

UNDERSTANDING THE MARKET FOR BUILDING COMMISSIONING IN WISCONSIN

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Introduction

Building commissioning promises a number of benefits to building owners, including high quality performance of building systems, lower operating costs, lower energy use, increased utilization of building space, increased productivity by building occupants, on-time availability of building space for occupancy, and reduced change orders. Despite the apparent appeal of building commissioning, its practice is far from widespread. Its use is growing in Wisconsin and other areas, but many building owners, architects, and engineers either are unaware of commissioning or otherwise do not include it in their work.

To understand better the market for building commissioning in Wisconsin, The Energy Center of Wisconsin (ECW) initiated market research on this topic in the spring of 1996. The objective of the research is to provide information on awareness, activity, and demand for building commissioning in Wisconsin. The research provides insight into the barriers towards this practice, and identifies the roles that utilities and other organizations, such as ECW, could play to increase this practice. The research also provides qualitative information on building design and construction practices as relate to building quality and performance. Hagler Bailly Consulting, Inc. (HBCI) performed this research under contract to ECW.

Background

Currently there is no nationally accepted definition of the term *building commissioning*. Several organizations have developed definitions, and ASHRAE has addressed building commissioning in its 1995 Handbook.¹ For the purpose of this research, a definition developed during the 1995 National Conference on Building Commissioning is used:

*Commissioning is a systematic process--beginning in the design phase, lasting at least one year after construction, and including the preparation of operating staff—of ensuring, through documented verification, that all building systems perform interactively according to the documented design intent and the owner's operational needs.*²

In short, building commissioning is a process to assure that building owners and occupants get buildings that meet their needs.

Commissioning has become a relatively routine and accepted practice in a few regions in the US, such as the Pacific Northwest. As energy markets are deregulated, commissioning may grow across the country as one of an entirely new array of energy services (or *products*) that will be offered by both competitive and regulated energy service providers. Commissioning could be part of a service package to commercial building owners to get their buildings operating efficiently as needed by occupants and to supply and manage building energy needs.

Research Design

The research consists of telephone interviews from sample populations of the principal groups involved with the design, construction, operation and management of commercial buildings: (1) building owners and managers (Owners), (2) architects and engineers (A/E), (3) general contractors (GC), and (4) heating, ventilating and air-conditioning contractors (HVAC). Originally, we intended to complete 20 interviews within each of these four groups. We initially envisioned that the interviews would be mostly open-ended. However, as the project progressed, the survey instrument became mostly close-ended. This change allowed us to increase the target number of interviews to 140 (instead of 80) as we could use phone lab interviewers instead of senior project staff. The limited size of the sample means that the results cannot be accurately projected to the entire population of the target groups. However, the results provide useful qualitative insights into this market. Additional qualitative information was obtained through six in-depth interviews with building design professionals as part of pre-testing the survey instrument.

A unique aspect of this research is that the term *building commissioning* is not introduced to the survey participant until well into the interview. Rather, the focus of the initial questions is *quality assurance* in building design and construction. This interview strategy is designed to avoid response bias due to misperceptions and different interpretations of the term *building commissioning*.

The interviews were conducted in February and March 1997. This paper presents results and analysis of the research. The Energy Center of Wisconsin will publish the final results and analysis of the research in fall 1997.

Researchable Questions

The research was designed to collect qualitative and quantitative information about the practice of building commissioning in Wisconsin. HBCI worked with ECW staff and a project working group of ECW constituents to develop a set of researchable questions to elicit the desired information. The researchable questions fell under the following categories:

- Awareness of building commissioning
- Perceived benefits of building commissioning
- Perceived barriers to building commissioning
- Building commissioning services offered or purchased
- Strategies used to market building commissioning services
- Assessment of building commissioning as a business opportunity
- Implementation process for building commissioning
- Interest in information, education, training, or demonstrations of building commissioning
- Desire to include building commissioning in practice

The final survey instrument contained about 45 questions.

Sampling Strategy

A key element of the research is the design of the sample population. For this project, the target groups are the building owners, contractors and designers most involved with new building construction in Wisconsin over the previous year. To identify these target groups and develop the sample, we used the F.W. Dodge Construction Potentials database for all counties in Wisconsin. The database includes only those new commercial construction projects that were reported in Dodge DataLine as being *started* (all bid selections made, construction to start within 60 days), or *construction* (construction has started). The period for this *snapshot* of new commercial construction in Wisconsin was September 1995 through mid October 1996.

Project report data for all the counties in Wisconsin were identified, extracted and downloaded to a database at HBCI, and then classified into market segments defined by Dodge structure codes (building type), project type (new building or major addition), building floor area (means and totals), ownership (private, government, etc.) and region within the state (NE, NW, SE, SW).

Projects were excluded from the analysis that were not relevant to commercial building commissioning (e.g., road construction, landscaping). The database contained 2,992 projects that were relevant. Key objectives of the sampling strategy were to obtain firms most active in the

market and firms from across Wisconsin—not just the southeast region, which is the most active region because of the Milwaukee metropolitan area. Below we summarize the sampling strategies.

Sampling strategy for building owners

- Include all non-government owners who are linked with five or more projects.
- Complete approximately 5 interviews with government organizations. Eliminate out-of-state owners. Random selection from the remainder who have 5 or more projects in the database.
- Complete approximately 5 interviews from a random sample of owners (government or non-government) who have fewer than 5 projects in the database. After sample is exhausted for non-government owners with 5 or more projects and government surveys are completed, fill in any remaining surveys from this group.

Sampling strategy for architects/engineers, general contractors and HVAC contractors

- Limit sample population to companies in Wisconsin.
- Survey the 5 companies with the most projects, regardless of location.
- Random selection from the remaining companies that have at least four projects in the database.
- Upper limit cap of 8 interviews for each target group for companies in the southeast quadrant of Wisconsin.
- Complete at least one interview for each target group in each quadrant of Wisconsin.
- Since there are fewer HVAC contractors, companies with fewer than 4 projects may be included after the initial list is exhausted.

Application of the sampling strategy yielded a starting sample size of 389, distributed across the four target groups as shown in Table 1. When adjusted for lack of phone numbers and ineligibility, the sample size is 245. A relatively high fraction of the building owners/managers group was ineligible, which greatly reduced the adjusted sample size compared to the other target groups. A total of 141 surveys were completed, distributed across the four target groups as shown in Table 1. Although the number of completed surveys for the building owners/managers group is roughly half that of the other target groups, the response rate is comparable. The difference in number of completed surveys is due to the smaller size of the adjusted sample.

Table 1: Sample Population

| | Building owners and managers | Architects and engineers | General con- tractors | HVAC con- tractors | Total |
|-------------------|---------------------------------|-----------------------------|--------------------------|-----------------------|-------|
| Starting sample | 103 | 97 | 91 | 98 | 389 |
| No phone number | 12 | 3 | 0 | 3 | 18 |
| Ineligible | 55 | 21 | 24 | 26 | 126 |
| Adjusted sample | 36 | 73 | 67 | 69 | 245 |
| Completed surveys | 20 | 44 | 37 | 40 | 141 |
| Response Rate | 56% | 60% | 55% | 58% | 58% |

Firmographics of the Survey Respondents

Representatives from 121 design professionals and contractor companies throughout the state participated in the telephone interviews. Interviews were also completed with 20 building owners or managers. For the design professionals and contractors, each interview began by establishing the type of firm and the primary business conducted. On average, the interviewed design professionals had worked about 12 years in their business.

As part of the background information gathered, design professionals and contractors were asked what percentage of their new construction projects was new buildings and what percentage was major additions or renovations. About 54 percent of their construction projects involved new buildings and 46 percent involved major additions or renovations. About 25 percent of the interviewees' projects were less than 5,000 square feet; 39 percent were in the 5,000 - 20,000 square foot range, and about 36 percent were more than 20,000 square feet.

Interviewees' new construction experience was primarily with office projects (about 50 percent), followed by education, retail, medical, and manufacturing. About 40 percent of these new projects were located in the southeast region of Wisconsin, followed by the south cen-

tral/southwest (21 percent), and the Fox River Valley/northeast (16 percent).

Survey Results

We present only selected results in this paper—mostly questions that address perceptions, attitudes, needs and demand relative to building commissioning. The complete research results and analysis will be published by ECW in fall 1997.

Existing quality assurance practice

The project's working group believed that the term *building commissioning* was not well understood among building professionals and owners. Because of this potential for response bias and misunderstanding, the survey did not introduce the term *building commissioning* until roughly half-way through the interview. Instead, the questions prior to introduction of the term building commissioning used *quality assurance* to convey the same idea as commissioning. The researchers asked a set of questions about existing quality assurance practice and related background information. We present selected questions and results on the status of quality assurance practice below.

Table 2: What formal or informal quality assurance procedures or services, if any, do you use in new construction projects to ensure clients a high quality project?

| | Owners | A/E | GC | HVAC |
|---|--------|-----|-----|------|
| Verification of design and installation of building systems | 65% | 70% | 70% | 45% |
| Testing of building system performance | 45% | 43% | 49% | 38% |
| Training of building operators | 30% | 23% | 30% | 33% |
| Documentation of building systems | 40% | 45% | 38% | 20% |
| None/done only on an as needed basis | 20% | 14% | 24% | 38% |

Table 3: Does your firm always, sometimes, or seldom offer (owners/managers: specify) quality assurance services when bidding (requesting bids) on a job?

| | Owners | A/E | GC | HVAC |
|-----------|--------|-----|-----|------|
| Always | 75% | 71% | 82% | 84% |
| Sometimes | 13% | 18% | 7% | 12% |
| Seldom | 13% | 11% | 11% | 4% |

Table 4: Are these quality assurance procedures or services formally stated or documented in the project bid or design phase?

| | Owners | A/E | GC | HVAC |
|-----|--------|-----|-----|------|
| Yes | 87% | 63% | 57% | 76% |
| No | 13% | 37% | 43% | 24% |

Table 5: Thinking about the mix of business services and products you provide, would you say that the quality assurance services are an integral component of your core business, or a separate component from your core business, provided only upon request?

| | Owners | A/E | GC | HVAC |
|--|--------|-----|-----|------|
| Integral component | NA | 89% | 84% | 75% |
| Separate component, provided only on request | NA | 11% | 16% | 25% |

Table 6: Do the quality assurance services you provide (owners/managers: request) typically apply to the whole building or only to selected systems in the building?

| | Owners | A/E | GC | HVAC |
|------------------|--------|-----|-----|------|
| Whole building | 69% | 69% | 68% | 28% |
| Selected systems | 31% | 31% | 32% | 72% |

Table 7: What selected systems or technologies does your firm most often address with the quality assurance services? (Owners/managers: For what systems or technologies do you most often encounter quality problems in new buildings?)

| | Owners | A/E | GC | HVAC |
|------------------------|--------|-----|-----|------|
| Heating | 81% | 59% | 68% | 88% |
| Air conditioning | 81% | 57% | 64% | 84% |
| Energy mgmt systems | 19% | 11% | 25% | 20% |
| Variable speed drives | 19% | 5% | 21% | 12% |
| Lighting controls | 19% | 19% | 25% | 4% |
| Daylighting | 6% | 3% | 7% | 0% |
| Electrical | 38% | 30% | 25% | 8% |
| Envelope | 25% | 32% | 36% | 4% |
| Plumbing | 25% | 32% | 25% | 20% |
| Refrigeration | 6% | 0% | 0% | 0% |
| Thermal energy storage | 6% | 0% | 0% | 0% |
| Life safety systems | 13% | 22% | 11% | 4% |
| Ventilation | 38% | 35% | 29% | 76% |

Table 8: What criteria are used in determining which systems and/or technologies require quality assurance services?

| | Owners | A/E | GC | HVAC |
|-----------------------------|--------|-----|-----|------|
| Cost of equipment | 44% | 38% | 36% | 36% |
| Presence of controls | 50% | 24% | 25% | 20% |
| Mandates of bids | 38% | 32% | 57% | 48% |
| Complexity of equipment | 50% | 19% | 36% | 40% |
| Known risks/past experience | 69% | 70% | 68% | 52% |
| Liability | 19% | 11% | 18% | 12% |

Table 9: At what stage of the construction process are these quality assurance services **first** performed? (Time scale given (1-11) with major milestones identified.)

| | Owners | A/E | GC | HVAC |
|------------------------------|--------|-----|-----|------|
| 1. Programming | 25% | 41% | 29% | 24% |
| 2. | | | | 4% |
| 3. Schematic design | 31% | 3% | 4% | |
| 4. | 6% | | 4% | |
| 5. Design development | 6% | 14% | 11% | 8% |
| 6. | | | 4% | |
| 7. Bid document development | | 16% | 7% | 12% |
| 8. | 6% | 8% | 14% | 4% |
| 9. Construction/installation | 6% | 14% | 18% | 12% |
| 10. | 13% | 5% | 4% | 4% |
| 11. Acceptance | 6% | | 7% | 32% |

Table 10: At what different points in a project are these quality assurance procedures/strategies performed?

| | Owners | A/E | GC | HVAC |
|-------------------------|--------|-----|-----|------|
| Before construction | 6% | 24% | 11% | 12% |
| Throughout construction | 88% | 68% | 82% | 48% |
| After construction | 6% | 8% | 7% | 40% |

Table 11: What do you see as some of the pricing issues associated with quality assurance? (Check all that apply.) Percentage of “yes” responses.

| | Owners | A/E | GC | HVAC |
|---|--------|-----|-----|------|
| It is perceived as being too expensive. | 0% | 36% | 14% | 25% |
| It is not worth the extra cost. | 13% | 8% | 11% | 8% |
| I don't see pricing as an issue. | 88% | 67% | 79% | 71% |

The survey results suggest that relatively few *formal* quality assurance procedures are regularly used other than the procedure of verifying the design and installation of building systems, which is reported by 65 percent of the owners, 70 percent of the architects/ engineers, 70 percent of the general contractors, and 45 percent of the HVAC contractors. Fewer than half of each group, however, report that they test building systems to assure a high quality project (see Table 2). Training and documentation of building systems also are performed by less than half the respondents (training is performed by only a third of respondents—see Table 2).

While specific quality assurance practices are not performed routinely to a high degree, responses to questions about offering quality assurance in general suggest that most building design professionals and contractors consider this as an integral part of the services they perform (or contract for) as shown in Table 3. This finding reflects the prevailing attitude that everyone wants good quality assurance, but most construction players simply see it as good project management and not a separate, formal set of tasks and responsibilities. Table 11 shows that most owners, design professionals and contractors do not see pricing as an issue associated with the delivery of quality assurance.

Table 7 reveals how well this more informal approach to quality assurance works in practice. Owners report that they encounter quality problems with heating and air conditioning systems 81 percent of the time. Ventilation and electrical problems are the next most frequently reported problems by owners—at 38 percent each. Building envelope and plumbing each are reported to be problems 25 percent of the time by owners. While these relatively high reported incidences of problems with new buildings may not surprise those familiar with the building construction market, such high rates of customer-reported problems would not be acceptable in most other service industries. This finding confirmed that quality *is not assured* in the design and construction of new buildings. This established a clear need for building commissioning as a means to ameliorate these problems.

Awareness and Perceptions of Building Commissioning

Survey respondents were first asked an open-ended question about what the term *building commissioning* meant to them. A follow-up question introduced a definition of the term, then asked, *Had you heard of building commissioning before today?* Table 12 presents the re-

sponses to this question. Additional questions probed perceptions about the barriers, benefits and market for building commissioning. Responses to an open-ended question

about understanding of building commissioning mirror the results below. Most respondents “did not know” or gave incomplete or inaccurate definitions.

Table 12: Awareness of the term, *building commissioning*.

| | Owners | A/E | GC | HVAC | Total |
|------------------------------------|--------|-----|-----|------|-------|
| Heard of bldg Cx before today? Yes | 55% | 45% | 35% | 58% | 48% |

Table 13: *What do you see as the drawbacks, or disadvantages, of building commissioning? (Check all that apply).*

| | Owners | A/E | GC | HVAC | Total |
|---|--------|-----|-----|------|-------|
| No drawbacks/disadvantages | 55% | 48% | 65% | 65% | 58% |
| Unnecessary service | 0% | 5% | 3% | 0% | 2% |
| Undue burden | 0% | 5% | 3% | 5% | 4% |
| Lack of time | 25% | 14% | 11% | 5% | 12% |
| Budgetary constraints | 25% | 18% | 8% | 10% | 14% |
| Has value, but customers don't want to pay for it | 15% | 14% | 5% | 3% | 9% |
| Difficulty in gaining cooperation among all parties | 5% | 9% | 14% | 15% | 11% |
| Lack of expertise and skill in staff | 10% | 7% | 3% | 3% | 5% |

Table 14: *What evidence would you need to see to better convince you of the benefits of commissioning? (Check all that apply.)*

| | Owners | A/E | GC | HVAC | Total |
|--|--------|-----|-----|------|-------|
| None needed, already convinced | 75% | 66% | 73% | 63% | 68% |
| Documentation of direct costs and benefits | 20% | 27% | 14% | 20% | 21% |
| Demonstration/pilot projects | 10% | 14% | 14% | 5% | 11% |
| Testimonials from participants | 5% | 14% | 8% | 8% | 9% |
| Documentation of related benefits | 10% | 18% | 11% | 23% | 16% |

Table 15: *People differ in their perceptions of the potential benefits of building commissioning services. On a scale of 1 to 5, where 1 is strongly disagree and 5 is strongly agree, how strongly do you agree that building commissioning would... (mean responses).*

| | Owners | A/E | GC | HVAC | Total |
|---|--------|-----|----|------|-------|
| Increase the quality/performance of building systems | 4 | 4 | 4 | 4 | 4 |
| Increase the value/profitability of building | 4 | 4 | 4 | 4 | 4 |
| Lower operating costs | 4 | 4 | 4 | 4 | 4 |
| Lower energy use | 4 | 4 | 4 | 4 | 4 |
| Increase utilization of building space | 4 | 3 | 4 | 3 | 3 |
| Increase productivity of building occupants/tenants | 3 | 4 | 4 | 4 | 3 |
| Improve the on-time availability of building | 4 | 3 | 4 | 4 | 4 |
| Reduce costs associated with change-orders | 4 | 4 | 4 | 3 | 4 |
| Detect and correct potential design flaws in the design phase | 4 | 4 | 4 | 4 | 4 |
| Avoid litigation costs | 4 | 4 | 4 | 4 | 4 |

Table 16: *Have you ever worked with a commissioning authority or served as a commissioning authority?*

| | Owners | A/E | GC | HVAC |
|-------------------------------|--------|-----|-----|------|
| Yes, worked with an authority | 0% | 11% | 14% | 15% |
| Yes, served as an authority | 25% | 5% | 5% | 5% |
| No | 75% | 84% | 81% | 80% |

Table 17: *Do you think there is a demand for building commissioning services?*

| | Owners | A/E | GC | HVAC |
|-----|--------|-----|-----|------|
| Yes | 79% | 71% | 65% | 55% |
| No | 21% | 29% | 35% | 45% |

Table 18: *In your opinion, who is creating the demand for commissioning services? (Check all that apply.)*

| | Owners | A/E | GC | HVAC |
|------------------------|--------|-----|-----|------|
| Building owners | 73% | 78% | 83% | 64% |
| Architects | 20% | 25% | 21% | 18% |
| Engineers | 7% | 19% | 8% | 32% |
| General contractors | 27% | 9% | 29% | 14% |
| Other contractors | 0% | 6% | 4% | 0% |
| Tenants/occupants | 7% | 0% | 13% | 0% |
| Equipment distributors | 7% | 3% | 0% | 0% |

Table 19: *What approaches do you feel would be most effective for stimulating and transforming the market for building commissioning? (Open-ended question. Categories below were developed by researchers based on responses.)*

| | Owners | A/E | GC | HVAC | Total |
|--------------------------|--------|-----|-----|------|-------|
| Advertise | 22% | 14% | 7% | 23% | 16% |
| Better education | 22% | 33% | 26% | 23% | 27% |
| Case studies | 6% | 8% | 4% | 0% | 4% |
| Educate the owners | 11% | 28% | 33% | 16% | 23% |
| Provide more information | 11% | 6% | 7% | 10% | 8% |
| Market more | 22% | 8% | 15% | 19% | 15% |
| Through building codes | 6% | 3% | 4% | 3% | 4% |

Table 20: *What groups would be most effective for developing and delivering these approaches and transformation of the market? (Open-ended question. Categories below were developed by researchers based on responses.)*

| | Owners | A/E | GC | HVAC |
|-----------------------------------|--------|-----|-----|------|
| AGC | | 3% | 13% | |
| AIA | 6% | 5% | 6% | |
| Architects/engineers | 28% | 50% | 25% | 47% |
| Building associations | 6% | 3% | | 3% |
| Building owners | 6% | 10% | 9% | 3% |
| Contractors | 6% | 5% | 13% | 8% |
| Designers | | 8% | | 3% |
| General contractors | 6% | | 3% | 8% |
| Government | | 3% | | 3% |
| HVAC contractors | | | 3% | 3% |
| Professional associations | 11% | | 3% | 8% |
| Building inspectors | 6% | | | 3% |
| Trade associations/groups | 22% | 10% | 19% | 11% |
| Advertising firms | | | | 3% |
| Utilities | | 5% | | |
| Equipment manufacturers/suppliers | | | 6% | |
| Financial institutions | 6% | | | |

Table 21: Awareness of the term, *recommissioning*

| | Owners | A/E | GC | HVAC | Total |
|-----|--------|-----|-----|------|-------|
| Yes | 80% | 48% | 35% | 48% | 49% |
| No | 20% | 52% | 65% | 53% | 51% |

The survey included a question on awareness of the term *recommissioning*. Table 21 gives the responses to the follow-up question, *Had you heard of this [recommissioning] before?* The responses to specific questions about building commissioning (and recommissioning) showed that less than half of the interviewees had heard of the term before (Tables 12 and 21). Follow-up open-ended questions that asked interviewees to give a definition of building commissioning as they understood it suggests that even those who reported awareness show incomplete or inaccurate knowledge of building commissioning. When given a standard definition of building commissioning, most respondents did not see drawbacks or disadvantages to it (Table 13). Twenty-five percent of owners, however, did report that *budgetary constraints* are a drawback. Over two-thirds of the respondents need no additional evidence to convince them of the value of building commissioning (Table 14). Despite this apparently high acceptance of the value and benefits of building commissioning, most respondents had not worked with or as a commissioning authority (Table 16). Yet a relatively high proportion of respondents believes that there is a demand for these services (Table 17). This finding was contradicted in the in-depth interviews—most of these respondents did not feel there was a demand for building commissioning.

Key Findings

The research has provided a rich information source for understanding the market for building commissioning in Wisconsin, as well as information on the commercial construction market in general. Below we give the key findings from this research.

- Quality assurance is generally considered an integral service by designers and contractors, but owners report a relatively high rate of quality problems in new construction.

- Building designers and contractors generally do not follow formal quality assurance procedures.
- Building designers and contractors perform elements of building commissioning in providing quality assurance, but not to a high degree.
- Owners report the highest rate of quality problems for HVAC systems.
- Pricing is generally not considered an issue associated with quality assurance.
- Awareness and knowledge of *building commissioning and recommissioning* are relatively low across all target groups.
- Building owners, designers and contractors see clear benefits from building commissioning.
- Barriers to building commissioning cited most often include lack of time, budgetary constraints, and difficulty in getting cooperation among all parties.
- Commissioning appears to be perceived as an extra service that would add to project costs. Quality assurance is not perceived as an extra cost or service.
- Few owners, designers and contractors have worked with or as a commissioning authority, although there is a relatively high perception of a demand for building commissioning.
- Education and marketing are seen as the best means to increase the practice of building commissioning.

Reference

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2. 1996 Proceedings of the 4th National Conference on Building Commissioning, Portland, Oregon, Portland Energy Conservation, Inc.