Research Article

Analysis of Standardization and Guidelines for Facility Condition Assessments

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ABSTRACT

Facility Condition Assessments (FCA's) in the facility management (FM) profession is a growing area of research. However, delivery methods of FCA projects and studies on standardization has largely not been a focus of further exploration. Thus, this research aims to identify a current state of academic research on standardization of condition assessments and FM practitioner perspectives on FCA delivery methods and standardization. Results revealed 75% of participants indicated that no standards were used in conducting their FCA. This study identifies underutilization of standards and guidelines to conduct an FCA and leads to the proposal of three FCA project delivery methods; 1. Conduct FCA's with in-house personnel and resources; 2. Outsource the FCA to a service provider; 3. Hybrid the approach with both in-house and contracted FCA service providers. This research contributes to the body of knowledge by proposing FCA project delivery methods for owners and or operators to consider when deciding to pursue an FCA project. Further, the apparent absence of standards and guidelines use in the practice of FCA's in the FM profession presents an opportunity for future research efforts towards FCA standardization.

Keywords: facility condition assessment; property condition assessment; project delivery methods

Introduction

In the 1940's the United States realized a baby boom following World War II. As boomers aged and population increased, commercial buildings and other facilities experienced a boom in the 1960's to accommodate the growth. The practice of Facility Condition Assessments (FCA's) emerged in the 1980's as an asset management tool for facility managers to identify the emergence of deferred maintenance (Kaiser, 1993). As stock of buildings has aged, so have renovations and attention to lifecycle cost analysis or total cost of ownership methods of asset valuation. FCA's serve both of these strategic planning tactics and provide building owners with a holistic view of their asset condition and performance. Further, FCA results aid in decisions with capital reinvestment and provide building blocks for an organization's portfolio of buildings by use of the FCI (Facility Condition Index) metric.

Standardization research associated with FCA's has largely focused on organization of asset information (Mayo & Karanja, 2018; Bartels, 2014; Grussing & Marrano, 2007). Overall standardization of the FCA process has not been significantly studied and presents an opportunity for new contributions to academia and the facility management profession. This paper organized background information through a review of literature and existing industry standards, then used a qualitative method for data collection. The contributions of the study include findings and discussion connected to research questions which aimed to provide a first attempt at research focused on how a facility manager utilizes FCA's standards in the profession.

The purpose of this study was to 1. Analyze literature to determine to what extent standards and guidelines are referenced in FCA research; 2. Identify how FCA's are conducted and limitations with current industry standards and guidelines. 3. Categorize FCA project delivery methods; 4. Identify future research opportunities. The results of this study revealed FCA project delivery methods for facility managers to consider when designing FCA's for their organization. While a variety of standards and guidelines do exist to support an FCA project, standards and guidelines are underutilized and the industry lacks an integrated asset management and facility management standardization approach to conduct an FCA.

Background and Literature Review

This section identifies literature review search methods used in this study, which included a review of existing research on facility condition assessments and current applicable standards used to conduct or support the practice of FCA's. A comparative analysis of industry standards is presented to illustrate commonalties and gaps in standardization. The literature review connects previous condition assessment research with standards referenced. Lastly, the role of an FCA project manager is reviewed and a lack of standardized approach to conduct an FCA is presented as a research opportunity.

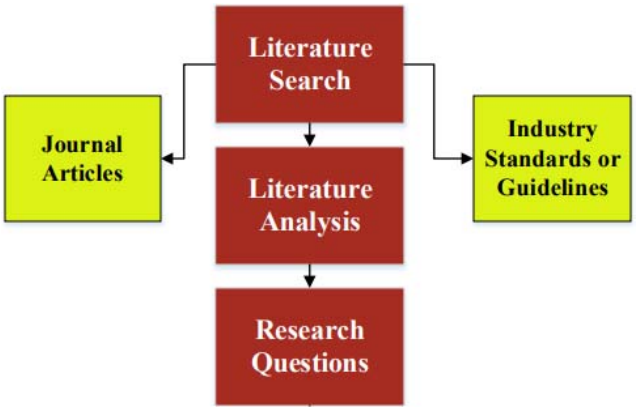

FIGURE 1.—Literature Review Approach

Search keywords "facility condition assessment standards" and facility condition assessment guidelines" were used in Google Scholar, Emerald, Taylor and Francis and Elsevier search databases. The literature search identified 17 articles that include facility condition assessment research and reference standards or guidelines. Journal of Facilities Management (3), Journal of Performance of Constructed Facilities (2) led with the most articles on the research objectives. The remaining 12 articles were located in one journal each, indicating how diverse this research extends within asset management, facility management and facility engineering realms. Comparatively, a search of industry standards and guidelines was performed to identify applicable resources available to the facility management profession to conduct an FCA.

Early Pioneer of the Facility Assessment Process

Origins of the term facility condition assessment (FCA) can be tracked back to as early as the 1970's, when the term "Facilities Audit" was used to describe the method of assessing facilities conditions (Kaiser, 1993). As an early pioneer of the strategic facilities condition assessment model, Dr. Harvey Kaiser introduced a phased approach for methods of conducting a facilities audit that closely resembles some standards FCA providers rely upon today, such as ASTM's E-2018-15: Guideline for Property Condition Assessment (2015).

In his research, Kaiser (1993) introduced the facilities audit process model, shown in Figure 2. This model included a process consisting of four phases.

In Kaiser's model, Phase 1 included designing the facilities audit including determination of scope, selection of the audit team, and identifying a plan to carry out the inspections. Phase II included data collection and preparation of checklists and inspection forms to collect data. Then, physical inspection of systems, building components and assets would be performed and reports would be prepared based upon a functional performance evaluation of the building(s). Phase III summarized the results by evaluating the inspection results, preparing reports, computerize findings and recommending a plan for future audits based upon findings. Phase IV presented the findings to stakeholders and looked to identify the best communicate format for audit results to gain support and put the audit into an actionable plan.

FCA Standards & Guidelines

The authors located 3 standards that provide structure and an administrative framework that detail how an FCA should be carried out. While other standards that compliment or support an FCA do exist (refer to Tables 2 and 3), the three standards selected represented a procedural approach to conducting an FCA.

- ASCE (American Society of Civil Engineers) (2014) Guideline for the Condition Assessment of a Building Envelope
- ASTM E-2018 (American Society for Testing and Materials) (2015) Standard Guide for Property Condition Assessments: Baseline Process
- RICS (Royal Institution of Chartered Surveyors) (2020) Technical Due Diligence of Commercial Property

These standards cast a wide net on the overall facility and property, while one standard focuses on building envelope only. The RICS guidance document is focused on technical due diligence of commercial property (RICS 2020) and differs from ASTM E-2018 standard in that a variable of the assessment procedure is facility operational performance. An additional comparative analysis was performed on the three standards as referenced in Table 1.

A key problem in facility management is that asset data hierarchy standards in facility condition assessments are inconsistent and not standardized. Mayo & Karanja (2018) studied asset hierarchy preferences in FCA processes and found no consensus in utilization of a specified asset organization format (Masterformat, Uniformat or Omniclass). This is compounded by the lack of a common, widespread facility management or engineering standard for asset hierarchy. However, ancillary standards could be used to compliment a comprehensive building assessment, focusing on measurement of building economics, performance and reporting the results of an economic evaluation of buildings and international standards (Chapman and Kasi, 2012). A list of supporting industry standards and guidelines from the literature were identified and is presented in Table 2. A comparative analysis of previous condition assessment research referencing industry standards and guidelines was performed with the intent to better understand frequency of standards applied to research efforts. Results indicated a diverse spectrum of standards applicable to condition assessment research, indicating the broad nature of an FCA project. Refer to Table 3 for a list of standards and guidelines in condition assessment mapped to research efforts.

The FCA Project Manager

With any project, there is a project manager and this is no different with the practice of FCA's. Organizations often

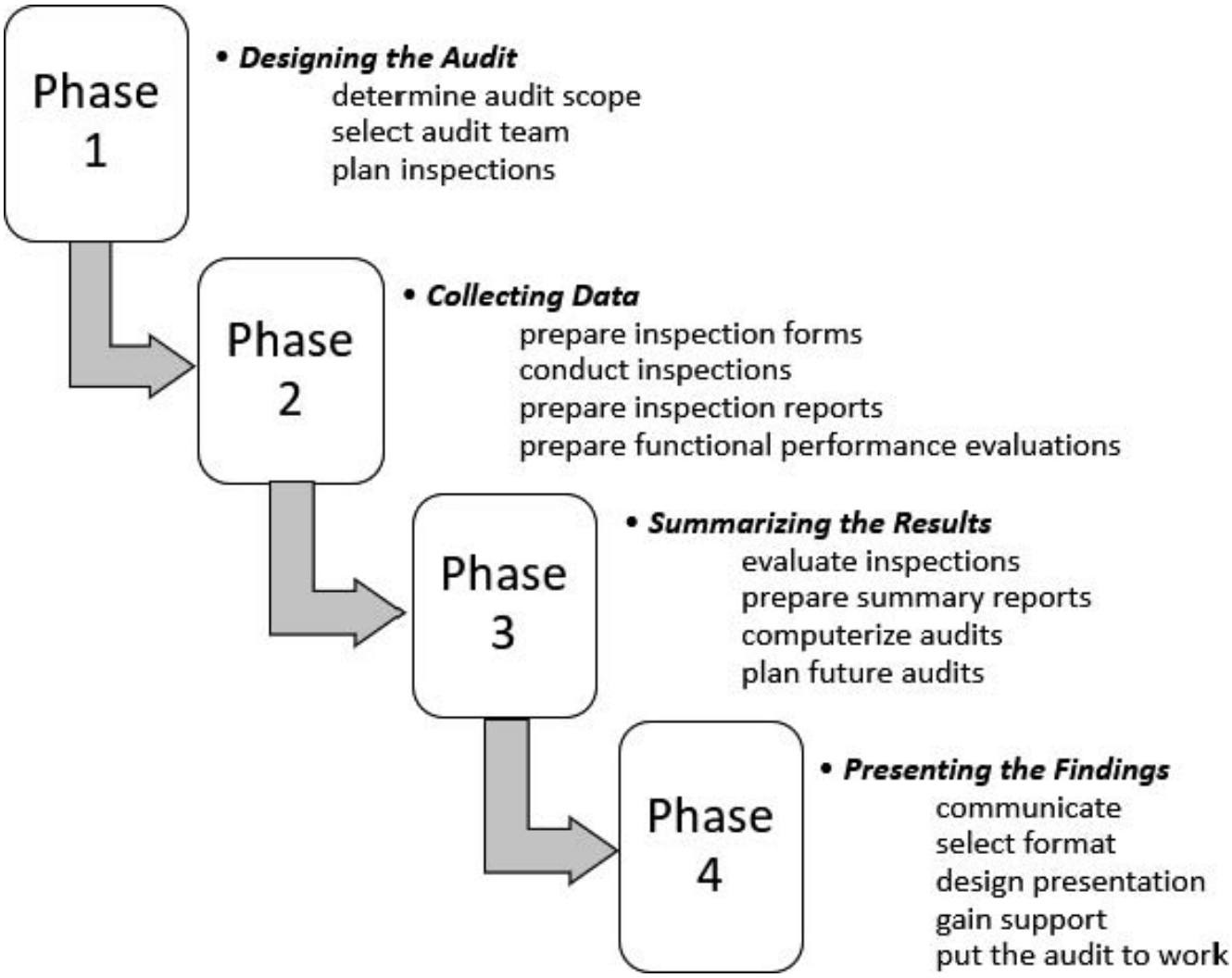

FIGURE 2.—Audit Process Model, adopted from Kaiser, 1993.

TABLE 1.—Comparison of Facility Condition Assessment Standards Criteria

Topic	ASTM E-2018-15	RICS	ASCE (Envelope Only)
Executive Summary	Yes	Yes	Yes
Purpose or Scope	Yes	Yes	Yes
Identification of Client Requirements	Yes	Yes	"base the definition of scope on client needs"
Desk Survey	Yes	Yes	Yes
Walk-Through Survey	Yes	Yes	Yes
Facility Staff Interviews	Yes	Yes	Yes
Opinions of Probable Cost	Yes	Yes	"cost-benefit decision"
Assessor Qualification Criteria	"professional architecture or engineering licensure and or certifications, education"	"lead consultant and specialist consultants"	"technical and practical experience, education, professional judgment"
Maintenance History	"apparent level of maintenance"; identify if a maintenance contract is reported to be in place"	Not identified	"maintenance procedures"
Energy Audit/Performance	"observe energy management systems"	Not identified	"energy usage records"
Limiting Conditions	Yes	Yes	Yes
Exhibits/Photos	Yes	Yes	Yes
FM Sector Specific Guidelines	Not identified	Not identified	Not identified

TABLE 2.—Building Related Standards

Standard	Description
ASTM E 917	Standard Practice for Measuring Life-Cycle Costs of Buildings and Building Systems
ASTM E 964	Standard Practice for Measuring Benefit-to-Cost and Savings-to-Investment Ratios for Buildings and Building Systems
ASTM E 1185	Standard Guide for Selecting Economic Methods for Evaluating Investments in Buildings and Building Systems
ASTM E 2204	Standard Guide for Summarizing the Economic Impacts of Building-Related Projects
ASTM E 1557	Standard Classification for Building Elements and Related Sitework – Uniformat II
CSI	Masterformat – Asset Hierarchy Standard
CSI	Omniclass – Asset Hierarchy Standard
ISO 6241	Performance standards in buildings – principles for their preparation and factors
ISO 9001	Quality Management Systems – Requirements
ISO 14001	Environmental Management Systems – Requirements with guidance for use
ISO 15686	Buildings and constructed assets – service life planning, life-cycle costing
ISO 19650	Organization and digitalization of information about buildings and civil engineering works, including BIM – information management using BIM, Part 1: concepts and principles
ISO 41001	Facility Management – Management systems
ISO 55000	Asset Management – Overview, principles and terminology
ISO 55001	Asset Management – Management systems
BUILDER	U.S. Army Engineering Research and Development Center, Construction Engineering Research Laboratory – BUILDER

assign an internal administrator to oversee a project. FCA project managers could be C-suite administrators or VP level Facilities Directors, Corporate level facility administrators and in some cases, operating facility managers. In any case, the assigned project manager is responsible for determining purpose, scope, budget and how the project will be carried out. Lewis and Payant (2000) advocate that in-house staff should be used to oversee and manage an A-E (architectural-engineering) firm, if outsourced.

The International Organization for Standardization (ISO) has proposed a path forward for procedural stewardship of facility assets which may include the practice of facility condition assessments. ISO presents the value of combining ISO 55001 (Asset Management Systems) and ISO 41000 (Facility Management Systems). ISO (2018) states "implementing ISO 55001 and 41000 empowers organizations to better utilize and manage facilities and assets, focus and optimize activities, and derive the required function and value in order to achieve their objectives." Although this conceptual path shows promise for future FCA standardization, a comprehensive framework that connect the practice of FCA's to ISO's vision has yet to be formally researched or proposed to the FM profession.

TABLE 3.—Standards and Guidelines in CA (Condition Assessment) Research

Reference	Standard or Guideline
Al-Kasabeth, et. al (2020)	Uniformat, Masterformat, Ominclass
Bartels (2014)	ASTM E1557 Uniformat II, ASTM D4788
Besiktepe, et. al (2021)	ASTM E2018-15, ASHRAE 180
Dejaco, et. al (2017)	ISO 55000
Ezovksi (2009)	ASTM E2018-15
Grussing & Liu (2014)	Uniformat
Grussing & Marrano (2007)	ASTM E-1557 Uniformat II, ASTM E-964
Guillen, et. al (2020)	ISO 9001, ISO 1400, OSHA
Jensen & Varano (2011)	ASTM E2018, RICS
Kim, et. al (2020)	ISO 19650
Kooymans & Abbott (2006)	ISO 15686
Loy & Coleman (2006)	RICS (1997-Stock Condition Survey)
Mayo & Karanja (2018)	ASTM E2018-15, Uniformat, Masterformat, Omniclass
ReCecconi, et. al (2018)	ISO 55000
Straub (2003)	ISO 6241
Uzarski, et. al (2007)	BUILDER
Uzarski & Grussing (2008)	BUILDER

A key finding in this literature review is that a framework to conduct an FCA has largely not been researched or presented for the facility management profession. While Kaiser (1993) introduces the Facilities Audit process, which resembles modern day practice of FCA's, research gaps are found in: 1. Selection criteria of an FCA provider and other foundational information requirements; 2. Tools or methods for calculation of remaining useful life of assets; 3. Cost estimation of FCA project recommendations; 4. Strategy of communicating FCA results; 5. Re-assessment practices or protocol.

The literature review and study of industry standards in previous research efforts revealed wide variations of standards and guidelines applicable to FCA's. While three main industry standards that focus specifically on how to conduct an FCA were identified, limited research exists associated with identifying how a facility manager plans for an FCA project.

Research Questions

Using findings from the literature review, research questions were generated based upon FCA standardization and or guidelines to conduct an FCA. This research considers international standards as part of a larger, broader effort to assess the practice of condition assessments in facilities or buildings.

- RQ1: Identify previous condition assessment research that includes references to industry standards and guidelines.

- RQ2: What standards or guidelines are used to conduct an FCA?
- RQ3: How are standards used for FCA's by FM practitioners?
- RQ4: What are the different types of FCA project delivery methods?
- RQ5: What recommendations do FM practitioners have to improve FCA processes?

Research Methodology and Approach

Research questions 1 and 2 were answered as part of the literature review. For research questions 3, 4 and 5, a qualitative study was performed with a subject matter expert panel of Facility Executives (FE's) that have experience with the practice of FCA's. To that end, a subject matter expert panel was assembled to further along knowledge and test the relevance and practicality of literature review findings. Data collection within the qualitative study included recorded semi-structured interviews and each individual session was transcribed in text to document responses and feedback. Themes were then developed based upon responses to help answer research questions.

Subject Matter Expert (SME) Panel

A study with subject matter experts consisting of Facility Executives (FE's) in various sectors of facility management was conducted to validate literature review and expand learning and knowledge on the topic of conducting an FCA and standardization thereof. Participants were initially approached via email and once their participation interest was confirmed, a calendar invitation was sent via email with an attached Zoom link for a virtual meeting. A general study purpose statement was included in the email along with research questions to allow SME's an opportunity to examine the questions being asked of them. SME's were then interviewed via a recorded Zoom session.

The following criteria was established for participant selection: 1. Manage a portfolio of a minimum 500,000 square feet; 2. Participants have either conducted or contracted at least two FCA's; 3. Participants have at least 10 years of FM experience. The data collection focused on current state of FCA standardization and how FCA processes can be improved with standardization efforts. Refer to Table 4 for interview respondent profiles.

Subject matter experts were asked questions that intended to answer the research questions. Each panelist was asked the same questions; 1. Was the FCA conducted in-house or contracted? 2. If contracted, who performed the FCA? 3. Did you use any type of industry standard or guideline to conduct your FCA? 4. What are your thoughts on the utilization of standards to conduct an FCA? After the questions were asked, an open discussion occurred on challenges associated with FCA standardization and recommendations to improve FCA processes.

Findings & Discussion

RQ#3: How Standards are Used for FCA's by Facility Managers

Interestingly, this study revealed that 75% of participants did not use standards or guidelines to conduct an FCA (see Figure 4). There appears to be consensus in this study that FCA's are largely a collaborative effort with contracted service providers as 75% of participants identified their FCA was conducted with both in-house personnel and a contracted FCA service provider (see Figure 5). When a contactor was selected, engineering firms were the most engaged stakeholder, participating in 83% of FCA's (see Figure 6).

A key finding in research by Mayo and Karanja (2018) was the lack of unified standard or approach to conduct an FCA and the systems or components asset identification structure to organize state of condition. In this study, CSI Masterformat, CoBIE, and ASTM Uniformat II were all identified as varying standards for organizing asset data within the condition assessment method, confirming a lack of uniformity and standardization with asset organization methods.

Panelists shared FCA costs vary widely based upon a number of factors; 1. Facility type; 2. Total square footage; 3. Level of analysis. There also seems to be a lack of information requirements within an FCA RFP as most respondents indicated that rather than define specifications and end deliverable requirements, they preferred to evaluate RFP proposals when making their decision on who to select to perform the FCA. Further research could be expanded on this finding to determine if a lack of information requirements within an RFP leads to wide range of overall FCA costs due to a lack of defined scope of services.

How FCA Service Providers are Selected

All expert panelists agreed the most important selection criteria for an FCA assessor is experience in conducting facility condition assessments and experience level with building types for the FCA being performed. Interestingly, 75% of panelists have no standards in their evaluation criteria for selecting an FCA service provider.

Ezovski (2009) recommends that when ordering a facility condition assessment, lenders (or facility managers) should consider adding items to the inquiry that are outside the scope of ASTM's E-2018 standard. As an example, Ezovski (2009) states that "polybutylene piping is not mentioned in the ASTM standard, but it has a history of failing at pipe joints and fittings and is therefore seen as a critical item in existing building condition assessments." Further analysis from within the ASTM E-2018 standard could include operational performance assessment to reflect that of RICS (2020) standard.

A finding from this study was the preference for an FCA provider to hold facility management, engineering or operations experience. Panelists said that when evaluating

TABLE 4.—Interview Respondent Profile

No.	FM Sector	Position	FM Experience	# of FCA's
FE1	Corporate/Office Property Management	Senior VP, Facility Engineering	25 years	11-50
FE2	Higher Education	Director of Facilities	18 years	2-10
FE3	Corporate/Manufacturing	Director of Facilities	20 years	2-10
FE4	K-12 Schools	Director of Facilities and Planning	35 years	50+
FE5	Public Assembly Facilities	Senior VP, Facility Operations	38 years	2-10
FE6	Data Centers	Chief Engineer	33 years	2-10
FE7	Corporate/Office Property Management	Vice President & Senior General Manager	18 years	2-10
FE8	Corporate/Office Property Management	Director of Facilities Management	15 years	2-10
FE9	Utilities & Infrastructure	Manager of Real Estate and Facilities	14 years	50+
FE10	Government – Municipality	Facilities Manager	10 years	11-50
FE11	Financial Services	Senior Director of Facilities and Administration	40 years	11-50
FE12	Higher Education	Vice President, Facilities	36 years	50+

resumes of proposed assessors, one of the major elements they look for is actual experience operating buildings. Panelists also agreed that FCA Request for Proposals (RFP's) are weighted heavily based upon overall cost, building operating experience, and experience assessing facilities that are similar to the type of facility they manage. FE5 shared that in their experience, working with an industry standard as a guide for the FCA has not been effective for making decisions with results from the FCA. FE5 adds:

"Opinions of probable cost and capital expense projections based upon result findings are a base expectation, but I am not interested in someone with a P.E. license or registered architect coming into my building and checking off items on a pre-determined list or standard. I want them to have experience operating buildings, understand the details of facility engineering and be able to provide a functional report based upon their acquired knowledge of building management experience."

RQ#4: FCA Delivery Methods

Three FCA delivery methods emerged from data collection within this study. The first method is an in-house or self-performed FCA by the facility management department. The second is an outsourced service provider and the third is a hybrid approach where the facility management department oversees the project management of the FCA and brings in consultants or engineers to supplement the FCA effort. Regardless of each delivery method, standards or guidelines should be researched for utilization consideration in order to create baselines for how to conduct the FCA.

In-House Method

Mature facility management departments may elect to perform condition assessments of their assets and or systems with in-house personnel. Panelists indicated the utilization of this method is largely dependent on many variables within the FM operation: 1. Availability of front-line engineers and technicians; 2. Current and projected work order backlog; 3. Ability to utilize experienced building personnel; 4. Current and projected renovations or other significant capital projects; 5. Support from C-suite to allocate labor and time for FCA data collection effort; 6. Availability of project cost modeling software or other tools; 7. Availability of asset or equipment useful life determination resources. A key limitation in performing FCA's with only in-house personnel is the possibility of bias in findings and recommendations. Advantages to this method is the asset hierarchy standard is consistent with existing building information and is easier to migrate results into the operating Computerized Maintenance Management System (CMMS) or Enterprise Asset Management (EAM) system the organization utilizes. A key finding in this study was the utilization of FCA's to counter loss of tribal knowledge in facility engineering and management. FE2 states:

"When I arrived in my position 3 years ago, I realized that over 70% of my trades workforce was planning on retiring in the next 5 years. We did not have an asset inventory or documented condition of any of our 55 buildings. I deployed in-house FCA projects every summer, focusing on up to 5 facilities per summer. We selected the oldest and most vulnerable facilities to start. Through this process, we were able to build internal institutional knowledge of our buildings, systems and assets in order to plan our capital allocation asks to funding authorities."

Contracted FCA Service Provider Method

An FCA team can be comprised of stand-alone or combination architectural, engineering and or asset management firms. The topic of FCA service providers' selection criteria and evaluation is not well researched and there are limited literature sources.

Many FM's simply do not have the time and or labor resource pool to conduct a large scale FCA. For this reason, outsourcing of FCA services may be an attractive project delivery method. This method can also prove useful depending upon the purpose or strategic vision of the organization. For example, if the organization is considering using condition assessment results to develop a facilities master plan, the utilization of an FCA team that includes architects could be of value. However, careful consideration should be given based upon recommendations from an architecture firm as overall findings could be motivated by

FIGURE 3.—Research Methodology

business development efforts. The system evaluator, such as a roof consultant should be specified so that assumptions are not made about remaining useful life, as this research found with FE4 and their roof replacement projection. Selman (2002) suggests that "life-cycle planning is a means of budgeting for the cost of replacing subsystems based on their expected design life, or expected time of failure." Some FCA methods of determining asset replacement rely solely on asset useful life / design expectancy life but Selman states further analysis may need attention. Selman (2002) states the expected time failure could be determined by maintenance history on a particular asset, therefore leading to either premature or extended asset life. This is validated by FE4 in their experience of a recent FCA of a portfolio of buildings. FE4 states:

"The FCA indicated that I needed to replace one of the roofs on an elementary building for $750,000. I deployed basic maintenance practices to extend and buy 3 more years of time and used that allocation to fund overdue HVAC upgrades in other buildings. The roof maintenance performed enabled the elementary building to be remain water-tight and no leaks were reported."

Another critical specification in this model is to align the asset data hierarchal standard for the FCA report with existing asset management systems for ease of data and or results migration for continuous use after the FCA is complete.

Hybrid of Contracted FCA Service Provider & In-House Staff

Another form of FCA project delivery could be the combination of using in-house personnel and contracted

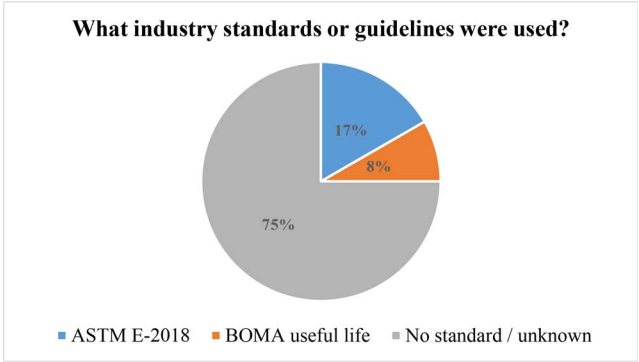

FIGURE 4.—FCA Standards or Guidelines Used by Facility Managers

FCA service providers. This method requires strong detail in the information requirements section of a bid proposal or RFP document. FCA service provider cost estimates or proposals would then include considerations and assumptions of in-house personnel efforts associated with supply of existing information. This information could be in the form of building information (square footage, age), an asset inventory or register, as-built drawings or floorplans, a history of permits pulled through local code office or AHJ (Authority Having Jurisdiction), or other sources of information that would prove useful in starting with more depth from project onset. Naturally, this information could afford lower costs associated with the FCA as the contracted provider doesn't need to spend the necessary hours gathering the data. A current model framework for this approach does not exist in research.

RQ#5: Recommendations to Improve FCA Processes

This study collected feedback from facility executives on how FCA's can be improved and how FCA's improve

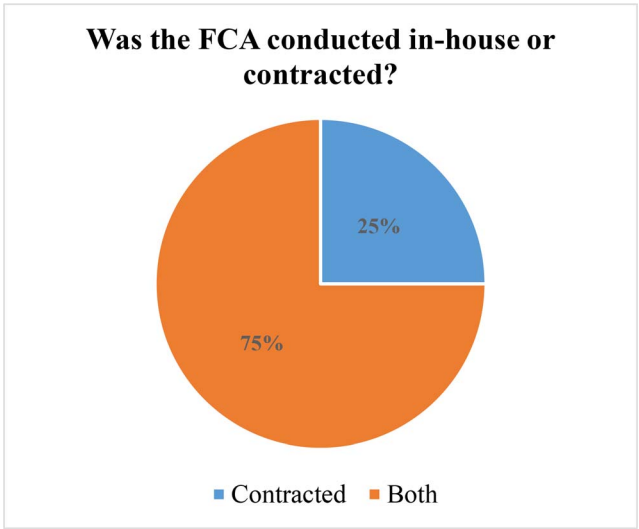

FIGURE 5.—FCA Project Delivery Approach

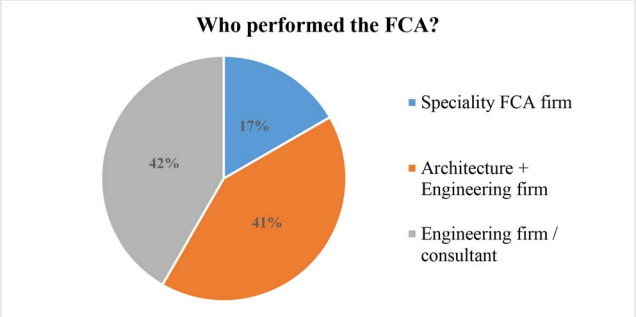

FIGURE 6.—Outsourced FCA Project Manager

organizational performance. The following themes evolved from open feedback on recommendations to improve FCA processes:

Theme 1: Knowledge Transfer and Management

As presented earlier FCA's can serve as a vehicle for in-house personnel to build institutional knowledge of assets and facility systems. FE2 uses the practice of FCA's to capture retiring trades staff tribal knowledge before decades of experience walks out the door. Interestingly, FCA's can also be used for motivational purposes with facility engineering staff. FE2 suggested that FCA results foster transparency and helps staff understand a common goal of keeping a building maintained for the next 30 years, knowing that it will likely not be receiving funding for major capital projects. FE4 adds that FCA's are a great tool for in-house engineers to learn more about the equipment and systems they support. If they are newer to the organization or the building, an FCA can help them learn what they are responsible for.

Theme 2: Integration with Technology for Operational Use

FE3 suggests that an FCA is not a one-time only report and an ongoing relationship with FCA service providers should be pursued as a best practice. The ultimate goal within FE3's organization is to use a software database of FCA information on assets as a living tool, helping with using FCA results in action. FE9 adds that utopia would be FCA data results combined with asset work management systems. This doesn't exist in their organization and is manual process to reconcile data. FE9 states that integration of operational data into FCA would be a huge step forward. The north star that their organization would like to get to is an asset hierarchal system specified in design stage of a construction project and asset data is collected and entered into the same format the Computerized Maintenance Management System (CMMS) and FCA system would use. A key challenge presented by FE9 is keeping FCA results relevant and useful. To that end, integration with work order management systems is crucial to keep in-sync asset data and information.

FE11 would like to see the integration of Building Automation System (BAS) sensors to collect data on system performance to better aid in FCA decision making. FE11 states "as facilities become more sophisticated, it is getting less expensive to install and have sensors for data collection. Increasing remote sensor data collection will allow us to get more data out of our buildings and aid in our decision making."

Theme 3: FCA as a Data Driven Tool to Justify Funding & Organizational Value

FE1 suggests "organizations that fail to have an FCA on-hand tend to operate in reactive mode and could be making poor decisions about some of the infrastructure such as repairing equipment that is 35 years old that should have replaced at year 25." FE2 notes that FCA's are used in their organization to make a decision on whether or not to renovate or perform demolition and build new. FE10 uses FCA's to organize projects and align city departments with a city-wide portfolio view of needs for the organization. With a finite amount of resources, this helps ensure the loudest voice in the room doesn't always receive funds and a more equalized approach can occur. FE12 observed chaotic funding decisions for capital projects without FCA methodologies in place. "The departments that whined the most were getting their projects funded, and when I reviewed the funding requests compared to building condition, I found other buildings in the portfolio that needed work first. Renovations were occurring without design solutions towards energy efficiency and a broader look at lifecycle costs for the organization." FE3 uses FCA's to move the organization forward by telling the story of how their deferred maintenance would multiply and place them in a disaster setting if not paid attention to with significant funding changes. The good news is the decision makers recognized it, understood and the State allowed more dollars to be allocated based upon building age. FE5 summarizes this theme directly by stating "we need more enlightened people to stop making decisions by gut instinct and make decisions with data. In order to have data, you need to compile it. There isn't a facility anywhere that isn't going to be better off without an FCA."

Benefits and Limitations with Current FCA Standards & Guidelines

FCA standards can be useful in the facility management profession. There is an opportunity for facility managers to use standards to communicate base expectations for the delivery of FCA services, thereby increasing transparency of owner expectations and enabling an evaluation criterion of FCA service providers. The problem of inconsistent asset classification standardization use in the facility management profession was first researched and confirmed by Mayo (2018) and validated by this study. Using an asset classification structure aligned with existing asset inventories for the building or portfolio can increase efficiency, speed and interpretation of results since the FCA report is delivered with the same format in which the building operator(s) reference asset data. A standardization method for integrating the practice of facility condition assessments

with asset management and facility management systems could be of value to the FM profession. ISO committees are working collaboratively on this problem in hopes of clarifying benefits and increasing organizational optimization.

Considerations for vague interpretations of scope within studied FCA standards include whether or not a property appraisal is included; forensic studies; specific environmental studies such as mold or asbestos; concealed conditions; utilization of testing and specialized equipment such as thermography and UAD's (unmanned aerial devices) for enclosure or roof imagery; equipment or asset information such as make, model, warranty and maintenance history; energy audits or performance. It is unclear how these considerations are surfaced for discussion in scoping and or identification of FCA owner requirements.

The main limitation of this study is that only facility executives in the United States of America were utilized. Therefore, the results of this study are not representative globally. Thus, results of this study may be different in other parts of the world. Another limitation is the sample may not be generalized by of all subject matter experts in the facility management field and specificity of the sample is acknowledged.

Recommendations for Future Research

Further research could explore frameworks that detail how to conduct an FCA and standardization methods for the practice of facility condition assessments in the built environment in all three FCA project delivery methods proposed in this study. There also seems to be a need for the identification of information requirements within an FCA bidding document (RFQ, RFP or other) in an effort to establish leveled comparisons of proposals for FCA provider selection. This framework may assist in lowering overall costs associated with performing an FCA as service providers can use this information as part of their FCA process and limit the creation of new work. Data from facility managers on whether or not they specified an asset data hierarchy standard in their information requirements within an FCA could further explore standardization themes.

Other future research could include:

- A closer look at asset organization standards of facility managers
- Data collection with facility managers on the three FCA delivery methods proposed as a result of this study
- Future research should explore other sectors of facility management.
- Study that evaluates various standards and guidelines presented in this research study for an integrated FCA delivery method for the facility management profession
- FCA research with integration of standardization methods associated with closely related FM strategic planning topics including, but not limited to;
  - Retrocommisioning
  - Facilities master planning
  - Lifecycle costing
  - Total cost of ownership
- Selection criteria of an FCA provider
- Tools or methods for calculation of remaining useful life of assets
- Cost estimation of FCA project recommendations
- Strategy of communicating FCA results
- Re-assessment practices or protocol

Conclusion

This study aimed to better understand FCA standardization research, if standards and guidelines are used by facility managers to conduct FCA's, and identify FCA delivery methods in the facility management profession. A variety of standards and guidelines have been identified within condition assessment academic research, however 75% of subject matter experts interviewed for this study stated that no standards were used in the administration of FCA's they conducted. Three FCA delivery methods have been identified as a result of this study: 1. In-house/self performed; 2. Contracted; 3. Hybrid of In-house and contracted FCA service provider. Although a variety of ancillary standards and guidelines support the practice of FCA's, there appears to be a gap in the identification of a framework that details how a facility manager or chief decision maker within an organization conducts an FCA. The outputs of this study will be of value to facility owners and or key capital decision makers who are trying to decide which FCA project delivery method aligns best with their organization and what standards or guidelines to consider for overall project adherence.

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