Research Article

Condition Assessments in the Facility Management Profession – A Literature Review

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ABSTRACT

Results from condition assessments can provide facility managers with key insights and knowledge to facilitate strategic planning of an organization's portfolio of facilities. The purpose of this paper is to identify what research has been conducted on the topic of Facility Condition Assessments (FCA) with an emphasis on impact to the facility management profession. This paper provides a structured literature review of assessments performed in the areas of facility, building, and property management. An emphasis of this study was to investigate how previous research supports the decision to pursue an FCA. This study maps condition assessment terminology, analyzes purpose of an FCA through previous research efforts, and proposes to identify future research opportunities that contribute to FCA decision making support for facility managers.

Keywords: Facility condition assessment; building condition assessment; property condition assessment; building evaluation; building performance

Introduction

In some organizations, funding allocations can be a competitive process with many departments advocating for funding levels to meet their organizational objectives. Thus, the facility manager is part of this struggle to justify funding allocations and Facility Condition Assessments (FCA's) can assist with communicating need in an objective and consistent way. Lewis and Payant (2000) explain the need to sell the maintenance program and emphasize that facility managers need to take the offensive and protect physical plant funding through condition assessments. A research study by Jin Lin, et. al (2015) revealed that building condition ranked second amongst 26 factors in procurement selection decision making for Malaysian university facility projects. In the United States, over 5.9 million buildings consume 40% of the nation's energy and half of those buildings were built between 1960 and 1999 with 25% have been built since 2000 (EIA, 2018). With a median construction year of 1982 (EIA, 2018), commercial buildings are getting older while capital funding for facilities is increasingly competitive within a unique societal context.

The lack of care or budget underfunding in many FM sectors can lead to reduced energy efficiency and convincing administrators to fund recapitalization budgets at a level to maintain assets in buildings continues to challenge Facility Managers. As buildings continue to age, the practice of FCA's in the built environment is positioned to offer strategic decision making for organizations and their respective facility management department.

FCA's can be used to fill a void that exists in asset performance documentation. The problem is compounded by lack of asset strategy development in design and construction phases of facility delivery. In some cases, owners and operators do not define their asset performance management strategy during the delivery of a project and therefore require a data collection process on their assets to make decisions during operating phase of the building lifecycle. These decisions may include recapitalization and investment to increase systems reliability, reduce organizational risk and create accurate financial allocation projections over a 5-10 year future outlook.

Origins of the term facility condition assessment 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, Kaiser introduced foundations for methodology used today for conducting a facility condition assessment.

IFMA (2008) defines an FCA as:

> "the structured development profile of existing facilities conditions typically placed in an electronic database format and populated with detailed facility condition inspection information. The FCA identifies existing deficient conditions (requirements) in logical grouping and priorities and also contains associated recommended corrections and corrective

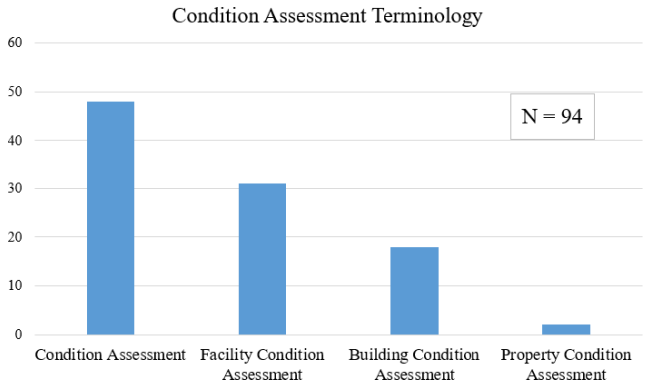

FIGURE 1.—

costs. Costs are generally based upon industry standard cost databases such as RS Means."

Ezovksi (2009) adds that facility condition assessments are often also referred to as engineering reports, a capital needs assessment or a physical needs assessment. IFMA (2008) recommends that FCA's are conducted on a regular basis, approximately every 3 years or conducting a portion of the overall portfolio annually.

This paper aims to address the following objectives: first, to develop an inventory of previous research associated with the practice of condition assessments in facilities or buildings within a built environment context. Secondly, we aim to organize the literature review by themes of varying purposes of conducting a condition assessment. The results of this paper are intended to bring to light research gaps of condition assessment use in the facility management profession and recommend future topics of study to align with industry standards and guidelines.

Research Methodology

This study analyzed and categorized existing research on condition assessments in facility management from 1993 until 2021 by conducting a search of literature. A specific aim of this study was to assess research efforts of facility condition assessments within the built environment, specifically buildings or facilities and their components. An inconsistency identified was the varying terminology used that represents alike meanings within literature. For example, "facility" can also be searched as "building" and "property". As a result, search terms were manipulated to increase connectedness to the practice of facility condition assessments. Further search criteria included topics that may be derived from facility condition assessments; operability, maintainability, decision making for capital projects, asset management, building performance measurement, maintenance management and corporate real estate due diligence. See Table 1 for initial starting point for search terms.

It is noted that internationally, facility condition assessments may be called by other terms such as building evaluations, building quality assessments, property efficiency evaluations, stock condition surveys or facilities audits. An illustration below indicates the diversity of condition assessment terminology within academic research. Condition assessment is the most common referenced term in research with 48 literature sources mentioning the term, followed by facility condition assessment (31), building condition assessment (18) and property condition assessment (2). For the sake of consistency, this study will use the term "Facility Condition Assessment" for terminology.

TABLE 1.—

Facility *and*	Condition *and*	Assessment
Or	*Or*	*Or*
"Building	"Performance"	"Measurement"
Or	*Or*	*Or*
"Property"	"Valuation"	"Management"
	Or	*Or*
	"Operations"	"Evaluation"
	Or	*Or*
	"Operability"	"Benchmarking"
	Or	*Or*
	"Maintainability"	"Diagnosis"
		Or
		"Audit"

All searches were conducted in English and focused on peer-reviewed articles. Textbooks, conference papers, facility management magazines, industry standards and guidelines were included in the literature review. The following databases were used; Google Scholar, Emerald, Taylor and Francis, Science Direct and Elsevier within the range of 1993 to 2021. The above parameters created search results for 124 sources.

A relevancy check of 124 sources was conducted by reviewing the title and abstract to align with the research objectives. A list of 94 sources identified closest related research to the topic of facility/property/building condition

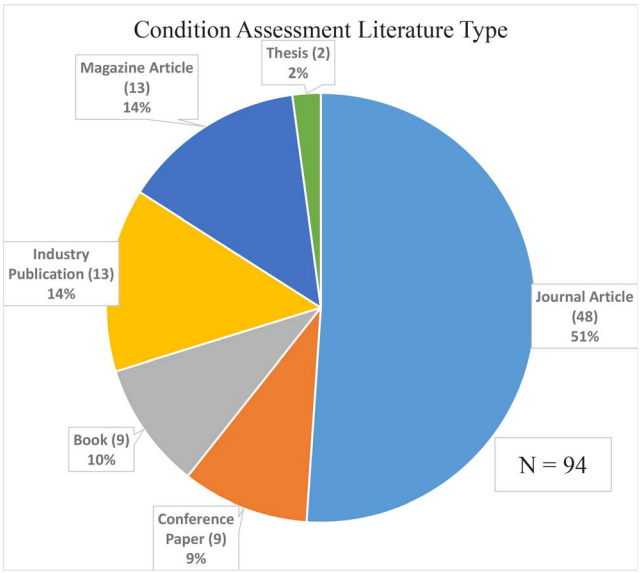

FIGURE 2.—

TABLE 2.—FCA Historical Definitions in Literature Review

Reference	FCA Historical Definition
Rush, Applied Management Engineering (AME) and NACUBO (1991)	A properly designed facility condition inspection program provides a comprehensive evaluation package that can be used to make informed facilities portfolio decisions and consists of two distinct phases; program design and implementation.
Kaiser (1993)	The facilities audit systematically and routinely identifies facility deficiencies and functional performance of facilities through an inspection program and observation reports.
Lewis & Payant (2000)	Process by whereby the organization's facility systems, components and subcomponents are evaluated as to their condition.
Teicholz & Edgar (2001)	Executive tool for both strategic capital planning and tactical project prioritization.
Straub (2003)	A condition survey is a tool in assessing the technical performance of the properties to underpin the long-term maintenance expectations.
IFMA (2008)	The structured development of a profile of existing facilities conditions, typically placed in an electronic database format, populated with detailed facility condition inspection information.
Rose (2007)	The condition of a facility can be assessed in a number of ways, all of which seek to identify, estimate and schedule a facility's maintenance needs in terms of projects or deficiencies.

assessments associated with the facility management profession.

Literature Review Results

Bibliometric analysis results were organized into the following categories: (1) sources by year; (2) type of literature (book, journal article, dissertation/thesis, industry standard or guideline); (3) literature sources by global origin; (4) themes or topics interrelated to the practice of FCA's.

The bibliometric analysis revealed that the largest number of publications over the last 27 years were conducted in the United States of America (49), Canada (5), United Kingdom (3) as shown in Figure 4.

Based upon our selection criteria, the largest number of journal articles in the field of FCA in the facility management profession were published in the "Journal of Performance of Constructed Facilities" with 7 of the total selected articles. This was followed by "Journal of Facilities Management" (6 articles) and "Facilities" (5 articles). Interestingly, articles are widely distributed amongst many journals, indicating the broad nature of FM impact to the built environment profession.

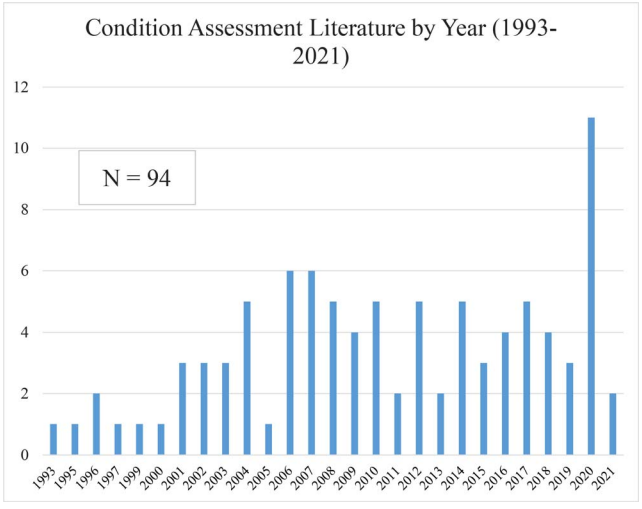

FIGURE 3.—

Literature Review Analysis

Next, we analyzed the literature review sources for condition assessment research themes. Literature sources selected represent research that presented a methodology or framework to conduct a condition assessment of facilities within the built environment. Within each article, a summary of the condition assessment methodology is summarized, mentions of FCA purpose within the article is mapped, and industry standards or guidelines referenced in the article are listed. Themes with purpose of an FCA included asset management/knowledge, capital planning, portfolio benchmarking/use of FCI (Facility Condition Index), risk in the form reliability or uptime, and real estate decision making.

Given these variations in the definition of FCA, the authors define a modern FCA as a systematic and comprehensive condition evaluation of building systems, components and assets for financial, risk and operational purposes in order to optimize performance.

Purpose of Facility Condition Assessments – How are Results Used?

Various purposes for conducting an FCA can be categorized into three categories; financial, risk and

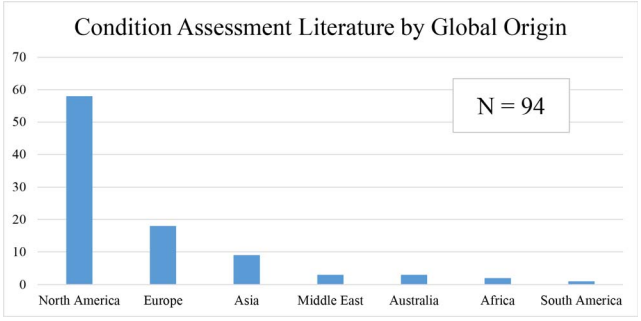

FIGURE 4.—

TABLE 3.—Purpose of Conducting an FCA

Purpose	Reference	Purpose Category		
		Financial	Risk	Operational
Gain a better understanding of the facility (asset knowledge & management)	Lewis & Payant, 2000			X
Build the maintenance backlog and determine priorities	Lewis & Payant, 2000; Rush et. al 1991			X
Identify impending deficiencies before they become major problems	Lewis & Payant, 2000; Rush et. al 1991	X	X	X
Minimize system downtime / increase reliability	Lewis & Payant, 2000; Rush et. al 1991	X	X	X
Extend useful life of the facility	Lewis & Payant, 2000	X		X
Obtain full economical life of equipment through proper maintenance, thereby decreasing the need for additional capital investment.	Rush, et al, 1991	X		X
Maximize energy efficiency	Lewis & Payant, 2000	X		X
Help maintain property value	Lewis & Payant, 2000	X		
Identify long-term issues for capital planning and renewal	Lewis & Payant, 2000; Rush et al, 1991	X		X
Assist in real estate decisions such as "due diligence"	Lewis & Payant, 2000	X	X	
Provide better services to facility occupants	Lewis & Payant, 2000	X		X
Improve communication among maintenance personnel, project managers, supervisors, engineers	Lewis & Payant, 2000			X
Enable better trained maintenance workforce	Lewis & Payant, 2000			X
Achieve productivity improvements by correlating priority maintenance workloads with workforce labor availability and scheduled material procurement.	Rush, et al, 1991	X		X
Enhance personnel safety by identifying potential hazards	Rush et al, 1991		X	
Reduce the overall costs of maintenance by initiating early corrective actions in lieu of reacting to later breakdowns	Rush et al, 1991	X	X	X
Reduce the frequency of trouble calls through proactive maintenance so that less resources are expended on crises, thereby enabling the preventive maintenance program to become more effective.	Rush et al, 1991	X		X

Adopted from Lewis & Payant, 2000

operational. Overall, limited research exists validating the purpose of FCA's in the facility management profession. Karanja and Mayo (2018) primarily researched purpose as it relates to how results are organized and delivered, but also noted consensus (87.5% of panelists in a Delphi method study) that an FCA report is used to prioritize capital spending. Further, Lewis and Payant (2000) validated use of FCA's for financial purposes to aid with capital projects, renewal and replacement projects or asset replacement due to deferred maintenance.

Building codes and environmental regulations are constantly changing under new federal, state and local policy changes. The evolution of facility technologies and emergence of smart buildings have accelerated the pace at which facility managers need to adapt. Facility condition assessments can help keep facility managers informed of these changes, reduce organizational risk and level-load capital funding projections. Lewis and Payant (2000) and Rush, et al (1991) identify purposes of an FCA. These purposes are organized into financial, risk or operational categories by the authors in Table 3 below.

Lewis and Payant's purpose variables (2000) can also be categorized into 5 main themes; asset management, capital planning, portfolio benchmarking, real estate decisions and risk management. Using the formula below, 94 (N) literature sources identify asset management (P1), capital planning (P2) and portfolio benchmarking (P3) as leading purposes for conducting an FCA. See figure 1.7 for statistical analysis of FCA purpose.

$$\text{FCA Purpose} = \frac{\text{P1 or P2 or P3 or P4 or P5}}{\text{N}}$$

In addition to mapping purpose of an FCA to the review of literature, the authors summarized previous research attempts to propose condition assessment methodologies. See table below for reference.

Capital Funding Allocation Decisions

Karanja (2017) states the FCA report is a starting point for the extensive scoping of a project and should feed directly into a budget approval process with the items most in need listed with associated costs which are used externally and politically to allocate funds. A funding success story in Malaysia helps shed light on the value of facility condition assessments in winning the battles associated with capital funding requests within organizations. Jin Lin, et. al (2015) discovered that building condition ranked second amongst 26 factors in procurement selection decision making for Malaysian university facility projects. That is, building condition results provided great influence on funds distributed. A review of current facility condition assessment standards indicates

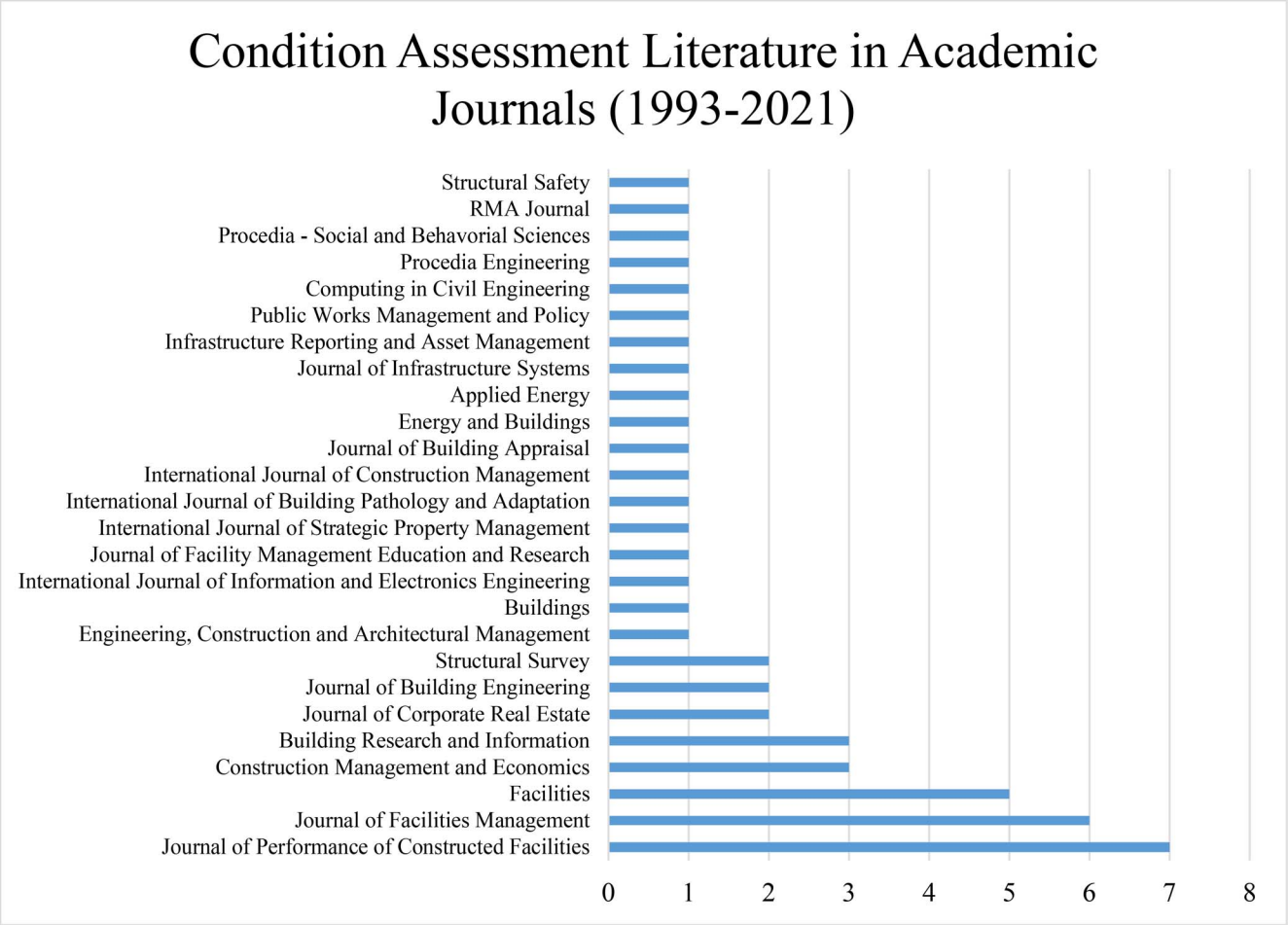

FIGURE 5.—

reports should include either opinions of probable cost or cost-benefit decision models for capital funding allocation decisions (ASCE, 2014; ASTM 2015; RICS, 2020).

Alignment of Organizational Strategy with Facility Condition – The FCI

An effective strategy for managing an institution's facilities portfolio must begin with the development of an accurate, detailed database of the condition of facilities organized in a way that supports continuing analysis, decision making, and effective corrective action (Middelton, 2003). The effect of funding levels and backlog is often referred to as the Facilities Condition Index (FCI). This method aggregates condition of multiple facilities in an organization's portfolio. FCI values can be mapped to a visual representation of overall portfolio condition, thus aiding funding allocations to be prioritized to buildings with the highest FCI. Decisions to buy, sell, lease or reinvest can be tied to FCI measures of buildings within an organization's portfolio. Researchers (Hegazy, et. al, 2010; Salim & Zahari, 2011; Dejaco, et. al, 2017) have identified condition indicator frameworks stemming from FCI methodology.

As literature states, an FCI metric serves as a base starting point for the economic repair, replace or renovate evaluation within an organization's portfolio of buildings. Given these variations and evolution of metrics in the definition of FCI, the authors define FCI as a strategic computational facilities portfolio performance metric that could include multiple variables driven by organizational standards and overall mission.

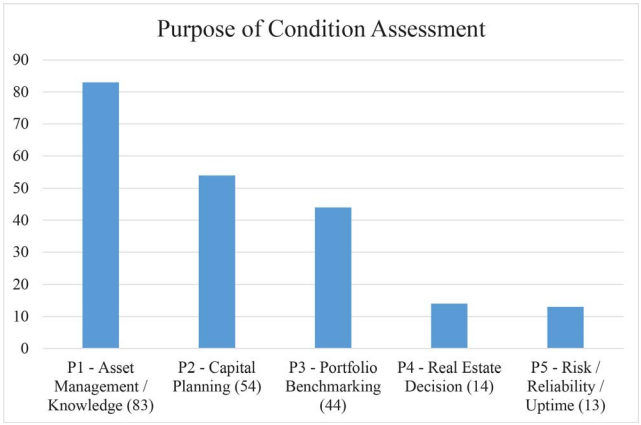

FIGURE 6.—

TABLE 4.—Condition Assessment Methodologies

	Purpose of Conducting FCA					
Reference	P1	P2	P3	P4	P5	Proposed Methodology to Conduct FCA
Abbott, et al, (2007)	X	X		X		South African condition assessment system and process including a five-point color coded rating system
Al-Kasasbeh, et. al (2020)	X					asset inventory and classification framework based upon WBS (work breakdown structure) as a basis for asset management and or condition assessment process
Bartels (2014)	X	X	X			use of SMS BUILDER for alternative methods to perform on-site FCA's in an attempt to reduce engineering and subject matter expert resources required.
Bartels (2020)	X	X	X			conceptual model supporting building system condition assessment and MR&R (maintenance, rehabilitation and repair) through analysis of interactions with building components
Besiktepe, et. al (2021)	X	X	X			Condition assessment framework using a range of variables towards reducing subjectivity.
Bortolini & Forcada (2020)	X			X		proposed condition assessment model based upon review and evaluation of 1974 defects and 5373 maintenance requests in forty buildings
Brandt & Rasmussen (2002)	X					European method (TOBUS) using physical degradation attributes coupled with checklists to determine condition, obsolescence and cause of complaints from users on IEQ (indoor environmental quality)
Dejaco, et. al (2017)	X	X	X		X	Proposes two types of KPI's (key performance indicators) to assist with operation or purchase. 1) technical index which consists of traditional physical degradation and maintenance findings and 2) documents index which looks at presence of legal documents or as-builts.
Ellingwood (1996)	X			X		Reliability framework for structures that organizes information for engineering decisions.
de Oliveira, et. al (2008)	X					Portuguese method for building condition assessment consisting of six phases that define objectives and present inspection criteria to further aid landlords with repair decisions.
Eweda, et. al (2015)	X					CA building asset hierarchy model with space as an element of evaluation.
Ezovski (2009)	X	X			X	Property condition assessments used as a decision support tool for lending decisions or prepurchase due diligence
Faqih, Zayed & Alfalah (2020)	X					Three-tiered building inspection framework assessing severity of defects
Grussing & Liu (2014)	X	X	X			Framework that uses multiple work activities considering condition, capability, performance and life cycle costs.
Grussing (2018)	X		X	X		This approach considers the time since the last inspection occurred, the expected condition state of the component, the risk consequence associated with failure, and the cost of risk mitigation related to proactive repair or replacement activities.
Guillen, et. al (2020)	X			X		Integration of FCA's with continuous improvement tools for the manufacturing sector.
Hegazy, et. al (2009)	X	X		X		Used reactive maintenance data (number of work orders and cost of reactive work orders) to develop indicators aimed to reduce subjectivity, cost and time in conducting inspections.
Jensen & Varano (2011)	X				X	Interviewed six consultants to ascertain opportunities for improvement in the practice of technical due diligence with buildings.
Jones & Sharp (2007)	X	X	X	X		Organizational strategy alignment that integrates corporate performance and asset maintenance practice.
Kim, et. al (2020)	X					Information commissioning study of asset information within a project context. Identified opportunities for owners to better define and articulate information requirements up front.
Kim & Ebdon (2020)	X	X				Capital allocation study that analyzed funding levels in 10 counties in the U.S. through interviews with 20 officials. Identified themes including four challenges and two efforts to improve maintenance through cost management.
Kooymans & Abbott (2006)	X		X		X	Developed a service life asset management and valuation model used for a portfolio of real estate assets.
Lavy (2008)	X	X	X			Academic course designed to teach students FM practices including the practice of benchmarking and condition assessments.
Lavy, et. al (2014)	X	X	X			Simulation of a single system lifecycle via deferred maintenance and condition indexes as part of KPI's

TABLE 4.—Continued.

Reference	Purpose of Conducting FCA					Proposed Methodology to Conduct FCA
	P1	P2	P3	P4	P5	
Loy & Coleman (2006)	X	X		X		Approach in which building systems can be appraised in order to provide budgetary advice specific to occupier's risk.
Marzouk & Seleem (2018)			X			System dynamics model using energy performance data in relation to operational costs and other variables as a building performance measure.
Mayo & Karanja (2018)	X	X	X			Delphi study with an industry panel resulting in the discovery of the lack of an assessment method for data collection and lack of proper categorization of assets, resulting in reduced use of CI metrics.
Rececconi, et. al (2018)	X	X	X		X	Literature review of the FCI metric. Results indicated that FCI should be tied to a strong CA framework and identified varying methodologies for computation of DM and CRV.
Salem & Elwakil (2020)	X	X				ACA (asset condition assessment) model for healthcare facilities using AHP (analytic hierarchy process) and regression techniques.
Selman (2003)		X	X			Use of lifecycle systems analysis coupled with FCI to create defensible recapitalization forecasts.
Selman & Schneider (2004)	X	X	X			Lifecycle costing model developed for NPS (National Park Service) via an integrated asset management program, including FCA's.
Straub, 2002	X					Dutch research effort to analyze condition assessment methods and defects using a six point scale.
Uzarski, et. al (2007)	X	X	X	X		KBCSI (knowledge-based condition survey inspection) approach that uses more information and less inspection efforts.
Uzarksi & Grussing (2008)	X	X	X			Identified two categories of building condition assessments; 1) monetary derived (FCI); 2) engineering derived (BCI). In this research, BCI is referenced as a performance metric.

Using Facility Condition Assessments for Decision Making in Facility Management

Grussing (2018) suggests many federal agencies with large facility portfolios have recognized the need for facility inspections to support effective asset management and decision making. Cable, et. al (2005) warns of outcomes of decisions not to invest in improvements. Organizations could realize future effects on cost avoidance, reliability, operating costs, life-cycle costs, facilities condition, space utilization, customer satisfaction and business effectiveness (Cable, et. al 2005). Dejaco, et. al (2017) states;

> "the periodic assessment of the condition of an asset, together with detailed reporting, is a critical activity in the facility management field; the joined information given by indexes and diagnostic forms allow decision-makers to base their choices about assets on reliable data, avoiding most of the consequences of the lack of information in property and facility management."

Real Estate Decisions

Facility condition assessment results can be useful in aiding real estate decisions associated with buying, selling or whether or not to lease a building. In a lease scenario, FCA results can be particularly effective with negotiation of a triple net lease or other lease structures. Kooymans and Abbott (2006) emphasize "effective service life asset management and valuation has been demonstrated to be useful in managing and in valuing a diverse portfolio of real estate assets, while providing reliable data to assist in making corporate decisions that depend upon to any extent on understanding the issues of life-cycle maintenance and renewal." Ezovki (2009) presents a case for lenders (or buyers) to consider a detailed facility condition assessment as part of their due diligence in deciding whether or not to proceed with purchase of a property.

Legal decisions associated with real estate can realize benefits from facility condition assessment results. Jensen and Varano (2011) present three primary types of comprehensive due diligence so that buyers learn enough to begin formulating their strategic business plan to implement under their ownership. Financial, legal and business factors serve as the basis for a DD process but environmental and technical due diligence has increasingly become more popular in the evaluation of constructed facilities (Jensen and Varano, 2011). Leaman, et. al (2010) notes building evaluations can assist in providing a duty of care for building occupants. Consider an assessment that reveals a stair tread has deteriorated and occupants may misjudge distances and trip. A documented discovery of this unsafe condition as well as many others could assist in reducing risk for the organization. In response to the importance of due diligence, RICS (2020) developed guidance for the facility management profession via their publication, "Technical due diligence of commercial property."

Asset Management Decisions – Life Cycle Cost and Total Cost of Ownership

A key finding and consistent theme in the literature review was the belief that condition assessments are a foundational element of asset management. Eweda (2010) argues;

TABLE 5.—FCI & Variations of FCI Definitions in Literature Review

Reference	FCI Definition
FCI (Rush & AME, 1991)	Cost of deficiencies divided by current replacement value
FCI (Clayton, 2002, p. 147)	Deferred maintenance plus capital renewal divided by current replacement value
FCI (Rose, 2007, p.33)	The sum of projected maintenance needs divided by the facility's current replacement value
FCI (Teicholz & Edgar, 2001)	A ratio used to measure the relative condition of a single building or portfolio of buildings taking into account either a specific priority system or all systems.
FCI (IFMA, 2008)	A comparative industry indicator/benchmark used to indicate the relative physical condition of a facility, group of buildings, or entire portfolio "independent" of building type, construction type, location or cost.
FCI (APPA, 2017, p.32)	An index that compares the cost to repair facility conditions to the cost of replacing the facility with the same amount of square footage.
FQCI (Kaiser & Davies, 2001, p.9.13)	Facilities Quality Condition Index – ratio of cost remedying facilities deficiencies to current replacement value.
FVI (FacilitiesNet, 2021)	Facility Value Index – metric that includes value proposition centered on investments to increase business practices and or increase revenue.
ACI	Asset Condition Index
API (FacilitiesNet, 2013, Rose, 2007 p. 55)	Asset Priority Index – contribution of each asset to achieve organizational mission.
EFCI (APPA, 2017, p.32)	Extended Facility Condition Index. Current deferred capital renewal (DCR) plus future renewals divided by current replacement value.
FQI (APPA, 2017, p.32)	Facilities Quality Index. Current deferred capital renewal (DCR) plus future renewals plus energy efficiency measures plus adaptation or programmatic needs divided by current replacement value.

> "condition assessment is the most important stage during the asset management process as it determines the starting point for other stages – determining repair, rehabilitation or replacement decisions."

Asset identification and inventory creates a base for a facility condition assessment and therefore asset management has a close relationship with facility condition assessments results. Gallaher, et. al (2004) states;

> "the deteriorating condition of public sector facilities is attributable, in part, to the failure to recognize the total costs of facility ownership. Contributing variables within this TCO model include activities required to provide necessary building services to the facility occupants, building maintenance (preventative and corrective), space and move management, health, safety and environmental management, janitorial, grounds keeping, pest control and snow removal services."

The literature review identified facility condition assessments as a tool for lifecycle cost and or total cost of facility ownership (APPA, 2017; APPA, 2019; Lavy, et.al, 2014; Uzarski, et. al, 2007; Selman, 2003; Selman & Schneider, 2004; Jones & Sharp, 2007; Loy & Coleman, 2006; Kumar, et. al, 2010; Salvado & Azevedo, 2019; Kooymans & Abbott, 2006; Rose, 2007; Grussing & Marrano, 2007).

FCA as a Tool for Building Performance Evaluations

FCA's can be a starting point for a broader effort to measure other strategic facility planning initiatives such as reliability, uptime, operability, maintainability, total cost of ownership, life cycle costing, energy management and facilities master planning. All of these facility performance evaluation methods play a crucial role in alignment with organizational core objectives and business continuity. Abbott et. al (2007) adds that "building performance can be measured in many ways, the most common is condition. The building's condition gives a measure of the effectiveness of current maintenance programs because it determines useful life of components or systems and compares it with full economic life expected, given good maintenance."

The connection of FCA's to building performance and evaluation has been studied (Lavy, et al, 2014; Shohet, 2003; Leaman, et. al, 2010; Støre-Valen & Lohne, 2016; Finch, et. al, 2007; Douglas, 1996; Grussing & Liu, 2014; Rose, 2007) and despite attempts to improve the process (see Table 1.4 for CA methods research efforts) a simplified guide for a facility manager to conduct an FCA still does not exist.

Discussion

Results of the literature review analysis indicate that significant condition assessment methodologies have been proposed for facility managers to reference for applied practice. The majority of these methodologies are complex, sophisticated and may require time for implementation that a typical facility manager does not have. There is a need for a simpler, more practical framework that identifies how a facility manager should start the process of considering using an FCA in their portfolio of facilities.

Interestingly, asset organization and data hierarchy continue to create inconsistency for the practice of condition assessments in facilities. Literature indicated an assortment of asset data hierarchal systems including Uniformat, Masterformat, COBie, Omniclass and others. This is a problem that can be traced back to design, construction and handover of building information to owners or operators due to the lack of an asset performance strategy and or integrated asset management software system identified in design phase. Although APPA (2017, 2019) has made considerable strides to map ISO standards to asset management and total cost of ownership, a lack of

standardized asset data organization with universal application effects utilization of a national or global standard for conducting a condition assessment in facilities.

Surprisingly, limited research has been performed connecting risk management or real estate decisions to the practice of condition assessments in the built environment.

Recommendations for Future Research

Future research could identify industry standards and guidelines as well as a review of existing frameworks that map the process of conducting a condition assessment in facilities or buildings. Alignment of existing industry standards and guidelines such as ASTM, APPA, ISO, RICS and ASCE to previous research efforts and textbook content could assist in the creation of a relevant and practical FCA framework or guide for a facility manager to conduct an FCA. Other future research opportunities include:

- A framework for conducting an FCA either with in-house personnel, external service providers or a hybrid of both.
- Future research with the practice of condition assessments should investigate what types of firms are providing FCA services
- There is a lack of mechanism to evaluate and select architectural, engineering, asset management or specialty consulting firms for conducting an FCA.
- A framework is needed for the identification of FCA information requirements standards, rubrics or assessments
- There is a need for quantitative research with facility managers and or C-suite decision makers on the current practice of FCA's
  - Purpose of conducting an FCA
  - How the FCA was conducted
  - Who performed the FCA
  - How results were used for decision making
  - Satisfaction levels of FCA's
  - Limitations of FCA's
- There is a need to develop quantitative measures for FCA research by FM sector (healthcare, higher education, K-12, public assembly facilities, industrial, retail, commercial office and other facility types)
- Asset management performance with and without utilization of condition assessments should be investigated.
- A framework is needed to connect risk management, reliability, up-time and organizational business continuity to FCA's.

Conclusion

A literature review of condition assessments in the built environment was conducted to identify purpose of an FCA and identify research gaps that exist. Inconsistency with condition assessment terminology in academic research may hinder future research efforts and clear search criteria affords holistic condition assessment research efforts. Historically, results indicate that significant research on condition assessments has been conducted in North America and an upward trend is developing internationally, with 10 sources of literature in 2020. A review of methods within the literature indicated that a good amount of research has been conducted on the approaches to measurement of condition and grading criterion. Literature analysis revealed the most dominant themes for FCA purpose are asset management, capital planning and portfolio benchmarking. However, research associated with alignment to industry standards, a multi-phased approach to conduct an FCA, and identification of information requirements to conduct an FCA is limited. Further research is needed to advance these critical topics within the practice of condition assessments in facilities.

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