Leveraging National Guidelines for Building Operator Credentialing

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ABSTRACT

With over 40% of the nation's total energy consumed by existing buildings, it is increasingly important to employ a cohesive national building operator professional standard that leverages industry-consensus stakeholder input and unifies the currently splintered training and credentialing systems. In the last 10 years, the role of the building operator has evolved dramatically and demand for credentialed operator technicians has increased in the facility/property management market as new public policies call for credibility and confidence in the building operator professionals charged with safeguarding the value of building stock, complying with evolving energy codes, and carrying out mission-critical directives to drive down energy usage and costs. This paper will examine the concepts of professional competence, certification, and accreditation as they relate to workforce credentialing programs serving the building operator audience. The job and task analysis (JTA) for building operators performed by Department of Energy (DOE) and other organizations using the Developing a Curriculum Method (DACUM) method is examined and the critical work functions and validation of operator knowledge, skills, and abilities are discussed. Opportunities for using the currently available standards for accrediting credentialing bodies, such as ISO standards also are examined. Discussion will center on the future steps needed to leverage DOE's JTA and to promote industry consensus on building operator certification schemes aligned with the current skill standard.

Introduction

Buildings account for 40% of total energy consumption in the United States, using 72% of electricity and 55% of natural gas, at a cost of $202.3 billion annually (EPA 2012). The energy used inefficiently or unnecessarily in buildings is estimated to be as much as 30% with buildings accounting for 38% of the carbon dioxide emissions in the country. Reducing the energy use of buildings lessens the adverse impacts on the environment and decreases operating costs.

Building operations and maintenance (O&M) play a key role in a company's energy management strategy. However, O&M is playing catch up to other business sectors where job-specific skill standards and organizational core competencies have long been defined and serve as a well-established means for organizational success and competitive advantage. Operators who leave or lose their jobs must be able to transfer knowledge to a new organization, sector, or even a different geographic region (or country). There is value in making visible the entire scope of knowledge and experience held by the building operator, regardless of where the learning took place. Building operators are expected to be lifelong learners and both informal and formal learning continues to be an important part of their professional development. Validation of competency is becoming a key aspect of hiring policies within the commercial buildings sector and well-designed certification schemes will continue to play an important role in validating

operator learning. This work examines: the concept of skill standards for building operators; the role of certification in operations and maintenance; who is doing the certifying; and who is accrediting the certification bodies. It then proposes steps towards industry consensus of current, validated skill standards for building operators to be an integral component of operator education and in realizing immediate and measurable goals for achieving and sustaining energy efficient and high performance operations.

The Building Operations Domain and Its Impact on Energy Efficiency

Building operations is a dynamic, evolving profession and the role of the building operator is changing. A building operator/technician is a professional who manages commercial and laboratory buildings by maintaining, operating, and performing repairs to mechanical HVAC systems, life safety, electrical, and plumbing systems, and performing general building maintenance to optimize equipment performance. The operator/technician also maintains the building's operability and ensures the comfort and safety of occupants (DOE 2011). Operators work in a variety of building types, including factories, hospitals, hotels, office and apartment buildings, schools, real estate firms, and shopping malls. There are employed as in-house staff or as contractors. A building operator's work requires technical skills gained either through a formal apprenticeship program or informal on-the-job training supplemented by courses at a trade or technical school. Valuable experience can be obtained in the Navy or the Merchant Marine because marine-engineering plants are similar to many stationary power and heating plants (DOLb 2012).

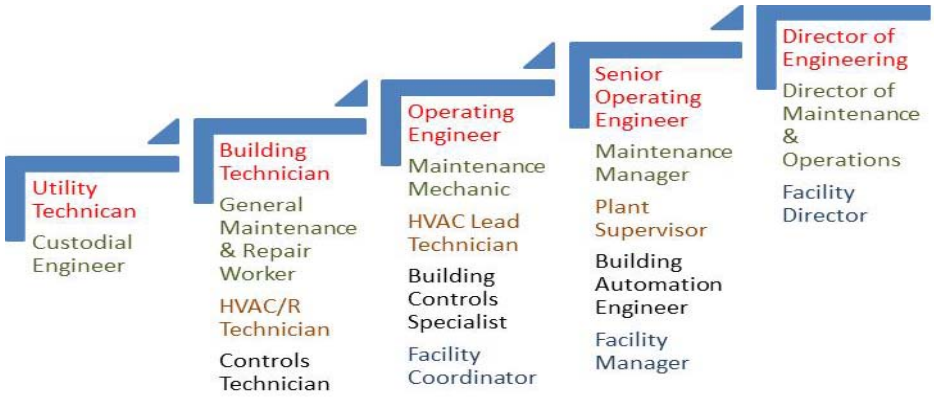
When properly performed, effective operations and maintenance ensures that the design life expectancy of equipment will be achieved (or exceeded) and implementation of low-cost and no-cost operating adjustments is a well-established means for generating energy savings in the range of 5-20 percent (PECI 1999). Experienced and trained building technicians familiar with building automation systems, common building mechanical system equipment, and HVAC control sequences are better prepared to identify frequent problems that afford the greatest energy benefits: equipment scheduling, sensor error, simultaneous heating and cooling, and outside air usage. Federal agencies, state energy offices, and industry supporters working towards the improved energy performance of buildings are concerned with ensuring an adequate pool of skilled operators to support effective O&M of property and equipment as mandated by key energy and operational efficiency-related provisions, including benchmarking, retrocommissioning, or retuning (Sullivan et al 2010). Furthermore, skilled operators, even those outsourced, are actively involved in the design and ongoing review of operational strategies for facility systems (Hodges 2005) and play an important role in an organization's energy management program. The LEED for Existing Buildings: Operations & Maintenance (LEED-EBOM) rating system, in which building technicians play a significant role, experienced explosive growth in the past three years with LEED-EBOM projects surpassing, for the first time in the program's history, those certified under its new construction counterpart on an annual basis (Zimmerman 2012).

According to EPA's Energy Star program there are 4.8 million commercial buildings in the U.S. There were 1,594,400 building trades jobs in 2010 (DOLa,b,c) combined: stationary building engineers (37, 600); heating, air conditioning, and refrigeration (HVACR) mechanics and installers (267,800); and maintenance and repair workers (1,289,000). Over 400,000 jobs openings are projected (2010-2020) – many of which are openings for HVAC/R technicians,

mechanics, and installers - generated by the growing number of highly skilled technicians retiring from the trade. Despite the bright outlook, there continues to be a significant shortage of technicians who can effectively operate and maintain commercial buildings. Employers faced with high energy costs are adopting practices and are on the search for skilled workers to help them achieve energy efficiency. Companies operating buildings that meet ENERGY STAR certification standards are rewarded with 20-30% lower operating costs while achieving high-value national recognition as good environmental stewards (Energy Star 2012).

Facility management was identified as one of the top ten fastest growing professions in 2010 by CareerBuilder.com. Operators who advance in their careers often move into specialized building trades or supervisory roles. Figure 1, developed by the Northwest Energy Efficiency Council, illustrates the technician's mobility potential into senior positions as operating engineers, controls specialists, and facility management professions. Facility managers must have a technical background in building systems and progressive experience in operations and maintenance in order to effectively lead high-performance teams doing the technical work (GSA 2012).

Figure 1. Career Ladder for a Facility Management Professional



Concepts: Professional Competence, Certification, and Accreditation

Understanding what operators are required to do and how they achieve their goals is a pre-requisite to the organization of facility management work, practices, tools, and equipment and in helping operators master their tasks (Shepherd 2001). Operators are assigned tasks with the goals of ensuring occupant comfort and safety, and that design life expectancy of the building and equipment are realized and job tasks are judged to be satisfactory (or not) against these and other standards. The cost of energy is also an important task specification constraint. An operator's composite skills should involve: individual operator functions; underlying characteristics (skills, knowledge, personal attributes); organizational competence e.g. team-based processes (energy audits, commissioning, and retro-commissioning); and education and training.

These four criteria, in various combinations, are typically used to measure professional competence. According to National Alliance of Business (1995) skill standards are performance specifications that identify the knowledge, skills, and abilities an individual needs to succeed in the workplace. Skill standards should be unbiased and developed independently of any type of

education or training provider and yet be leveraged by a wide variety of providers. Highly adaptable and voluntary, skill standards can be benchmarked to ideal levels of industry performance and linked to measurable, competency-based outcomes that can be readily assessed. "Without this fundamental information, employers do not know whom to hire or where to focus their limited training dollars; employees and new entrants to the workforce do not know what they need to do to improve their performance; and educators do not know how to prepare students for the challenges of the workplace." (WSCTC 1999)

In the 1990s, there was a push from U.S. businesses calling for the identification of skills needed in high performance workplaces (NAB 1995). Companies like Boeing, with well-established training functions within the organization and a strong culture of learning, keenly understand their employees' skills and the core competencies of their organization, which gives them an edge over the competition (Ernest-Jones 2005). Job skills standards assist employers in identifying critical work functions in O&M that can have immediate, measurable impact (and lowest initial capital investment) for achieving and sustaining energy efficient and high performance operations (GSA 2012).

In 2009, IFMA conducted a global job task analysis (GJTA) to better define the knowledge and skill areas for facilities managers. In 2010, the Northwest Energy Efficiency Council conducted a job task analysis (JTA) for building operators using the DACUM. The JTA surfaced the scope of skills needed to operate and maintain efficient buildings over time. It was validated by over 300 operators. A validatedJTA was also conducted by theDOE in 2011 using DACUM that produced the comprehensive performance specifications (skills standards) an operator needs to effectively operate and maintain a facility. DOE recruited experienced workers who are experts in their field and sought wide public review and comment on the work.

The Federal Buildings Personnel Training Act of 2010 (FBTA) requires all federal building personnel to be trained in energy efficient operations by 2013 and DOE's JTA will inform hiring and contractual decisions. By Instructional Systems Design standards, deciding whether to train a person requires a needs analysis using a JTA. If a skills gap exists, then appropriate methods of intervention are examined, including but not limited to training. If training is the appropriate intervention, it should address the skill gaps found in the needs analysis. According to a 2010 study by the Institute for Market Transformation, "measuring the quality of training and certifications for energy auditors poses significant challenges with regards to lack of uniformity among existing programs." As with any trade organization, training programs are not equal by design nor do providers agree on content, rigor, quality assurance, and professional accountability of their trainees. The Center on Wisconsin Strategy (2010) sees the demand for credentialed technicians, a lack of national consensus on occupational skills standards, and the lack of resources to scale an operator-credentialing program nationally, as factors that currently promote fragmentation among training providers.

Because building technicians receive their experience, training, and credentials in a variety of ways, employers and other decision-makers are keen on drawing a distinction between certification, certificate, and certificate of completion. According to the American Society for Testing and Materials (ASTM), a "certificate of completion" (or participation) may be obtained from an education or training provider upon completion of a learning event(s), verifying attendance only. Whereas, a certificate awarded as part of a certificate program verifies completion of a program of learning including, but not limited to, an assessment of the learner's attainment of intended learning outcomes. In a certificate program, there is an integral link between the training provided and the assessment, both are developed and administered by the

certificate issuer. Once issued, certificates cannot be revoked nor do they have maintenance and renewal requirements. For example, Laney College in Oakland, California has a certificate program in building operations consisting of coursework in environmental control technology, carpentry, architecture, electronics, and engineering.

Certificate programs are distinguished from the certification of individuals in two ways. Professional certification is a time-limited recognition granted to an individual verifying that she or he has demonstrated mastery/competency via an application of eligibility and standardized exam. In contrast to certificate programs, certifications usually require renewal and regular maintenance of proficiency/competency and can be revoked if requirements for certification are not met. Another distinguishing criterion of certification is education and/or training requirements: education and training is generally not provided by the certification body. The certifying body administers a standardized assessment of current proficiency or competency and verifies education, training, and experience obtained elsewhere through an application process. Certification has been common for building operators and various specializations for many years including but not limited to HVAC specialty. The North American Technician Excellence (NATE) has a certification program for HVAC/R technicians under the ISO 17024 standard, for example.

Another important distinction within the credential arena is that of public and private credentials. The former are usually exclusionary, consisting of licensure and legal prohibitions against practicing without a license. Boiler operators are often licensed through the state or city where they practice. Private credentials are voluntary in nature and do not impede those lacking a credential from the legal right to practice, though the value of the credential in the marketplace may put them at a disadvantage among employers and other decision-makers. Licenses can be complemented by specialty certifications and certification requirements often include licensure. Many public licensing agencies require an initial examination and continuing education units (CEU) to maintain licensure, much like certification schemes. According to the International Association of Continuing Education and Training (2011), “One CEU equals ten contact hours of participation in an organized CE/T experience, delivered under responsible sponsorship, capable direction, and qualified instruction”.

By way of the credential it confers, the credentialing body declares to its customers that its credential holder has “passed” examination according to its standards (Havighurst & King, 1983). The credentialing body could also choose to contract with another entity to actually do the certification to verify its participants conform to the standard. In the case of third-party certification, assessment is carried out by an independent, third-party organization that is qualified to issue certification. U.S. government agencies use certification requirements to ensure quality in professional services purchased and generally require written assurance that an individual conforms to specified requirements or standards for professional competence (GAO 1999).

Accreditation

As certified individuals are held to standards with regard to skills, experience, ethics, etc., so are the credentialing bodies held to standards of practice. By placing confidence in the standards of a certifying body, one hopes to save the cost of independently assessing the qualifications of a candidate or the time-intensive work of comparing those qualifications to others. Transparency, quality assurance, and impartiality are the hallmarks of good business and

a customer value proposition of accredited credentialing bodies. ISO 17000 defines accreditation as a "procedure by which an authoritative body gives formal recognition that a body or person is competent to carry out specific tasks". A certification body accredited by a third-party demonstrates compliance with a set of business standards and the necessary core competencies to perform the certification of persons and/or training functions. Federal agencies must consult with voluntary consensus standards bodies, both domestic and international, and must participate with such bodies in the development of voluntary consensus standards (GAO 1999). In a 2007 newsletter, Chris Scolese, then Chief Engineer of the NASA Academy and the current director of the Goddard Flight Center, noted that standards are the backbone of a competent and strong engineering workforce and that the codification of best practices leads to increased quality, reliability, and safety. The U.S. Department of Defense (DoD) Directive 8570.1 now requires any one with privileged access to a DoD information system to obtain certification accredited through ISO/IEC 17024 (DoD 2012), for example.

Depending on the type of provider and service, several accreditation avenues exist. Currently, there are three national (and international) standards organizations (a fourth is being piloted) that accredit workforce programs serving commercial and residential real estate, industrial, government, and construction sectors. Table 1 provides a comparison of the voluntary standards developed by these four organizations and the target programs voluntarily seeking accreditation under each. All four standards are, themselves, accredited by the American National Standards Institute (ANSI), a leading facilitator of voluntary consensus standards in the U.S.

Table 1. Program/Provider Accreditation Standards: An Overview

Accrediting Agency	**International Association for Continuing Education and Training (IACET)**	**International Organization of Standardization (ISO) and International Electrotechnical Commission (IEC)**	**American Society for Testing and Materials (ASTM)**	**Interstate Renewable Energy Council, Inc. (IREC)**
Standard	**IACET – 1-2007**	**ISO/IEC – 17024**	**ASTM – E2659-09e1**	**IREC – 14732: 2012 (pilot)**
Standards Referenced	The IACET Council on Standards Development	ISO/IEC 17030 ISO 9001 ISO 9011	IACET 1-2007, ISO/IEC 17024	ISO/IEC 17011 IACET 1-2007 ISO/IEC 17024 ASTM E 2659 IREC 01022
Framework	Iterative	Iterative	Iterative	Iterative
Target Programs	Continuing Ed And Training Developers And Providers	Entities Offering Personnel Certification Programs	Certificate Program Developers And Certificate Issuers	Renewable Energy and Energy Efficiency Certificate Programs

Certification/training providers wishing to voluntarily earn accreditation undergo an iterative application process demonstrating conformity to defined standards and best practices. The criteria common to all four standards include, but are not limited to, organizational structure and administration, management, financial responsibility, resource requirements, program design, instructional systems design (valid and reliable exams and measurement of intended outcomes), records management, and credential awards processes. Both IREC 14732 and ISO 17024 require a job task analysis as a basis for program design. A certifying body wishing to

conform to the 17024 standard must demonstrate impartiality and articulate a plan (certification scheme) for obtaining sufficient objective evidence upon which to base a certification decision, taking into account threats arising from self-interest, personal bias, and financial gain/loss. The accrediting agency reviews the application documents, conducts an on-site assessment, provides feedback, and identifies action items. Once the applicant responds to the action items, there is a final review and decision.

ISO/IEC 17024

Quality management and performance accountability strategies have shown to be just as successful in the continuous improvement of education programs as they have been in business sectors over the years (Sims and Sims 1995). The manufacturing sector has long adhered to ISO standards for quality management in manufacturing processes, making the sector a prime candidate to test the new ISO 50001 Standard for Energy Management. A workforce of (ISO 17024 accredited) Certified Practitioners will assist facilities in conducting energy system-specific assessments and help establish procedures for continuously improving energy efficiency (CEEM 2011).

Though ISO 17024 is not enough to certify a person, it guides the certifying body in the task of defining the "certification scheme," which lays out the education, knowledge, skills, experience, and other requirements that a certified person in a given occupation would be expected to meet. The standard provides guidance on forming a scheme committee to ensure representation of all interested parties in the process of developing and maintaining the scheme.

ISO-17024 is unique to the other standards discussed in that it requires certifying bodies that both train and certify persons to demonstrate how training is independent of the evaluation and certification process. Training is treated as a means of providing certification candidates an edge over others taking the certification exam, hence a threat to impartiality. Even if a certifying body were to demonstrate impartiality in the matter, distinct separation between the administration of training and certification administration and relevant activities including the separation of the personnel involved must be strictly maintained to ensure the uncompromised integrity of the evaluation and certification processes. For most credentialing programs, this is a major obstacle to overcome. To earn ISO-17024 accreditation, the U.S. Green Building Council created the Green Building Certification Institute (GBCI) as a firewall between its training and certification processes. Under ISO-17024, Building Performance Institute (BPI) does not provide residential weatherization training. BPI only certifies by a certification examination and accredits training providers.

The purpose of the certification exam is to make a clear distinction between technicians who are competent to perform O&M job tasks at the desired level and those who are not. In general, certification exams allow technicians to earn certification from a variety of training systems by demonstrating proficiency through aptitude testing. When properly developed and validated, aptitude tests are one of the most accurate and objective means of predicting job performance and the extent to which a technician has the capacity to perform well on the job (Hunter and Hunter 1984). These tests involve a sample of the work that an operator is expected to do. This may be mechanical, such as, maintaining a piece of equipment. According to Early and Wheeler, knowledgeable experts on testing, “for a certification program to be defensible, the use of job task analysis is an essential component for the program.”

ISO 17024 (2003) states, “assessment shall be planned and structured in a manner which ensures that the requirements of the scheme are objectively and systematically verified with documented evidence to confirm the competence of the candidate.” It further states that “the credentialing body shall verify the methods for assessing candidates that include ensuring that each examination is fair, valid and reliable.” In other words, the certification body would measure the reliability of its examinations using recognized statistical methods to determine passing scores and to ensure that its examination results are relatively free from error.

A Comparison of National Certification Programs

Portable, national certifications available in the market are playing an increasingly important role in many engineering disciplines and other professions where health, safety, finance, and security are important concerns (Kabay 2010). In this section we examine national certification programs in O&M for the commercial building operator audience. The certification renewal/maintenance aspect of certification is well aligned with lifelong learning theory, supporting the rapid growth and adoption of new technologies within the industry and the ever-evolving energy codes that help make buildings “high performing”. The certification programs discussed here have hurdled the challenge of scaling their programs nationally, opening the door to address the next big challenge – consensus on skills standards for operators. Table 2 compares the top five national certification programs and key features including prerequisites: focus area; course delivery; training hours; maintenance of certification; and accreditation.

Table 2. National Certification Programs for Building Operator Audience: A Comparison

Organization	**American Society of Heating, Refrigeration and Air-Conditioning (ASHRAE)**	**Association of Energy Engineers (AEE)**	**BOMI International**	**Northwest Energy Efficiency Council (NEEC)**	**US Green Building Council (USGBC)**
Program Name	**Operations and Performance Management Professional (OPMP)**	**Building Energy & Sustainability Technician (BEST™)**	**Buildings System Technician (SMT®)**	**Building Operator Certification (BOC®)**	**LEED Existing Buildings O&M Accredited Professional (LEED AP)**
Offered Since	2009	2011	1970	1996	2007
3rd-Party Accreditation	NONE	NONE	ACE	IACET 1-2007	ISO/IEC 17024
Prerequisite	Work Experience and/or Related Degree	Work Experience and/or Related Degree	None	Work Experience and/or Related Degree	Work Experience on LEED project
Focus Area	HVAC, Refrigeration Systems	Multi-disciplinary	Multi-disciplinary	Multi-disciplinary	Multi-disciplinary
Course Delivery	Exam only	Classroom training	- Classroom - Online -Self Study	Classroom training and hands-on projects at the facility	Classroom training
Training Hours	Self-Guided	28 hours	120 hours	135 hours (Level I & II)	8 hours
CEU Hours	45 hrs./3 yrs.	10 hrs./3 yrs.	18 hrs./3 yrs	5 hrs./year for Level I 10 hrs./year Level II	30 hrs/2 yrs.

There is growing synergy among some certification bodies. BOMI awards credit for specific courses from accredited colleges and universities, or from specific professional credentials. NEEC and BOMI have a partnership agreement that awards competency credit between the BOC® and SMT® credentials. AEE, NEEC, and BOMI classes qualified for USGBC's Credential Maintenance Program. Beyond recognizing each other within the continuing education scope and/or credential reciprocity, training providers typically do not coordinate within and across states to promote a single occupational standard nor a portable national credential. Without consensus on a voluntary national skills standard for operators (at a minimum), credentials remain self-defined. An amalgam of various certifications will continue to exist without the benefit of consistent and measurable skills specifications benchmarked to high levels in work performance.

Towards Consensus on Skills Standards and ANSI Accreditation

The practices and procedures involved in the daily O&M of commercial buildings have significant impact on energy performance. An ample body of evaluation research points to the importance of trained and motivated operators achieving energy savings and reduced utility costs (Schueler 1995; Peters & McRae 2011; NEEA 2012; Navigant 2011; Abramson 1999; BOC 2012). Credentials based on national skills standards can promote synergy within workforce systems, define clear career pathways, and help establish common benchmarks at all career levels, from entry to intermediate and beyond, through advanced career capstone credentials (White et al. 2010). Broad national agreement is needed among industry stakeholders on job skills standards and the impartial certification of their attainment. DOE's JTA (2011) for building operators marks a significant contribution to the O&M body of knowledge. If more readily referenced, DOE's JTA can promote alignment of the commercial building technician programs offered by the national certification community as well as those of unions, post-secondary schools, and trade organizations. NEEC is currently referencing DOE's JTA in its certification scheme and in its pursuit of accreditation. ASHRAE, USGBC, BOMI, and AEE should also consider referencing DOE's JTA in their respective certification schemes and aim to work together in the national interest. NEEC could take a leadership role by convening interested parties to discuss a long-term national strategy that moves toward an ideal standard of quality for building operator certification. Future work could also include crosswalking skill standards against different building types and uses (hospitals, labs, airports) and identifying specialty certification schemes.

Accreditation is valuable to consumers, employers, governments, and the O&M industry because it ensures a certification body and its certification scheme were vetted to meet all established benchmarks for operating a competent and impartial certification program. Accreditation is a rigorous process and requires a significant budget, expertise, legal support, and industry cooperation. An important consideration of ANSI/ISO/IEC 17024 accreditation is international and government agency recognition. The Northwest Energy Efficiency Council (NEEC) has expressed interest in the ISO 17024 accreditation. NEEC plans to conduct a feasibility study this year that will include an informal conformity assessment of the Building Operator Certification (BOC®), as currently designed and administered, to ascertain which areas BOC administration meets and does not meet the standard. There are opportunities for NEEC to work with the national O&M certification community and federal agencies to make certain that

conformity to international accreditation standards harmonize with and support NEEC's vision for operator certification.

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