Regular Article

An Educational Framework for Healthcare Facility Management: Preparing Future Professionals

Steven Call[1], Kenneth Sullivan[1]

[1]Arizona State University

ABSTRACT

Purpose—The purpose of this research is to better understand learning outcomes essential for college students to be effective entry-level healthcare facility managers, establishing a healthcare FM education framework to further open FM academic programs as a sustainable source of new talent for the healthcare FM industry.

Design/methodology/approach—A Delphi method was used for this research to draw upon the collective knowledge and experience of 13 experts over three iterative rounds of input. Phone interviews were also employed.

Findings—This study shows that gaps exist in student learning outcomes for a comprehensive healthcare FM education; key technical topics specific to the healthcare industry are not being addressed by organizations accrediting construction and facility management academic programs. Many of these student learning outcomes could be readily combined into existing learning outcomes or used to develop a comprehensive healthcare FM education covering accreditation, regulatory and code compliance, infection control, systems in healthcare facilities, healthcare construction project management and methods, and clinical operations and medical equipment. Interestingly, academics in the field of FM generally disagree with industry professionals that these technical topics are important student learning outcomes. Consequently, FM academics prefer to teach students general FM principles with the expectation that specific technical knowledge will be gained in the workplace after graduation from college. Nevertheless, candidates attempting to enter healthcare FM without industry specific knowledge are disadvantaged due to industry perceptions and expectations. University-industry linkage must be improved to successfully attract students into the field of healthcare FM and open colleges and universities as a sustainable recruitment source in helping address FM attrition.

Originality/value—This paper is valuable in establishing a healthcare FM education framework to elucidate college student learning outcomes upon graduation for successful employment as an entry-level healthcare facility manager. These student learning outcomes provide a framework for healthcare FM education to be used by industry and academia in preparing future professionals.

Introduction

The healthcare facility management (FM) workforce is aging with no clear path to replace the many professionals retiring within the next decade (Call et al, 2018b). Historically, the FM industry has relied on promotion from the building trades to address management attrition (Sullivan et al., 2010); however, this succession model appears unsustainable as the building trade workforce is experiencing a talent shortage of their own while taking almost two decades to prepare building tradespersons for entry-level healthcare FM jobs (Benavot, 1983; Bigelow et al., 2017; Call et al., 2018b).

Colleges and universities would seem to be a likely source for new talent in addressing healthcare FM attrition as colleges and universities are the primary recruitment source for most organizations seeking highly-capable new talent (Lindquist & Endicott, 1986; Perna, 2003; Howard, 1986; Miner & Wachtel, 1995), there is a strong industry demand for built environment graduates (Bilboa et al., 2000; Cabral & Mindonca, 2012; Christofferson et al., 2006), and younger professionals prefer to enter healthcare FM through the path of higher education (Call et al., 2018b). Notwithstanding the rationale for leveraging colleges and universities as a key source for new talent, Call et al. (2018b) explained that the healthcare FM industry is recruiting and hiring very few new college graduates for entry-level jobs even among new graduates with FM degrees; this hiring dearth may be due to several issue including low pay and an expectation that candidates possess many years of full-time trade experience. There also appears to be a gap between the industry's expectation of entry-level facility manager competencies and contemporary student learning outcomes at FM academic programs. The purpose of this research is to better understand learning outcomes essential for college students to be effective entry-level healthcare facility managers and establish a healthcare FM education framework to further open FM academic programs as a sustainable source of new talent for the healthcare FM industry. This research does

not seek to establish FM academic program curriculum, nor does it attempt to project necessary supply of future healthcare facility managers.

Literature Review

An extensive literature review found limited published research on student learning outcomes for healthcare FM education. In the United States, accreditation of colleges, universities, and academic programs are performed by private organizations. There are three types of accrediting organizations: regional, national, and programmatic. The United States Department of Education (USDE) and the Council for Higher Education Accreditation (CHEA) are the foremost organizations that officially recognize these accrediting organizations (CHEA, 2016; CHEA, 2017). For accrediting organizations to receive official recognition by CHEA or USDE, they must meet eligibility requirements and supply information to enable a review process that assesses if accreditation is warranted (CHEA, 2016). These requirements are established to ensure that accrediting organizations have standards that advance academic quality, demonstrate accountability to the public and community, and encourage improvement for sustained student achievement (CHEA, 2010).

Most healthcare FM professionals that entered the industry as full-time college students graduated from undergraduate programs in engineering, construction management, or facility management (Call et al., 2018b). The Accreditation Board for Engineering and Technology (ABET), the American Council for Construction Education (ACCE), and the Facility Management Accreditation Commission (FMAC) are the programmatic organizations accrediting engineering, construction management, and facility management academic programs, respectively. Programmatic accrediting organizations review educational programs to ensure students receive training consistent with standards for entry into practice within a specific profession or field of study. Both ABET and ACCE are currently recognized by CHEA and had previously been recognized by USDE; FMAC is not, and has never been, recognized by either CHEA or USDE (CHEA, 2018).

Student learning outcomes are established by ABET, ACCE, and FMAC to assess student achievement and ensure a minimum level of learning for graduation from an accredited undergraduate degree program (ABET, 2017; ACCE, 2017; FMAC, 2017). Battersby (1999) defines learning outcomes as what a student should know or be able to do upon completion of a course or program, combining the effective use of skills and knowledge. Accordingly, a primary goal of the FMAC is to ensure FM college students acquire the skills, competencies, and knowledge to positively impact employer organizations (FMAC, n.d.). Call et al. (2018b) explained that although new FM college graduates entering healthcare FM typically have no full-time work experience, they appear to quickly and add value to their employer evidenced by similar promotion timeframes compared to those with many years of trade, management, and healthcare experience. Remarkably, there currently exists a general industry perception that new FM college graduates do not possess the necessary skills to be effective entry-level healthcare facility managers; yet the more familiar healthcare FM professionals are with FM students, the more likely they are to have a favorable opinion on this matter. Likewise, healthcare FM professionals that actively recruit or hire new FM college graduate believe they do indeed possess the necessary competencies for success in entry-level FM jobs, except in the area of industry knowledge. The American Society for Healthcare Engineering (ASHE) recently defined eight essential competencies for senior-level healthcare FM roles (See Appendix D), listing the skills, talents, and traits necessary to adequately perform the tasks of a director-level healthcare FM professional (ASHE, 2018; Kurian, 2013). However, understanding the distinct competencies, specifically around industry knowledge, expected for entry-level healthcare facility managers is warranted to elucidate student learning outcomes and develop a framework for healthcare FM education.

Methodology and Data Collection

Hypothesis

The review of literature provided a foundation for current student learning outcomes at accredited engineering, construction, and facility management undergraduate programs (See Appendix A-C). However, there was insufficient data to determine if any student learning outcome gaps exist for a comprehensive healthcare FM education to successfully prepare future healthcare FM professionals for entry-level jobs; comparing these contemporary student learning outcomes to senior-level competencies described by ASHE, the supposition is there are missing outcomes specifically related to regulatory and code compliance, building systems, and infection control; contrasting the healthcare FM industry's hiring practices from FM academic programs with FMAC's goal of preparing students to positively impact hiring organizations also suggests a lack of healthcare applicable student learning outcomes in accredited FM academic programs. Therefore, the hypothesis is that ABET, ACCE, and FMAC lack undergraduate student learning outcomes for a comprehensive healthcare FM education.

Delphi Method

The Delphi method was used for this research to draw upon the collective knowledge and experience of experts. Hallowell and Gambatese (2010) explained that the Delphi method is an interactive research technique that secures experts' input from two or more rounds of structured surveys to develop highly reliable results on a specific topic. After each round, inputs were analyzed and anonymous summaries were provided back to the experts with the goal of eventually achieving group consensus (Figure 1).

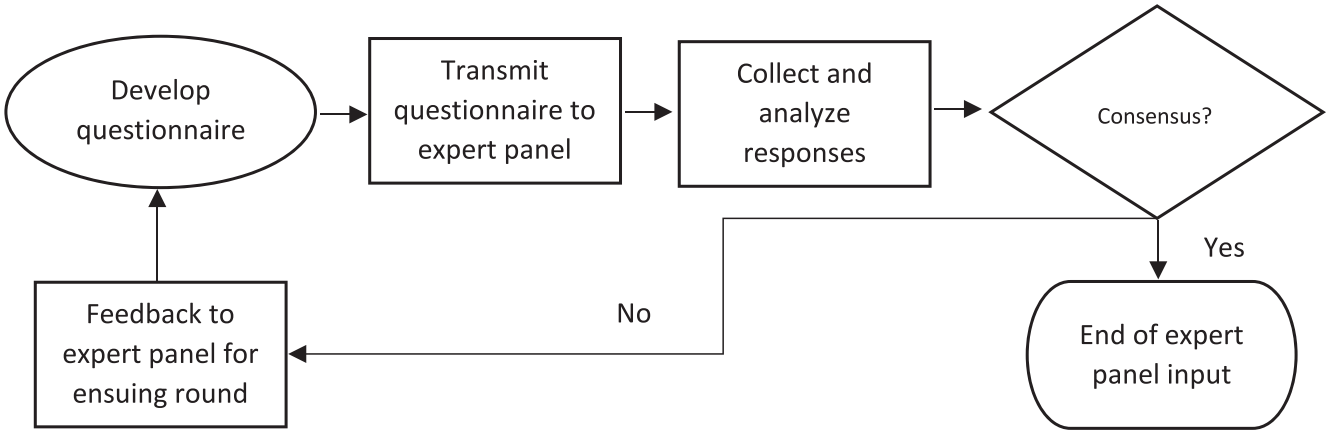

FIGURE 1.

Panelists

As the success of a Delphi study depends upon the proper selection of expert panelists (Chan et al., 2001), this selection process was guided by the Flexible Point System for the Qualification of Expert Panelists established by Hallowell and Gambatese (2010). At least eight experts were sought but no more than twenty (Ameyaw et al., 2014); all experts involved with this research exceeded the minimum qualifications by scoring more than 10 points and at least one point in four different achievement or experience categories. Categories included education levels, professional registration and experience, conference presentations, committee or faculty membership, and journal authorship.

Thirteen expert panelists were selected for this research study. Experts include eight facility management executives, employed by large healthcare systems or national service providers accountable for healthcare FM accounts; five of these healthcare FM executives have local or national leadership roles with the American Society for Healthcare Engineering (ASHE). Two healthcare human resource (HR) directors are also part of the expert panel, as many healthcare organizations control candidate screening and recruitment activity within their HR departments (Call et al., 2018b); both HR directors hold local leadership roles in the American Society for Healthcare Human Resources Administration (ASHHRA) and have responsibility for healthcare FM recruiting within their healthcare system. Three academics complete the panel as active instructors and researchers within the field of facility management; a technical college and two research universities are represented.

Survey

Round one served as a brainstorming round to identify all potential student learning outcomes in healthcare FM and solicited opinions from the expert panel in an open-ended way. A questionnaire was developed from a review of literature and listed all existing baccalaureate level student learning outcomes from the organizations accrediting engineering, construction management, and facility management programs (See Appendix A-C). Several new student learning outcomes were also proposed based upon ASHE competencies (See Appendix D). Panelists were instructed to review the list of learning outcomes and respond with recommended changes to the list or suggestions for new student learning outcomes they considered missing for a comprehensive healthcare FM education. Panelists considered their responses in the context of learning outcomes required for new college graduates in the first three years of employment as an entry-level plant operations and maintenance (POM) managers at a large healthcare FM department; clarifying timing is important in this context as college students average three years in their first healthcare FM job before promotion to a more senior-level role (Call et al., 2018b). Clarifying the POM role is also important as FM in healthcare can be interpret as either POM or environmental services (EVS); however, it is not uncommon for healthcare POM managers to have some overlap in these responsibilities. The entry-level classification for this role was also explained to hold a title that included, but not limited to, foreman, coordinator, supervisor, team leaders, assistant managers, or manager. Additionally, a large healthcare FM department was defined as an organization that managed more than a million square feet, 500 beds, and 50 inhouse POM staff; this emphasis is also important as most recruiting and hiring for entry-level healthcare facility managers in the United States comes from large healthcare organizations (Call et al., 2018a; Call et al., 2018b).

After input was received from the expert panelists on the round one questionnaire, the information was summarized and provided to the panelists for review with explanations and reasoning. They were asked to review the summarized results and respond with any changes or additions they considered necessary to establish a comprehensive healthcare FM education prior to developing a structured questionnaire. This concluded round two.

A structured questionnaire was developed for round three based upon the expert panel input from the previous two rounds. This questionnaire included a list of new student learning outcomes suggested by the expert

TABLE 1.—Consensus Criteria

Agreement Levels	Conditions
Strong agreement	Absolute deviation ≤1 and median score 8-9 (Likert scale 1-9)
Agreement	Absolute deviation ≤1 and median score 6-7 (Likert scale 1-9)
Disagreement	Absolute deviation ≤1 and median score 3-5 (Likert scale 1-9)
Strong disagreement	Absolute deviation ≤1 and median score 1-2 (Likert scale 1-9)

panelists; panelists were asked to rate their level of agreement on a Likert scale (1 = strongly disagree to 9 = strongly agree) that students should understand each new learning outcome. They were also asked to select a higher learning category, if they believe it was expected, based upon a progressive description of Blooms Taxonomy: understand, apply, analyze, evaluate, and create (ACCE, 2017); a Likert scale was used (1 = understand to 5 = create).

Phone Interviews

The two academic panelists from research universities institutions were interviewed by phone to better understand their rationale for Likert scale scores on students' understanding of healthcare regulations and systems.

Consensus Criteria

For this research, absolute deviation was used to measure consensus, as is most common in CEM research (Ameyaw et al., 2016). Consensus for student learning outcomes was considered achieved with absolute deviation within one unit on the 1-9 scale (Hallowell & Gambatese, 2010). Furthermore, agreement levels were categorized by median Likert scale scores (Table 1). Consensus for learning levels for each student outcome was considered achieved with absolute deviation within one unit on the 1-5 scale.

Data Results & Analysis

Regulatory Compliance

Data collected demonstrate a strong panel consensus that understanding accreditation, regulatory, and code compliance for the healthcare built environment is important for college students preparing for employment in healthcare FM. This student learning outcome was explained to include healthcare related regulations and codes from the American Institute of Architects (AIA), Building Officials Code Administrators International (BOCA), Southern Building Code Congress International (SBCCI), International Building Code (IBC), Uniform Building Code (UBC), Americans with Disabilities Act (ADA), The Joint Commission (TJC), National Fire Protection Association (NFPA), Occupational Safety and Health Administration (OSHA), Centers for Disease Control and Prevention (CDC), Centers for Medicare & Medicaid Services (CMS), Facility Guidelines Institute (FGI), and American Society of Heating, Refrigeration and Air-Conditioning Engineering (ASHRA). This student learning outcome had a median Likert scale score of 9.0 and consensus was achieved with absolute deviation at 1.0 (Table 2). Panel consensus was also achieved regarding the level of learning expected of college graduates for accreditation, regulatory, and code compliance in the healthcare built environment; the expert panel selected "apply" with a median score of 3.0 and absolute deviation at 0.0 (Table 4). Interestingly, academics disagreed that an understanding of accreditation, regulatory, and code compliance for the healthcare built environment is important for college students preparing for employment in healthcare FM with a median Likert scale score of 5.0. Comparing rankings suggests a gap between industry and academia on expected student learning outcomes for understanding of accreditation, regulatory, and code compliance in healthcare FM education (Table 3).

Building Systems

Data collected show a strong panel consensus that systems in healthcare facilities are important for college students preparing for employment in healthcare FM. This student outcome was explained to include medical gas, vacuum, and pneumatic tube systems; it had a median Likert scale score of 9.0 and consensus was achieved with absolute deviation at 0.0 (Table 2). Panel consensus was also achieved regarding the level of learning expected of college graduates for systems in healthcare facilities; the expert panel selected "apply" with a median score of 2.0 and absolute deviation at 0.0 (Table 4).

TABLE 2.—Consensus Results and Agreement for Student Outcomes Understanding in Healthcare FM Education

Student Learning Outcomes	Median Score (Likert Scale 1-9)	Average Score (Likert Scale 1-9)	Absolute Deviation	Agreement Level
Accreditation, regulatory, and code compliance for healthcare built environments	9.0	8.2	0.0	Strong agreement
Systems in healthcare facilities	9.0	7.9	0.0	Strong agreement
Infection control in the healthcare built environment	8.0	8.1	1.0	Strong agreement
Lifecycle asset management concepts, practices, and tools	8.0	7.9	1.0	Strong agreement
Operational excellence in FM	8.0	7.8	1.0	Strong agreement
Healthcare construction project management and methods	8.0	7.8	1.0	Strong agreement
Employee and customer conflict resolution	8.0	7.6	1.0	Strong agreement
Clinical operations and medical equipment	7.0	6.7	1.0	Agreement
Materials management in healthcare facilities	6.0	6.0	1.0	Agreement
Environmental services (EVS) in healthcare facilities	6.5	6.75	1.5	-

TABLE 3.—Rank of Student Outcomes in Healthcare FM Education by Median Scores of Industry and Academic Groups

Student Learning Outcomes	Healthcare FM Executives' Median Score (Likert Scale 1-9)	Academics' Median Score (Likert Scale 1-9)	Industry Rank	Academic Rank
Accreditation, regulatory, and code compliance for healthcare built environments	9.0	5.0	1	9
Systems in healthcare facilities	9.0	4.0	1	10
Infection control in the healthcare built environment	8.5	7.0	3	4
Lifecycle asset management concepts, practices, and tools	8.5	8.0	3	2
Operational excellence in FM	8.5	7.0	3	4
Healthcare construction project management and methods	8.0	8.0	6	2
Employee and customer conflict resolution	7.5	9.0	7	1
Clinical operations and medical equipment	7.0	6.0	8	7
Materials management in healthcare facilities	5.5	6.0	9	7
Environmental services (EVS) in healthcare facilities	5.5	6.5	9	6

Interestingly, the academic group disagreed that an understanding of systems in healthcare facilities is important for college students preparing for employment in healthcare FM with a median Likert scale score of 4.0 (Table 3). Furthermore, academic panelists scored significantly lower than the 9.0 score from healthcare FM executives. A Mann-Whitney U test shows a statistical difference in these two groups with ordinal dependent variables, $U = 1.5$, $z = -2.3$, $p = .02$, confirming a considerable divide between industry and academia on expected student learning outcomes for technical understanding of systems in healthcare facilities in healthcare FM education. Moreover, the academic panelist representing the technical college scored 8.0 on this topic, highlighting misalignment with the two academic panelists from research universities. Both academics from research universities reported during phone interviews that their classroom instruction is general to the FM industry with the expectation that industry specific knowledge or skills would be learned in the workplace after graduation.

Infection Control

Data collected reveal a strong panel consensus that infection control in the healthcare built environment is important for college students preparing for employment in healthcare FM. This student learning outcome had a median Likert scale score from expert panelists at 8.0; consensus was achieved with absolute deviation at 1.0 (Table 2). Panel consensus was also achieved regarding the level of learning expected of college graduates for infection control. The expert panel selected "apply" with a median score of 3.0 and absolute deviation at 0.0 (Table 4).

Lifecycle Asset Management

Data collected reveal a strong panel consensus that lifecycle asset management concepts, practices, and tools is important for college students preparing for employment in healthcare FM. This student learning outcome had a median Likert scale score from expert panelists at 8.0; consensus was achieved with absolute deviation at 1.0 (Table 2). Panel consensus was also achieved regarding the level of learning expected of college graduates for lifecycle asset management concepts, practices, and tools. The expert panel selected "apply" with a median score of 2.0 and absolute deviation at 1.0 (Table 4).

Operational Excellence

Data collected show a strong panel consensus that operational excellence in FM is important for college students preparing for employment in healthcare FM. This student outcome was explained to include outsourcing considerations and continuous quality and process improvement (i.e. Lean six-sigma). This student learning outcome had a median Likert scale score from expert panelists at 8.0; consensus was achieved with absolute deviation at 1.0 (Table 2). Panel consensus was also achieved regarding the level of learning expected of college graduates for operational excellence in FM. The expert panel selected "evaluate" with a median score of 4.0 and absolute deviation at 1.0 (Table 4).

TABLE 4.—Consensus Results and Agreement for Learning Levels of Student Outcomes in Healthcare FM Education

Student Learning Outcomes Achieving Consensus	Median Score (Likert Scale 1-5)	Absolute Deviation
Accreditation, regulatory, and code compliance for healthcare built environments	2 - Apply	0.0
Systems in healthcare facilities	3 - Analyze	0.0
Infection control in the healthcare built environment	2 - Apply	0.0
Lifecycle asset management concepts, practices, and tools	3 - Analyze	1.0
Operational excellence in FM	4 - Evaluate	1.0
Healthcare construction project management and methods	3 - Analyze	1.0
Employee and customer conflict resolution	3 - Analyze	1.0
Clinical operations and medical equipment	2 - Apply	1.0
Materials management in healthcare facilities	3 - Analyze	1.0

Construction Project Management

Data collected show a strong panel consensus that healthcare construction project management and methods are important for college students preparing for employment in healthcare FM. This student outcome was explained to include access, environmental remediation, shielding, smoke and fire compartments, system redundancy and shutdown, project phasing, and moves and changes. This student learning outcome had a median Likert scale score from expert panelists at 8.0; consensus was achieved with absolute deviation at 1.0 (Table 2). Panel consensus was also achieved regarding the level of learning expected of college graduates for healthcare construction project management and methods. The expert panel selected "analyze" with a median score of 3.0 and absolute deviation at 1.0 (Table 4).

Conflict Resolution

Data collected show a strong panel consensus that employee and customer conflict resolution is important for college students preparing for employment in healthcare FM. This student outcome was explained to include communication and negotiation with diverse stakeholders like patients, visitors, doctors, nurses, and community leaders. This student learning outcome had a median Likert scale score from expert panelists at 8.0; consensus was achieved with absolute deviation at 1.0 (Table 2). Panel consensus was also achieved regarding the level of learning expected of college graduates for employee and customer conflict resolution. The expert panel selected "analyze" with a median score of 3.0 and absolute deviation at 1.0 (Table 4). Interestingly, comparing rankings suggests a large gap between industry and academia on expected student outcomes for employee and customer conflict in healthcare FM education, with academic panelists valuing these soft skills more than healthcare FM executives (Table 3).

Clinical Operations

Data collected show a panel consensus that clinical operations and medical equipment is important for college students preparing for employment in healthcare FM. This student learning outcome had a median Likert scale score from expert panelists at 7.0; consensus was achieved with absolute deviation at 1.0 (Table 2). Panel consensus was also achieved regarding the level of learning expected of college graduates for clinical operations and medical equipment. The expert panel selected "apply" with a median score of 2.0 and absolute deviation at 1.0 (Table 4).

Materials Management

Data collected show a panel consensus that materials management in healthcare facilities is important for college students preparing for employment in healthcare FM. This student outcome was explained to include supply chain and sourcing. This student learning outcome had a median Likert scale score from expert panelists at 6.0; consensus was achieved with absolute deviation at 1.0 (Table 2). Panel consensus was also achieved regarding the level of learning expected of college graduates for materials management in healthcare facilities. The expert panel selected "analyze" with a median score of 3.0 and absolute deviation at 1.0 (Table 4).

Environmental Services

Data collected show a consensus was not achieved for environmental services (EVS) in healthcare facilities with absolute deviation at 1.5, the only student outcome not to achieve panel consensus (Table 2). This is understandable, however, considering that entry-level POM managers spend very little time managing EVS activities (Call et al., 2018a). This student outcome was explained to include waste management and cleaning processes.

Comprehensive Healthcare FM Education

Data collected show a strong panel consensus that the list of new student learning outcomes (Table 2) fill the gaps in existing ABET, ACCE, and FMAC student outcomes for a comprehensive healthcare FM education. For this question, panelists had a median Likert scale score of 8.0 with absolute deviation at 0.0.

Conclusion

This study confirms that gaps exist in learning outcomes for a comprehensive healthcare FM education; central learning outcomes not being addressed by organizations accrediting engineering, construction management, and facility management undergraduate programs appear to be technical or vocational topics specific to the healthcare industry that include regulatory compliance, infection control, and building systems. Interestingly, academics in the field of facility management generally disagree with industry professionals that these technical topics are important student learning outcomes. Consequently, FM academics prefer to teach students general FM principles with the expectation that industry specific knowledge be gained in the workforce after graduation from college; this approach seems reasonable considering the myriad industries that employ facility managers. Furthermore, new FM graduates entering healthcare FM are experiencing similar promotion timeframes compared to those with many years of industry experience, suggesting that new FM graduates are quickly and sufficiently learning the technical or vocational competencies valued by the healthcare industry. Nevertheless, candidates attempting to enter healthcare FM without industry specific knowledge are disadvantaged due to industry perceptions and expectations.

The list of healthcare FM learning outcomes, elucidated from this research, can be adopted into academic programs to better prepare graduates with at least a basic understanding of key industry topics and help overcome industry recruiting bias. Many of these learning outcomes could be readily joined or integrated with existing learning outcomes adopted by FMAC accredited undergraduate programs due to their similarities (See Appendix E). Integrating specific

industry learning outcomes like healthcare regulations and infection control, however, may not be so ostensible; these student learning outcomes could be addressed with additional courses and/or developed outside of a classroom environment through internships. Notably, participation in healthcare FM internships show a positive association with new college graduate hiring (Call et al., 2018b).

Facility management academic programs interested in providing a more comprehensive healthcare FM education may consider a concentration or emphasis in healthcare FM. At minimum, it is proposed that dedicated courses be adopted to address the following top tier of expected healthcare FM learning outcomes that may not be easily addressed in existing courses:

- Accreditation, regulatory, and code compliance for healthcare built environments
- Infection control in the healthcare build environment

Other healthcare FM learning outcomes that may warrant dedicated courses include:

- Systems in healthcare facilities
- Healthcare construction project management and methods
- Clinical operations and medical equipment
- Materials management in healthcare facilities

Ultimately, it is incumbent upon the healthcare FM industry to encourage and support adoption of more comprehensive healthcare FM education at academic programs to attract new talent in response to an ongoing FM workforce shortage. Currently, there appears to be little incentive for academic programs to expend resources implementing these changes as so few students are being recruited by healthcare FM professionals. With historically high placement rates for graduates, FM academic programs are clearly inclined to focus on industries that proactively support and connect with students and faculty. The healthcare FM industry should consider ways to improve its relationship with colleges and universities including funding program resources and research, sponsoring student events and internships, and participating in advisory boards (Christofferson et al., 2006). Nevertheless, even if university-industry linkage improves and healthcare FM professionals dramatically increase recruitment levels of new FM college graduates with a comprehensive healthcare FM education, these efforts may not significantly increase the number of new college graduates entering the healthcare FM field due to low starting salaries compared to offers typically received by new FM college graduates. The healthcare FM industry must address competitive pay in conjunction with its other fundamental recruiting issues to attract students and ensure that colleges and universities open as a sustainable recruitment source in helping address FM attrition.

Further Research

Although this research sought to better understand student learning outcomes specific to healthcare FM education, it also elucidated learning outcomes that may be considered applicable for FM education in general. These student learning outcomes include:

- Lifecycle asset management concepts, practices, and tools
- Operational excellence in FM
- Employee and customer conflict resolution

Further research may be warranted to understand how these student learning outcomes can be better integrated into FM education to prepare future FM professionals. Moreover, exploring how accrediting organization and academic programs ensure student learning outcomes align with evolving FM industry expectations is necessary to continuously produce highly-capable graduates. Subsequently, understanding the current and future demand for healthcare FM professionals is necessary to predict the supply of new graduates needed to meet this demand as support for the advancement of healthcare FM education.

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Appendix

APPENDIX A.—ABET Student Learning Outcomes at the Baccalaureate Level

Student Learning Outcomes
An ability to apply knowledge of mathematics, science, and engineering
An ability to design and conduct experiments, as well as to analyze and interpret data
An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
An ability to function on multidisciplinary teams
An ability to identify, formulate, and solve engineering problems
An understanding of professional and ethical responsibility
An ability to communicate effectively
The broad education necessary to understand the impact of engineering solutions in global, economic, environmental, and societal context
A recognition of the need for, and ability to engage in life-long learning
A knowledge of contemporary issues
An ability to use the techniques, skills, and modern engineering tools necessary for engineering practices

APPENDIX B.—ACCE Student Learning Outcomes at the Baccalaureate Level

Student Learning Outcomes
Create written communications appropriate to the construction discipline
Create oral presentations appropriate to the construction discipline
Create a construction project safety plan
Create construction project cost estimates
Create construction project schedules
Analyze professional decisions based on ethical principles
Analyze construction documents for planning and management of construction processes
Analyze methods, materials, and equipment used to construct projects
Apply construction management skills as a member of a multi-disciplinary team
Apply electronic-based technology to manage the construction process
Apply basic surveying techniques for construction layout and control
Understand different methods of project delivery and the roles and responsibilities of all constituencies involved in the design and construction process
Understand construction risk management
Understand construction accounting and cost control
Understand construction quality assurance and control
Understand construction project control processes
Understand the legal implications of contract, common, and regulatory law to manage a construction project
Understand the basic principles of sustainable construction
Understand the basic principles of structural behavior
Understand the basic principles of mechanical, electrical, and piping systems

APPENDIX C.—FMAC Student Learning Outcomes at the Baccalaureate Level

Student Learning Outcomes
Graduates understand the FM history, practice, and profession
Graduates can plan and manage projects
Graduates can manage building systems, facility operations, occupant services and maintenance operations
Graduates apply assessment, management and leadership principles of facility organizations and their stakeholders
Graduates apply fiscal management tools to the Facility program and organization
Graduates apply human factor principles to the facility operation and stakeholders
Graduates are effective communicators
Graduates will be able to apply FM Computer Applications

APPENDIX D.—ASHE Competencies for Senior-level Healthcare Facility Managers

Competencies
Technical and System Knowledge - regulatory awareness, code compliance, building system operation and shutdowns, and energy management
Ability to Transform - problem solving, strategic facility planning, culture transformation, and strategic leadership. Communication - project management and infection control
Cultural understanding - networking and relationship building
Diverse talents - contract management, commissioning, financial decision making, business case development, property management, and safety management
Collaboration
Resource Management - compliance management and construction delivery method
Personnel Management

APPENDIX E.—Matching Similar FMAC and "Healthcare FM" Student Learning Outcomes

FMAC Student Outcomes	**Healthcare FM Student Learning Outcomes**
Graduates understand the FM history, practice, and profession	
Graduates can plan and manage projects	Healthcare construction project management and methods
Graduates can manage building systems, facility operations, occupant services and maintenance operations	Systems in healthcare facilities Materials management in healthcare facilities
Graduates apply assessment, management and leadership principles of facility organizations and their stakeholders	Lifecycle asset management concepts, practices, and tools Operational excellence in FM
Graduates apply fiscal management tools to the Facility program and organization	
Graduates apply human factor principles to the facility operation and stakeholders	
Graduates are effective communicators	Employee and customer conflict resolution
Graduates will be able to apply FM Computer Applications	
	Accreditation, regulatory, and code compliance for healthcare built environments Clinical operations and medical equipment Infection control in the healthcare built environment