

No Operator Left Behind: Effective Methods of Training Building Operators

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Synopsis

This paper will address the issue of methods of training of facility operators to adequately operate buildings once they have been commissioned. A detailed description of the training methodologies required to develop training and materials is included that describes basic instructional concepts. These concepts include analysis, design, development, delivery, and evaluation of the training. Also discussed is the development of training materials including preparing an outline, gathering project information and preparing the training materials. A discussion of typical continuous training activities to ensure that training progresses after commissioning is also included.

About the Author

Bradley Brooks is an Associate Commissioning Manager with Glumac, a consulting engineering firm. He has more than twenty years of experience in all phases of the building industry, including design, construction, controls and facilities. Dr. Brooks has provided instruction on various topics for universities, colleges, and corporations. He holds a Bachelor of Engineering Technology, Masters of Arts Degree in Education, and a Doctorate Degree in Occupational and Technical Education. Dr. Brooks is a LEED® Accredited Professional, a member of BCA and an instructor for the University of California, Davis Extension Program providing training to facility staff to properly operate buildings.

Introduction

Operating a modern building is a complex task and the design and construction industry has yet to address the required training for facility staff to operate and maintain buildings as they are designed. Even the best designed and commissioned systems may be ineffective unless the facility staffs are trained to optimize performance of the systems. Training methodologies need to be developed and suited for building operators. Construction documents lack performance criteria on how the contractor will ensure that the facility staff has adequate training and skills to operate the building. Commissioning professionals are missing a profitable opportunity as they can add tremendous value by performing expert training and becoming a vital resource. Owners should get what they are paying for – a commissioned building with facility staff that are properly trained and understand how to operate the building to its optimal performance.

Developing Training

All instruction must have the proper design to be effective. The proper design provides a solid foundation for the instruction and supports the entire process. Developing any training program is a serious undertaking and the time and resources should be set aside to develop the facility operator training. Initially, specific analysis must be done to completely understand the characteristics of the work setting and define performance goals. The operators characteristics need to be assessed and a specific job content analysis to be performed. Once the analysis is completed, the training can be designed to meet the performance goals and objectives. This design is used to develop the content and the method of delivery of the training. The concluding step in the design of the training is to detail how the training will be evaluated to continue to improve the training.

Analysis

This step requires careful unbiased review of the work setting and the performance goals you wish to achieve. This often requires measurements of how the systems perform to provide a benchmark of the system. For example, if you are having difficulty maintaining boiler chemical treatment program, specific performance measurements must be recorded to know what current conditions exist. The degree of difficulty operating the equipment is of major concern when assessing systems for training. Also document the recorded history of performance of the equipment. Was it operated and maintained in the past? Is there a record of deficiencies, repairs, and upgrades? It is best to limit your analysis and scope to specific outcomes and small training modules. This will also help you manage your analysis and provide clear boundaries of the design.

As part of this analysis, the facility operator characteristics need to be assessed. There are many factors regarding the operator that can be recorded that may affect the design of the training; however, one should take note that too much data can cloud issues at hand and be detrimental to developing a training module. Some of the major characteristics to be noted include the following:

- Demographics-Age, gender, race, culture and physical condition.
- Aptitude-General skills, knowledge, abilities, experience, education and potential.
- Procedural Skills-Specific knowledge regarding the specific system, orientation, assistance, and resources.

Design

During the initial analysis phase, performance issues become evident and specific performance goals developed. The next step is designing a training plan that will meet the needs of the analysis. This training plan will be your road map for the entire training effort and detailed enough to meet the goals and objectives determined in your analysis.

This phase is essentially the schematic or design development phase. A summary of the goals and objectives are developed for the specific performance objective. Examples of the goals that one may be trying to achieve would be to reduce time spent on a procedure or maintain a piece of equipment to operate within defined limits. Goals should be specific, measurable and attainable within a timeframe.

Once the goals are defined then content description should be developed along with content topics and general instructional sequence. Goals form the basis for developing learning objectives. A goal may be for example: The purpose of the training is to teach operators how pleated air filters are properly changed in the fifth floor air handlers to maintain proper indoor air quality. Once the purpose is defined, learning objectives can be developed. For example: At the conclusion of this training, operators will be able to change pleated air filters in the fifth floor air handlers to maintain proper indoor air quality. You may need to develop the correct maintenance procedures before you can start developing your content.

Other design elements to be considered would be the length of training, number of participants, delivery strategy, and participant evaluation (testing). Evaluate all the delivery methods and vary them in order to provide a comprehensive discussion of the topics you wish to present. The use of lecture modes of instruction may be suited for short elementary sessions. Some of the best learning experiences for operators are to perform the actual work, perhaps a demonstration of the procedures, and then providing an opportunity for the operator to demonstrate their understanding by having them perform the procedure with assistance from the instructor or experienced operator.

The design should also describe the requirements of the facilities, when and where training will take place, the equipment utilized, tools required and any additional support staff. The qualifications of the instructors should not be overlooked as one needs to be skilled in the operation of the building and understand the fundamentals elements of delivering training. A start-up technician may be an expert in mechanical and electrical systems; however, they may not have the skills to present and train others. Evaluation methods should also be included in the design of the training.

Development

This element of the training is where the actual content is developed. The content is then developed utilizing the design guidelines, learning objectives, delivery and evaluation methods.

The actual procedure outline of the tasks of a maintenance process is detailed in an easy understandable method focusing on the learning objective. Instruction lesson plans, discussion points, safety issues, lists tools and equipment needed are all developed in this phase. The development of lecture notes, discussion points, graphics, demonstration points and procedures, and tests are also developed in this phase.

The use of visuals and actual equipment is extremely effective when training operators. Studies have concluded that engaging as many senses as possible results in very effective training and retention of concepts.

Delivery

Once the development is complete, the training is now ready to be conducted. This phase is where the actual training takes place and is provided to the operator. An experienced operator with adequate training qualifications should be able to review the training content and deliver the instruction with little or no research or development. Some points to be considered in delivering the training include:

- Explain roles, responsibilities, learning objectives, and expectations clearly
- Provide opportunities for operators to share their expectations
- Respect and build on the knowledge and skills of operators
- Use your own experience to explain concepts and procedures
- Exhibit energy by interacting with learners, asking effective questions, presenting with intensity, and using humor appropriately
- Develop collaborative relationships among operators
- Provide positive, timely feedback to operators constructively
- Listen to the learners for evidence of learning and engagement
- Ask for feedback on content and delivery and encourage learners to share new ideas to improve the learning experience
- Be flexible and make changes in the original design, based on the feedback gathered directly through questions, or through observation
- Interact with operators during breaks and visits to site
- Conduct training in a responsive and collaborative way
- Vary the use video presentations, lecture, slides, and testing.
- Try to use short informal quizzes to reinforce concepts with feedback.
- Respect answers and viewpoints different from yours, do not belittle learners and offer feedback in ways that are socially inappropriate for the ethnic or cultural groups represented in the training
- Make training a fun activity

Evaluate

Any training program should have evaluation to determine if was effective. To work toward excellence we need to be constantly improving the system, or in this case the training. Training is a rapid fluid process and when in progress it is difficult to make adjustments along the way. Some simple steps can be taken to improve the training process if not the actual training itself. The standard sequence to evaluate any training activity is represented by four levels. The levels gain in difficulty as you move through them; however the information you gain is more valuable.

The four levels are:

- Level 1 – Reaction
- Level 2 – Learning
- Level 3 – Behavior
- Level 4 – Results

Reaction

This is the simplest form of evaluation and it asks how operators react to the training. It is a measure of participant satisfaction. Usually done by a series of questions where participants rate the training. Positive responses are welcome but do not ensure learning, but a negative reaction certainly reduces the possibility of its occurring.

Learning

Learning is defined as the adopted new skill or knowledge by attending the training. This can be measured by observing the participant demonstrate their skills or knowledge that was presented in the training. One way is to perform an activity that they were not able to perform prior to the training. Another way is to design an instrument that records their new knowledge or skills performed and rates the performance.

Behavior

Behavior is defined as the extent to which a change in behavior has occurred because the operator has attended the training program. Often this measurement is not viewed as a part of an operator's training, especially when contractors are providing training as part of a construction project. However, a little training can go a long way if an operator develops an interest in a topic and begins to learn concepts independently; this is a change in a behavior that results from the training.

Results

Results are defined as the final results that occurred because of the training. The final results can include reduced engineer and contractor callbacks, improved system efficiency, longer life cycle of equipment, and improved productivity.

Developing Materials

Developing training materials for operators is a crucial component of the training. These materials may be utilized as part of the actual training or be designed as stand alone documents or media. It is important to understand the intended use of the training materials before you begin to design them. The basic steps to develop materials for training include:

- Preparing an outline
- Gathering project information
- Preparing the training materials

Preparing an Outline

This is the initial step in preparing training materials. This outline summarizes all the concepts included in the training materials. An outline is helpful as it keeps the focus on the goals and purpose of the training materials and helps address all the objectives.

Gathering Project Information

In this stage all the project and building information is compiled. Drawings, specifications, submittals, commissioning plans and reports, operation and maintenance manuals, RFI's, change orders, meeting notes, e-mails, issue logs, etc. After obtaining all the project documents, a thorough review of the documents must be completed to determine if sufficient information is available to develop training materials. In some cases, interviews with technicians or factory start-up representatives may yield information that was not documented in the construction documents. One should understand construction documents are designed to build a building or install equipment, not to be used for training of facility operators. This job is reserved for the person developing the training and requires analysis and selection of the proper project information.

Preparing the Training Materials

Once you have gathered all the project information and reviewed it for possible content in the training materials you must make decisions as to the type of training materials that will be developed. The materials that are developed should provide instructions to the learners as they may be used independent of the training. Actual contents of the material must be included, including all text and visual aids. This provides the operator with the information they need to achieve the performance objectives. Pre-tests and post-tests provide a method for the operator to assess their own understanding of the subject matter.

Developing Continuous Training

After the owner takes occupancy of a building or subsequent to a retro-commissioning process is an excellent time for the adoption of a continuous facility staff training program. The facility staffs has been exposed to training, there is new equipment, systems, and new procedures to be followed. As soon as possible the training program should be started. This task can be relatively simple at first and grow to something larger later on. The key is to start training on a regular basis to make learning a part of the facility operator's activities. One objective would be to reinforce the training provided after construction. Another would be to build on what was already provided.

An analysis should be performed on a regular basis to determine your department's training goals and objectives. Various informal activities can be arranged that inform, educate and train. A move to a more formal training format can be tailored to provide basic skills, specific systems training, or advanced instruction and education. The typical in-house learning activities include:

- Discussions of lessons learned
- Brown bag or lunch-and-learn sessions
- Formal training program

Discussions of Lessons Learned

These are very informal training sessions held occasionally to share tips and outcomes of actual experiences. This type of training helps others who may experience a similar situation. Lesson learned sessions are typically unstructured; however, a good synopsis of the problem or issue helps the participants understand better. Providing a question and answer period is a good way to provide detailed procedures and processes for solving the issue discussed. The sessions can be documented, recalled, and reviewed at a later time when a similar problem presents itself.

Brown Bag or Lunch-and-Learn Sessions

This type of training is more formal and presented in lecture format. A brown bag session is typically a short presentation on a specific topic and follows with discussions, questions and answers. Brown bag training requires some development of the training that will be presented and possibly a short evaluation. As the name suggests, this form of training is arranged during lunch time and therefore there is no normal workday interruptions.

Formal Training Program

Developing a formal training program requires significant resources. It can be a simple class or full blown set of courses tailored to the facility. However, courses will need to be developed, instructors will need to be determined, and facilities designated for the training. One distinct advantage is that it provides a framework for learning by designing a curriculum that operators can work through to build and construct knowledge and skills.

Conclusion

Few can dispute the importance of proper design and quality construction. Proper training requires the same level of detail as the design and construction process. Training and training materials need to adhere to a standard framework for training to be effective. Specifications need to incorporate these training methodologies and systems similar to other large sophisticated items. If we are to have buildings operate effectively and efficiently, the training must not be neglected and initial and continuous training of facility operators is one method to ensure a properly operated and maintained building.