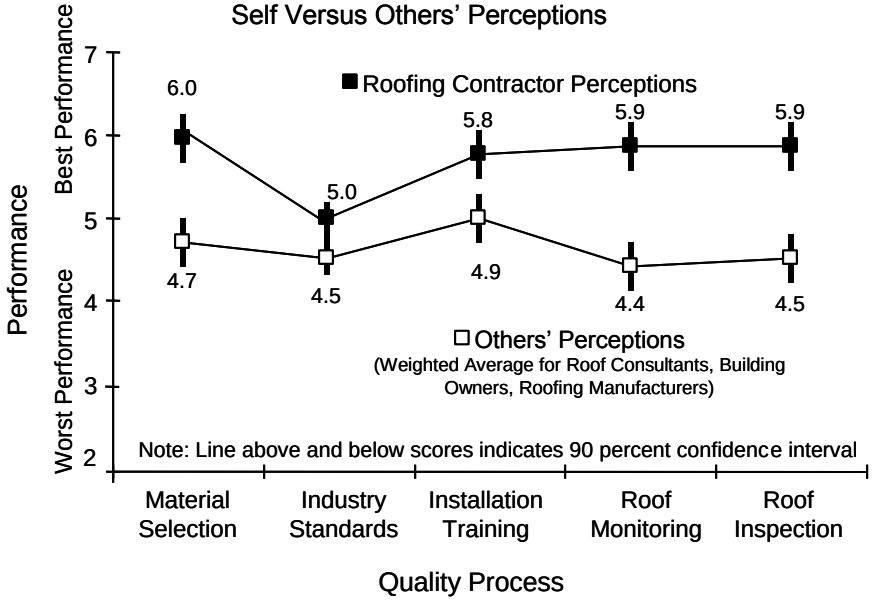


Chart 9

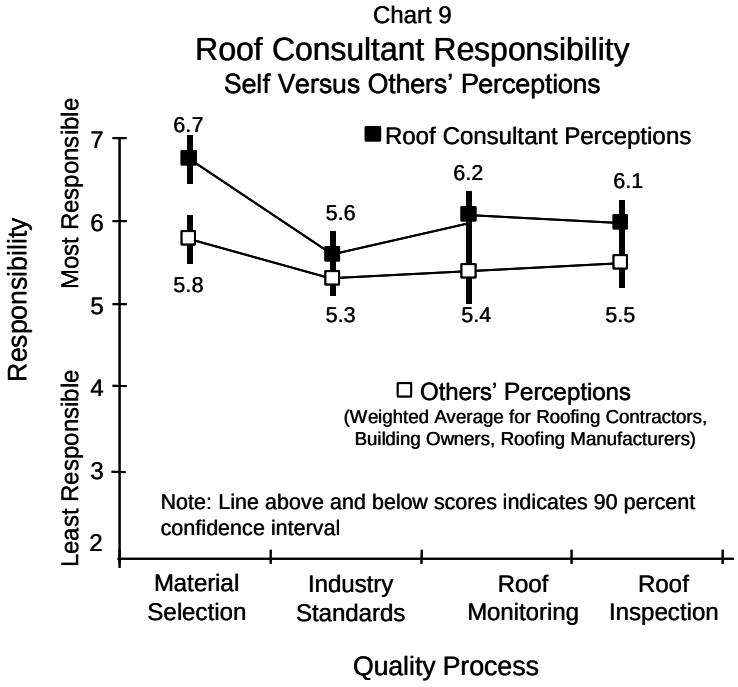


Chart 10

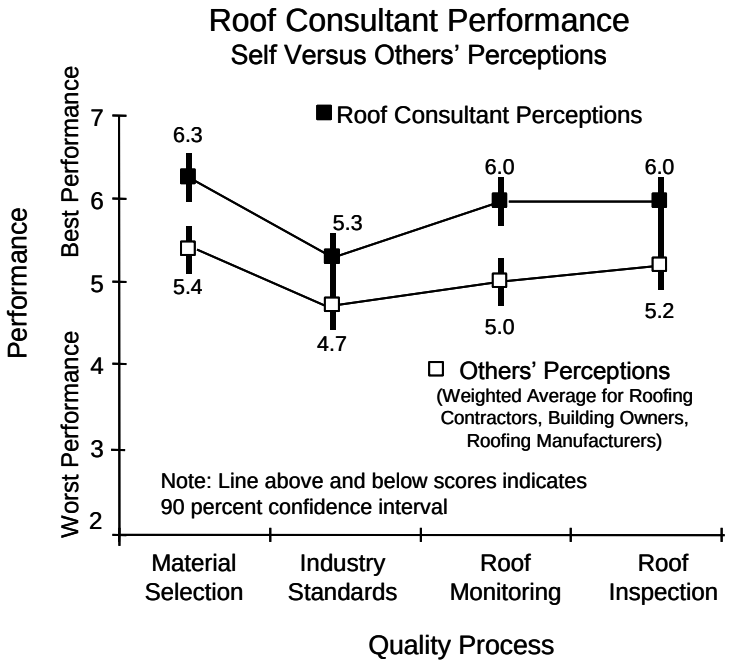


Chart 11

Roofing Manufacturer Responsibility

Self Versus Others' Perceptions

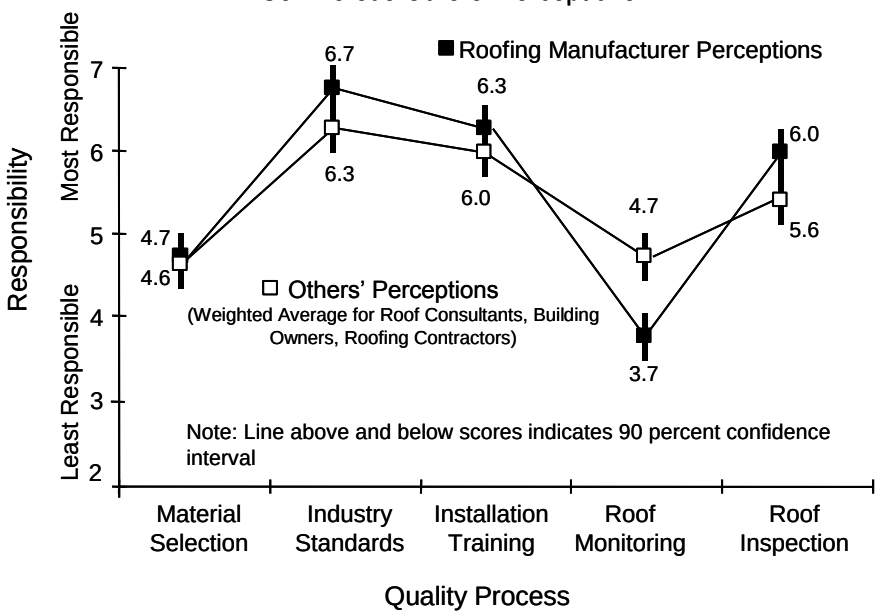
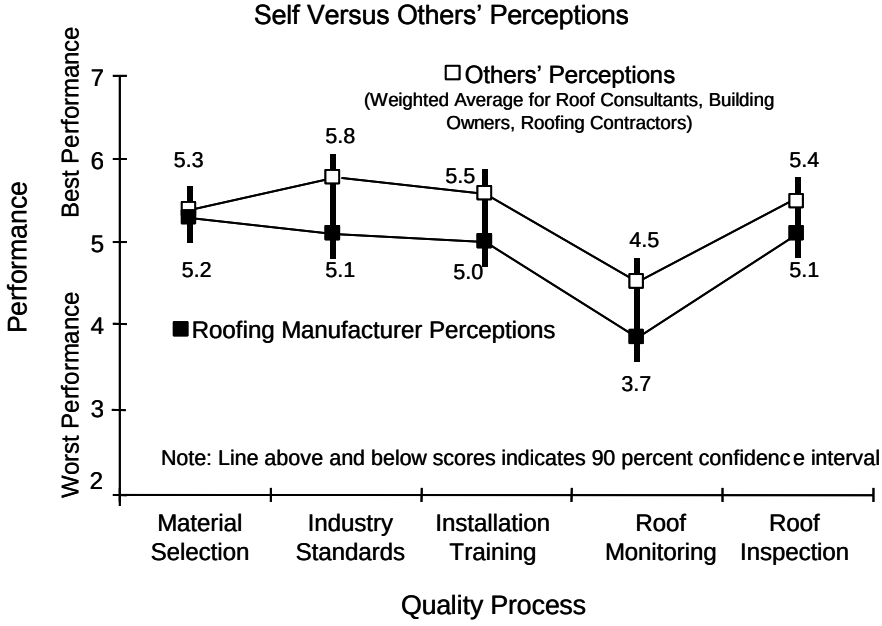
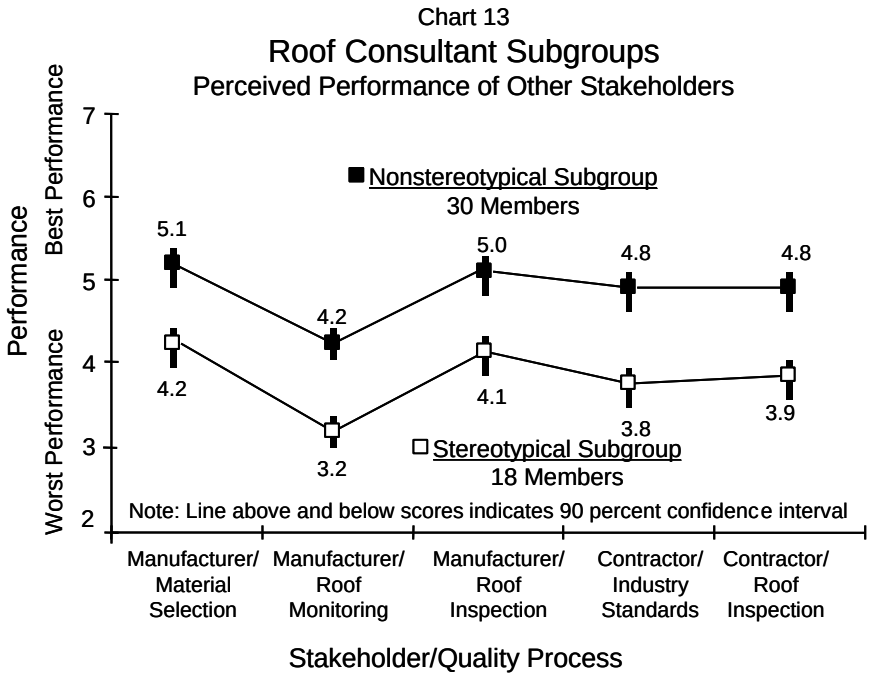


Chart 12

Roofing Manufacturer Performance

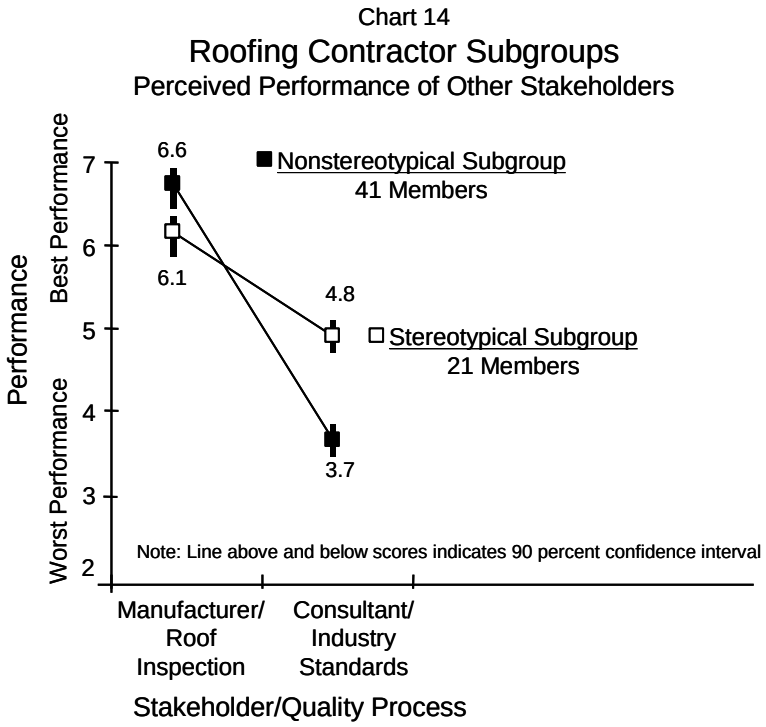
Self Versus Others' Perceptions





Stakeholder Perceptions: Stakeholder Subgroups. The stereotypical subgroups of roof consultants and roofing contractors previously identified appear to follow a similar pattern in their ratings of other groups. This is especially true for the stereotypical roof consultant subgroup. As shown in Chart 13, when comparing the responses of the stereotypical and non-stereotypical consultant subgroups, the stereotypical subgroup assigns significantly lower performance ratings to roofing contractors and roofing manufacturers, especially in the areas of material selection and roof inspection. As shown in Chart 14, stereotypical roofing contractors display fewer differences when compared to their nonstereotypical counterparts. However, in addition to the ratings shown in this chart, the stereotypical roofing contractors perceive their own performances in roof monitoring (6.2) to be significantly better than roof consultants (4.6), but nonstereotypical contractors see little difference in their roof monitoring abilities as compared to consultants.

Chart 14



Before leaving the discussion of performance ratings, it may be useful to compare the self-perceptions of roof consultants and roofing contractors against the perceptions of building owners, who are the ultimate customers. This is especially revealing because the owner respondents in the survey were among the most professional within the overall population of building owners. Although the self-ratings of both roofing contractors and roof consultants tended to be significantly higher than the weighted overall average ratings, building owner ratings tend to support this higher self-rating. When comparing roof consultants' self-ratings against owner' ratings for consultants (Chart 15), the building owner assessment is virtually identical to the consultant self-rating. When comparing contractors' self-ratings against owners' ratings for contractors (Chart 16), the building owner assessment actually tends to be higher than the contractor self-rating.

Chart 15

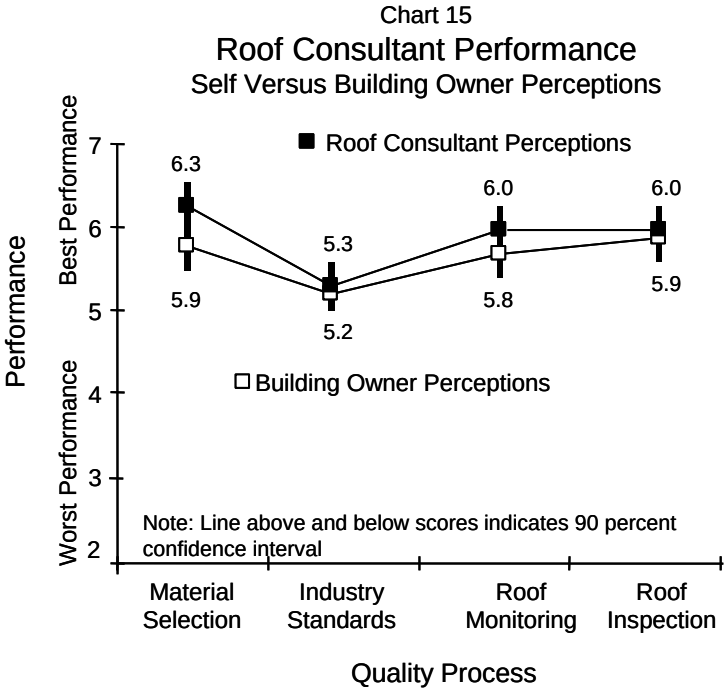
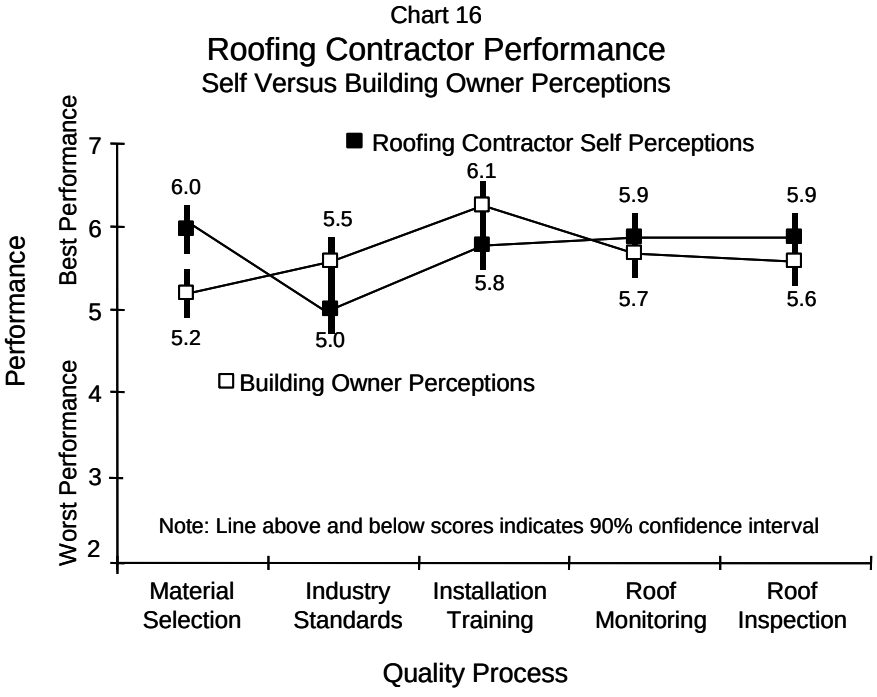


Chart 16



Discussion

Consensus on Training. Undoubtedly the most encouraging finding in the survey is the apparent unanimous agreement regarding the importance of installation training as a means of improving quality. At a time when interest in industry training seems to be waning (witness the dissolution of the Roofing Industry Education Institute in 2001), the presence of a widely shared attitude regarding the importance of training from all key stakeholder groups may provide needed impetus for future training initiatives.

The Quality Conflict in the Field. Although the importance of training reveals strong consensus, roof monitoring and roof inspection remain the subjects of considerable debate. Given the survey's uncertainty regarding who should be responsible for roof monitoring and inspection, as well as strong differences in performance ratings for monitoring and inspection among the stakeholders, it is clear that little consensus exists about how the industry should address quality control in the field. Without such consensus, roof monitoring and roof inspection will remain contentious, and this contentiousness may fuel ongoing conflicts among industry participants.

The Role of Extreme Opinion Holders. The identification of differing subgroups among roof consultants and roofing contractors offers both hope and concern. On the hopeful side, the majority of consultants and contractors surveyed do not subscribe to common industry stereotypes and appear to have a balanced view of roof system quality. Given such an outlook, it is likely that the majority of contractors and consultants would be prepared to cooperate in industry-wide initiatives to improve quality. However, the attitudes of the minority stereotypical subgroups raise several concerns. Not only do many of the attitudes of these two subgroups follow the traditional stereotype of mutual distrust, but they also appear to support this stereotype in the extreme. Just as new levels of cooperation may be possible among nonstereotypical contractors and consultants, new levels of conflict are also possible if the more extreme elements of each stakeholder group dominate opinion and agenda-setting in the industry.

Lessons From Building Owners. As mentioned previously, the building managers surveyed in this study are obviously not representative of all building owners because they were selected from a population charged with the professional management of building assets. However, for this very reason these professional building managers can provide a useful insight into potential "best practices" for roof system quality. Throughout the survey, the building owners gave very high performance ratings to the contractors, consultants and manufactures with which they obviously work closely on roof system installations. If we assume that the professional building managers in this survey would naturally engage similarly professional consultants, contractors and manufacturers, it is only logical for the performance assessments to be high.

This indicates that “best practice” models likely exist among such building owners that could be used to improve the quality processes of all stakeholders.

In addition to their apparent satisfaction with the contractors, consultants and manufacturers they employ, the building managers in this study do not appear to perceive any inevitable conflict among these stakeholders. Because these owner representatives appear to value *all* the dimensions of roofing quality – thoughtful selection of materials, thorough training of workers, responsible monitoring during installation, and professional inspection upon project completion – they also appear to envision an important role for *all* stakeholders in the roofing process. This indicates that the “best practice” model developed by such professional building managers may also include effective approaches to conflict resolution and consensus building among industry stakeholders.

Opportunities for Future Research

Developing a Unified Approach to Roof System Monitoring and Inspection. Just as the survey appears to indicate considerable confusion regarding the relationship between roof system monitoring and inspection, it is likely that much of this confusion could be eliminated by the development of a unified standard integrating monitoring and inspection into a single, seamless quality process. The integration of monitoring and inspection may offer an additional advantage for the industry. Because the level of engagement required between industry stakeholders to conduct such an initiative would clearly require new channels of communication and consensus building, such a process could lead to improved industry relationships and new approaches to improving all roofing quality processes. As a first step, research is needed to identify the processes involved in roof system monitoring and inspection, compare these processes against quality methods used in other industries, and establish an integrated working model for effective field quality assurance.

Understanding the Effect of Stereotypical Attitudes on Industry Quality. Although this study identified the presence of industry subgroups that appear to hold negative stereotypes regarding the performance of other stakeholders, it would be beneficial to understand what actual effect such opinions have on the overall development of industry quality processes. As a first step, a follow-up research study should be conducted to verify the presence of such subgroups and examine the relationship between these subgroups and the opinion-making and agenda-setting processes in the industry.

References

Carlisle, J., & Kanji, G. K. (1998). Appreciation for a system: From fragmentation to integration. *Total Quality Management, 9 (4/5)*, 24-29.

Dutka, A. (1995). *AMA handbook for customer satisfaction*. Lincolnwood, IL: NTC Business Books.

Flanagan, J. C. (1954). The critical incident technique. *Psychological Bulletin, 51*, 327-358.

Good, B. (1995, March). TQM is finding its place in the roofing industry. *Professional Roofing*, pp. 32-38.

Hayes, B. E. (1998). *Measuring customer satisfaction: survey design, use and statistical analysis methods.* (2nd. ed.). Milwaukee, WI: ASQC Quality Press.

Hoff, J. L (1998). *Firestone Building Products: Taking quality from the factory to the field*. Unpublished masters thesis, Indiana Wesleyan University, Marion.

Parasuraman, A., Zeithaml, V. A., & Berry, L.L. (1985, fall). A conceptual model of service quality and its implications for future research. *Journal of Marketing*, 41-50.

Puniani, A. (1997, January). Quality management is a team effort. *Professional Roofing*, pp. 24-26.

Schriener, J., & Angelo, W. J. (1995). Total quality management struggles into a low orbit. *Engineering News Record, 234 (19),* 24-27.

Sommerville, J. (1994). Multivariate barriers to total quality management within the construction industry. *Total Quality Management, 5 (5),* 289-298.

Seymour, D., & Sui-Pheng, L. (1990). The quality debate. *Construction Management and Economics, 8*, 13-29.

Tobica, Z. M. & Stroh, R. C. (1999). An assessment model for quality performance control in residential construction. *Journal of Construction Education, 3 (3),* 313-321.