

***Final Technical Report
Development of a Total Energy,
Environment and Asset Management
(TE²AM™) Curriculum***

***Submitted by
The University of Wisconsin–Madison College of
Engineering
Department of Engineering Professional
Development***

***To:
U.S. Department of Energy
National Energy Technology Laboratory***

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Reference Information:

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Johnson Controls, Inc.

Other Collaborators:
Baruch College of the City University of New York

Executive Summary:

The University of Wisconsin Department of Engineering Professional Development (EPD) has completed the sponsored project entitled, *Development of a Total Energy, Environment and Asset Management (TE²AM™) Curriculum*. The project involved the development of a structured professional development program to improve the knowledge, skills, capabilities, and competencies of engineers and operators of commercial buildings.

TE²AM™ advances a radically different approach to commercial building design, operation, maintenance, and end-of-life disposition. By employing asset management principles to the lifecycle of a commercial building, owners and occupants will realize improved building performance, reduced energy consumption and positive environmental impacts. Through our commercialization plan, we intend to offer TE²AM™ courses and certificates to the professional community and continuously improve TE²AM™ course materials.

The TE²AM™ project supports the DOE Strategic Theme 1 - Energy Security; and will further advance the DOE Strategic Goal 1.4 Energy Productivity. Through participation in the TE²AM™ curriculum, engineers and operators of commercial buildings will be eligible for a professional certificate; denoting the completion of a prescribed series of learning activities.

The project involved a comprehensive, rigorous approach to curriculum development, and accomplished the following goals:

1. Identify, analyze and prioritize key learning needs of engineers, architects and technical professionals as operators of commercial buildings.
2. Design and develop TE²AM™ curricula and instructional strategies to meet learning needs of the target learning community.
3. Establish partnerships with the sponsor and key stakeholders to enhance the development and delivery of learning programs.
4. Successfully commercialize and sustain the training and certificate programs for a substantial time following the term of the award.

The project team was successful in achieving the goals and deliverables set forth in the original proposal. Though attempts were made to adhere to the original project timeline, the team requested, and was granted a 6-month project extension, during which time the project was completed.

Project Accomplishments:

The stated goals for the project were to:

1. Identify, analyze and prioritize key learning needs of engineers, architects and technical professionals as operators of commercial buildings.
2. Employ a rigorous approach in the development of curricula and instructional strategies to meet learning needs of the target learning community.
3. Establish partnerships with the sponsor and key stakeholders to enhance the development and delivery of learning programs.
4. Successfully commercialize and sustain the training and certificate programs for a substantial time following the term of the award.

The project team successfully achieved each of the stated goals.

Goal 1: Needs Identification

For the first goal, *“Identify, analyze and prioritize key learning needs of engineers, architects and technical professionals as operators of commercial buildings.”* Team members performed a comprehensive assessment of the knowledge, skill, and mindset attributes of capable engineers and operators. The needs analysis lead to the development of a comprehensive competency model (Appendix A). The competency model not only provides insight into learning needs, it also provides a rubric for performance assessment, talent management, and organizational development.

Goal 2: Rigorous Development

For the second goal, *“Employ a rigorous approach in the development of curricula and instructional strategies to meet learning needs of the target learning community.”* The project team engaged a comprehensive curriculum development process and supporting educational technologies. These include, but are not limited to, design meta-data forms, modularization of the curriculum, development of PowerPoint and other instructional technology templates, creation of design and production standards, and strict adherence to recognized citation standards.

In addition the TE²AM™ project employed educational technologies in the support and management of course materials. This includes the development and implementation of test and production course and learning management systems as well as integration of TE²AM™ activities into EPD business management systems and structures.

Goal 3: Establish Partnerships

The project team was successful in achieving the third goal, *Establish partnerships with the sponsor and key stakeholders to enhance the development and delivery of learning programs.* Throughout the project, team members worked in consultation with our sub award partners, University of Michigan, Georgia Institute of Technology, and Johnson Controls, Inc. These partners provided guidance as to curricular and instructional design strategies, learning content, pilot review and testing of course materials, and peer review of the final program product.

In addition to partners included in the award, EPD reached out to, and collaborated with Baruch College of the City University of New York; sharing our expertise in Asset Management and Engineering, while benefiting from their expertise in commercial real estate. Similarly, EPD actively participated in efforts to incorporate DOE Job Task Analysis (JTA) work products into TE²AM™ products and services. Unfortunately, the timeline and work product from that team conflicted with our project goals and project plan. We will evaluate future outputs from that project as part of our continuous improvement activities.

Goal 4: Successful Commercialization

Though the project team is in the process of full commercialization of the TE²AM™ curriculum and Certificate Plan, we are confident that our long-range commitment to the project will serve the goals of the program well into the future.

Project Activities

The Project plan included seven main tasks. This section describes the task and sub-task structure of the project plan as well as adherence to the original schedule and major accomplishments. The project team was successful in achieving the goals and deliverables set forth in the original proposal. Though attempts were made to adhere to the original project timeline, the team requested, and was granted a 6-month project extension, during which time the project was completed.

Task 1: Project Management Plan.

The TE²AM™ curricula was developed using EPD's New Program Development Process (NPDP). The NPDP employs a "phase review discipline" project management structure. Each phase is characterized by a defined series of tasks, culminating in a phase (milestone) review. The NPDP process employs tools and processes common to best practices in industrial and educational product development.

Key subtasks of the project management plan accomplished throughout the lifecycle of the project include:

1. Project Initiation
2. Project Plan Development
3. Ongoing Project Management
4. Project Close-Out

The following table identifies key Task 1 activities and compliance to the project plan.

TE2AM Timeline - Task One Project Management and Planning	Start Date	Planned Date	Complete Date	Variance from Plan	% Complete
Task 1: Project Management and Planning					
Subtasks					
1 - Project initiation	7/2/10	8/16/10	8/15/10	1	100%
2 - Project plan development	8/15/10	2/11/11	10/1/10	133	100%
3 - Ongoing PM	12/28/10	12/7/12	12/31/12	-24	100%
4 - Project Close-out	6/10/12	6/10/12	12/31/12	-204	100%

Task 2: Integration Plan.

The TE²AM™ curriculum was designed using modular structural concepts. The design makes learning objects accessible to myriad instructional strategies, and making learning objects available through a mix of face-to-face, synchronous (live) on-line, and asynchronous (anytime) on-line instructional delivery systems.

Key subtasks of the integration plan accomplished throughout the lifecycle of the project include:

1. Development of the high-level concept

2. Development of the preliminary design

The following table identifies key Task 2 activities and compliance to the project plan.

TE2AM Timeline - Task Two Integration Plan	Start Date	Planned Date	Complete Date	Variance from Plan	% Complete
Task 2: Integration Plan					
Subtasks					
1 - High-level concept	7/2/10	8/16/10	8/1/10	15	100%
2 - Preliminary design	8/15/10	10/14/10	8/1/10	74	100%

Task 3: Curricula Deficiency/Developmental Needs Analysis

A crucial part of this effort was a comprehensive learning needs assessment. The needs assessment employed industry standard tools and processes to gain a complete understanding of participant learning needs as well as the program performance requirements.

The assessment focused on the leaning needs and requirements of program participants, the organizations in which they are employed, as well as societal needs related to the goals and objectives of the training program. In addition to learning needs, the assessment included technical requirements, including instructional system design requirements, performance attributes such as access, logistics, technical support, and participant engagement. Finally, the assessment identified key performance indicators and business process requirements so to enhance the effectiveness of marketing communications, financial performance, and participant support.

Upon completion of the needs assessment the project team developed a prioritized list of program requirements, which in turn was used to perform a gap analysis. The gap analysis was used to identify learning resources that were readily available, versus those needed development.

Unplanned was the development of a competency model for the target audience (Appendix A). One of the sources of delay was the additional step of building a comprehensive competency model. The model describes knowledge, skills, and mindsets of competent practitioners; and became the foundation for the curriculum and certificate structure.

The final design concept resulted in a curricular design that combines technical depth with managerial breadth into the design. In the area of management, the curriculum includes three courses, *Asset Management*, *Change Management*, and *Implementing Asset Management*. The technical course tracks include, *Energy Management*, *Environmental Management*, and *Energy Modeling*.

Key subtasks of the curriculum deficiency / developmental needs analysis accomplished throughout the lifecycle of the project include:

1. EPD project review
2. DOE review (not completed – no formal DOE concept review performed)
3. Modify project plan

The following table identifies key Task 3 activities and compliance to the project plan.

TE2AM Timeline - Task Three Curriculum Deficiency / Developmental Needs Analysis	Start Date	Planned Date	Complete Date	Variance from Plan	% Complete
Task 3: Needs Analysis					
1- Define program objectives / user requirements	8/15/10	2/11/11	5/1/11	-79	100%
Subtasks					
1 - EPD project report	12/28/10	4/1/11	4/20/11	-19	100%
2 - DOE review	12/28/10	4/30/11	4/30/11	0	0%
3 - Modify project plan	4/1/11	5/1/11	5/1/11	0	100%

Task 4: Curricula Development.

The development of the TE²AM™ curricula was executed in two phases. The first phase was the development of the High-Level Course Design. During this phase the project team weighed alternatives, developed course design elements, and managed risk. From there the team selected the most promising approach, then moving to the development of the initial curricular outline and the functional specifications for instructional processes, facilities, systems, and information technologies, as well as enumerating critical resource requirements and support elements.

Following the high-level design, the team progressed to a detailed design. Using standard instructional design methods, the design group engaged a rigorous curricular design and production process. The final design concept resulted in a curricular design that combines technical depth with managerial breadth into the design. In the area of management, the curriculum includes three courses, *Asset Management*, *Change Management*, and *Implementing Asset Management*. The technical course tracks include, *Energy Management*, *Environmental Management*, and *Energy Modeling*. The curriculum – including course titles, descriptions and contact hours can be found in Appendix B

Key subtasks of curriculum development accomplished throughout the lifecycle of the project include:

1. Prioritize learning needs
2. Develop detailed design requirements
3. Develop learning objectives
4. Develop alternative design concepts

5. Select most promising design strategy
6. Translate requirements into design specifications
7. Produce content
8. Evaluate design capability
9. EPD management review

The following table identifies key Task 4 activities and compliance to the project plan.

TE2AM Timeline - Task Four Curriculum Development	Start Date	Planned Date	Complete Date	Variance from Plan	% Complete
Task 4: Curriculum Development					
Subtasks					
1 - Prioritize learning needs	11/18/10	5/17/11	6/30/11	-44	100%
2 - Develop detailed design requirements	12/28/10	8/25/11	6/30/11	56	100%
3 - Develop learning objectives	12/28/10	8/25/11	6/30/11	56	100%
4 - Alternative design concepts	2/26/11	12/23/11	6/30/11	176	100%
5 - Select design	2/26/11	2/21/12	6/30/11	236	100%
6 - Translate requirements to specifications	2/26/11	4/1/12	10/30/11	154	100%
7 - Produce content	6/26/11	8/19/12	12/31/12	-134	100%
8 - Evaluate design capability	3/24/11	5/17/12	10/30/11	200	100%
9 - Management review	8/15/11	10/8/12	10/30/11	344	100%

Task 5: Consolidated Training Material

The development of the TE²AM™ curricula and associated learning technologies was accomplished through integration of management and technical subject matter in such a way as to make it immediately applicable in the workplace. Course learning objects were developed to accommodate learners at all levels, from novice to expert, and for all levels of Bloom's Taxonomy of learning engagement. This scalable approach provides optimal use of learning objects and enhances the cohesion of learning assets across learner groups and industry sectors.

The detailed design and consolidation phases ended with pilot testing and a cross-functional peer review by members of the sub award group. Thought leaders from the University of Michigan, Georgia Institute of Technology, and Johnson Controls, Inc. participated in a comprehensive peer review of the course content, instructional systems, commercialization plan, and continuous improvement strategy for the program.

Key subtasks of consolidating training material accomplished throughout the lifecycle of the project include:

1. Consolidate content and learning management systems
2. Pilot testing / peer review

The following table identifies key Task 5 activities and compliance to the project plan.

TE2AM Timeline - Task Five Consolidated Training Material	Start Date	Planned Date	Complete Date	Variance from Plan	% Complete
Task 5: Consolidated training material					
Subtasks					
1 - Consolidate content / learning systems	8/25/11	4/16/13	12/31/12	106	100%
2 - Pilot testing	2/21/12	1/31/14	12/12/12	415	100%

Task 6: Certification/Accreditation Plan

One feature of the TE²AM™ program is that participants in TE²AM™ courses are eligible for Continuing Education Units (CEU) or their equivalent, Professional Development Hours (PDH). EPD provides CEU/PDH certificates to participants who successfully complete TE²AM™ courses. EPD CEU/PDH's are recognized by all state regulatory/licensing agencies and satisfy professional licensure requirements. Similarly, CEU/PDH provided through EPD are applicable toward continuing education requirements of all generally recognized professional certification boards.

In addition to providing CEU/PDH certification, EPD has a mechanism in place to provide a professional certificate for those successfully meet TE²AM™ coursework and program requirements. TE²AM™ certification involves application to the program and completion of a approved program of study. TE²AM™ Certificates are valid for a period of five years and may be renewed by completing approved supplemental learning activities during the term of the Certificate. Certification Plan materials are included in Appendix C

Key subtasks of certification/accreditation plan accomplished throughout the lifecycle of the project include:

1. Include in multi-generational plan
2. Include in needs assessment
3. Include in curriculum development
4. Formalize and validate certification criteria
5. Develop certification plan, tools, and business systems

The following table identifies key Task 6 activities and compliance to the project plan.

TE2AM Timeline - Task Six Certification / Accreditation Plan	Start Date	Planned Date	Complete Date	Variance from Plan	% Complete
Task 6: Certification / Accreditation Plan					
Subtasks					
1 - Include in multigenerational plan	9/29/10	1/27/11	10/1/10	118	100%
2 - Include in needs analysis	11/18/10	5/17/11	6/30/11	-44	100%
3 - Include in curriculum development	12/28/10	8/25/11	6/30/11	56	100%
4 - Formalize and validate criteria	8/25/11	4/16/13	9/30/12	198	100%
5 - Develop tools	3/12/12	2/20/14	12/31/12	416	100%

Task 7: Implementation and Sustainability Plan

Though the actual commercialization of the TE²AM™ program is “out of scope” for this project, developing a commercialization plan was in the project plan and is included in project deliverables. The commercialization plan commits our organization to the commercialization and ongoing maintenance of the learning assets for a minimum of five years.

The goals of the commercialization are:

- To effectively communicate with potential customers and secure enrollments sufficient to meet the business plan and program goals
- To implement a regular schedule for review and revision of course materials and learning assets
- To develop and support an instructor corps sufficient to support instruction
- To enhance the environmental and economic performance of each program offering.

To achieve these goals, EPD will implement a Commercialization and Sustainability plan. The initial version of the plan addresses marketing activities, financial performance, technical support and maintenance of the learning assets, and environmental performance. A full description of the plan is presented in the Appendix D.

Key subtasks of commercialization and sustainability plan accomplished throughout the lifecycle of the project include:

1. Include in multi-generational plan
2. Develop detailed business plan
3. Develop continuous improvement plan
4. EPD management review

The following table identifies key Task 7 activities and compliance to the project plan.

TE2AM Timeline - Task Seven Commercialization / Sustainability Plan	Start Date	Planned Date	Complete Date	Variance from Plan	% Complete
Task 7: Commercialization and sustainability plan					
Subtasks					
1 - Include in multigenerational plan	9/29/10	3/28/11	10/1/10	178	100%
2 - Develop Detailed business plan	12/23/11	9/3/13	12/31/12	246	100%
3 - Develop continuous improvement plan	12/23/11	9/3/13	12/31/12	246	100%
4 - Management review	3/22/12	12/12/13	12/31/12	346	100%

Products and Technology Transfer

In this section products developed under the award and technology transfer activities, such as publications, websites, networks and collaborations, technologies and techniques, inventions and patent applications, and other products are identified.

Publications

During the term of the award, project team members participated in a number of conferences, presenting the results of project work, or including elements supported by project activities combined with other works. These include:

International Standards Organization – ISO 55000 Technical Advisory Group
Presentation on Asset Management
Thomas Smith
February 5-11, 2012
Pretoria, South Africa (award funds were not used to fund meeting attendance)

Baruch College - CUNY Conference
Asset Management Concepts and Applications
Carl Vieth
Thomas Smith
February 24, 2012
New York, NY

International Standards Organization – ISO 55000 Technical Advisory Group
Presentation on Asset Management
Thomas Smith
March 13-26, 2012
Virtual Meeting

World Conference - International Association Engineering Continuing Education
Presentation: Linking Engineering Continuing Education To Learning Needs, An Emerging Paradigm
Carl Vieth
May 18, 2012
Valencia, Spain (award funds were not used to fund meeting attendance)

World Conference - International Association Engineering Continuing Education
Presentation: Integrating “Big Data” into Engineering Continuing Education
Philip O’Leary
Thomas Smith (did not attend)

May 19, 2012

Valencia, Spain (award funds were not used to fund meeting attendance)

World Conference - International Association Engineering Continuing Education

Presentation: A Competency Model Approach To Engineering Continuing Education Program Development

Carl Vieth

Philip O'Leary

Thomas Smith (did not attend)

May 19, 2012

Valencia, Spain (award funds were not used to fund meeting attendance)

Meridium Conference 2012

Asset Management Concepts and Applications

Thomas Smith

April 23, 2012

Jacksonville, FL

Baruch College - CUNY Conference

Panel Discussion – Facility Operator Competencies

Carl Vieth

Thomas Smith

April 26, 2012

New York, NY

University of Wisconsin – Madison Short Course

Advanced Asset Management

Thomas Smith

Carl Vieth

May 9-10, 2012

Madison, WI

University of Wisconsin, Electrical and Computer Engineering Alumni

Presentation: TE²AM™ - Engineering Competencies for Energy and

Environmental Management

Carl Vieth

June 6, 2012

Santa Clara, CA

International Standards Organization – ISO 55000 Technical Advisory Group

Presentation on Asset Management

Thomas Smith

June 10-16, 2012

Prague, CZ (award funds were not used to fund meeting attendance)

Baruch College - CUNY Conference
Overview Asset and Energy Management
Carl Vieth
Thomas Smith
June 21, 2012
New York, NY

Johnson Controls, Inc.
Energy Town Hall
Carl Vieth
July 20, 2012
Milwaukee, WI

University of Wisconsin Distance Learning Conference
Presentation: A Competency Model Approach To Engineering Continuing
Education Program Development
Carl Vieth
Thomas Smith
August 9, 2012
Madison, WI

University of Wisconsin – Madison Short Course
Asset Data Management
Thomas Smith
September 26-27, 2012
Madison, WI

Baruch College - CUNY Conference
Presentation: TE²AM™ and Alternative Energy in Facilities
Thomas Smith
November 20, 2012
New York, NY

University of Wisconsin – Madison Short Course
Implementing Asset Management
Carl Vieth
Thomas Smith
December 12-14, 2012
Madison, WI

Institute for Engineering and Technology
Advanced Asset Management
Thomas Smith
Carl Vieth, Chicago
October 5, 2012
Chicago, IL

Web Sites

During the term of the award, no TE²AM™ content web sites were developed.

Networks and Collaborations

During the term of the award, TE²AM™ project team members fostered an ongoing collaboration with Baruch College – City University of New York. This has resulted in sharing of TE²AM™ work products, including competency model and presentations.

Technologies and Techniques

During the term of the award, TE²AM™ project team members refined a novel approach to competency modeling, including a comprehensive TE²AM™ competency model. The technique and work product were not patented.

Inventions and Patent Applications

During the term of the award, no TE²AM™ patent applications were submitted.

Other Products

During the term of the award, no TE²AM™ products, other than those described above, were developed.

Appendix A: Competency Model

Energy, Environmental, and Asset Manager Competency Model

With Application to Commercial Facilities

Science and Technology

Economics and Business

Analysis, Modeling and Design

Management and Planning

Tools and Support Systems

Ideas and Innovation

Personal Effectiveness

Working Across Boundaries

Competency Model Contents

- Target Audience
 - Background
 - Levels of Engagement
- About the Model
 - Topics in the Model
 - Levels of Performance
- Functional Descriptions for Level II Performer (team leader)
 - Science and Technology
 - Economics and Business
 - Planning, Analysis, Modeling and Design
 - Management
 - Tools and Support Systems
 - Ideas and Innovation
 - Personal Effectiveness
 - Working Across Boundaries
- Appendix A: Bibliography
 - Competency Modeling literature
 - Technical References by Competency

Energy, Environmental and Asset Manager Competency Model

Target Audience

1. Technical professionals who are open to using an asset management approach and are responsible for facility engineering, energy management, and/or environmental management.
2. Building or facility managers looking for new approaches to more effectively manage their facilities while balancing energy, environmental, and cost constraints.
3. Asset managers and facility managers with comprehensive responsibilities for energy and environmental programs and projects.

Assumed Background

1. Bachelors degree
2. Significant work experience in energy, environmental or asset management
3. Significant work in facilities management, design and construction or maintenance and reliability

Levels of Engagement

The target audience includes individual contributors and team leaders within an organization. The competency model document describes the knowledge and skills necessary for a team leader involved in supporting organizational change.

Energy, Environmental and Asset Management

The functions of energy management and environmental management fit well under an asset management umbrella. In many organizations, management structures separate these management areas into different functional silos. Similarly, organizations often “silo” design/build, operations, maintenance, and retirement operations. As a result, there is often little or no consideration of the system interactions and the lifecycle performance of the asset when making business decisions. In many organizations, organizational systems and structures are such that they make impossible such integration. The TE2AM project advances an integrated structure. The abbreviation EEAM (Energy, Environment, and Asset Management) will be used throughout this document to refer to the integrated approach.

Commercial Facilities Defined

The *Commercial Sector* is defined by the Department of Energy to include the following activities, in order of total consumption: Office, Mercantile, Education, Health Care, Lodging, Warehouse, Food Service, Public Assembly, Food Sales, Service, Other, Religious Worship, Federal Facilities, Public Safety, and Vacant.

“Facilities” is a term used to refer to the primary building, its internal activities, and associated external activities and functions, such as parking and landscaping. Management of traditional internal functions common to commercial facilities, such as a lighting or HVAC, is included in the competency model. Management of specialty facilities or specialty functions with large energy and environmental impacts, such as data centers or refrigerated storage, are not specifically addressed, though it is recognized that facility managers will have responsibilities for integrating specialty functions in the overall management of the facility.

About The Model

The Department of Engineering Professional Development (EPD) has constructed a number of competency models to guide engineering curriculum in the academic setting and engineering talent management in commercial and governmental organizations. Several of these models have been tested and evaluated within a corporate setting and are in use today. This activity has led to the development and adoption of a generic advanced engineering competency model (Figure1.)

In developing this model, EPD staff reviewed the competency modeling literature and benchmarked the internal models used in a number of technology-based companies and agencies, as well as the Bodies of Knowledge published by relevant engineering organizations. The attached bibliography provides a listing of the key literature and references to competency models, and related information on the websites of leading businesses, societies and organizations.

The EPD competency model is more holistic compared to the functionally focused models favored at the vocational level. The model is hierarchical in structure, with 8 competency *domains*. Each domain consists of *attributes*; that provide boundary, scope, and definition to the domain. Each attribute describes knowledge, skill, and attitudinal characteristics of competent practitioners. Attributes may be further defined by *observable behaviors*.

The model has been tested with a variety of triangulation techniques, including individual self-assessment, peer assessment, and managerial assessment. The competency model is capable of incorporating other empirical assessment techniques, including knowledge and performance testing. To aid in this effort, an industry standard reference is provided for each of the competencies listed.

Topics in the Model

The overall structure of the competency model provides for consistent definition and application of competency domains and key attributes. But since competent practice is defined within the context and culture of the local organization, individual competencies, and level of detail associated with them will vary based on the organizational requirements. The EEAM model was created for general application within a broadly defined commercial sector, therefore the model contains “generic” knowledge, skill and value attributes.

In our model, competencies are grouped into three related clusters – these are represented in the above block diagram as rows. The clusters are:

- Domain Knowledge and Skills: includes the competencies:
 - Science and Technology,
 - Economics and Business,
 - Analysis, Modeling and Design
- Institutional Knowledge and Skills: includes the competencies:
 - Management and Planning,
 - Tools and Support Systems

- Personal Knowledge and Skills: includes the competencies:
 - Ideas and Innovation,
 - Personal Effectiveness,
 - Working Across Boundaries

The competencies and their grouping are similar to those found in most professional or managerial competency models.

Science and Technology

This domain describes knowledge and skill attributes demonstrated by competent practitioners in the area of science, engineering, and technology. The attributes represent an advanced understanding and application of scientific principles, engineering constructs, and technologies relevant to EEAM. Science and technology attributes represent a cross section of basic and applied science disciplines, and describe what and how competent EEAM practitioners apply these attributes in professional practice.

Economics and Business

This domain describes knowledge and skill attributes demonstrated by competent practitioners in the area of economics and business. The attributes represent an advanced understanding and application of macro- and microeconomics principles, finance, and how EEAM impacts the business enterprise specific to commercial real estate. Economics and business attributes provide a sound foundation for decision making to create value throughout the lifecycle of the facility.

Planning, Analysis, Modeling, and Design

This domain describes knowledge and skill attributes demonstrated by competent practitioners in the area of planning, analysis, modeling, and design. The attributes represent an advanced understanding and evaluation, selection and application of advanced engineering tools that support effective decision-making throughout the lifecycle of the facility. In addition to modeling and simulation, attributes incorporate the application of building codes and standards, operations and maintenance, and end-of-life retirement of the facility.

Management

This domain describes knowledge and skill attributes demonstrated by competent practitioners in the area of management. The attributes represent an advanced understanding and application of management systems standards, management and operations principles, accounting, and how EEAM impacts the business enterprise specific to commercial real estate. Quality and continuous improvement practices, such as PDCA or Lean Six Sigma provide a structural framework for addressing business challenges throughout the lifecycle of the facility. Similarly, the attributes within this domain incorporate management activities and information systems employed in the management of the facility; these include, but are not limited to, ERP and BIM.

Tools and Support Systems

This domain describes knowledge and skill attributes demonstrated by competent practitioners in the area of engaging organizational tools and support systems. The attributes represent an advanced understanding and application of classes and types of tools that are general in nature. The attributes describe how competent practitioners effectively apply key concepts in their interaction with and application of local IT and decision support systems and structures in the management and operation of the facility throughout the lifecycle.

Ideas and Innovation

This domain describes knowledge and skill attributes demonstrated by competent practitioners in the area of ideation and innovation. The attributes represent an advanced understanding and application of tools and processes that engage creativity and translate ideas to innovative design and management practices specific to commercial real estate. Attributes within this domain define how competent practitioners create, evaluate, and employ innovative elements into the design, operation, maintenance, and retirement of commercial facilities.

Personal Effectiveness

This domain describes knowledge and skill attributes demonstrated by competent practitioners in their personal effectiveness. The attributes represent an advanced understanding and application of key behaviors in knowledge management, professional development, effective oral and written communication, ethical behavior, and team leadership.

Working Across Boundaries

This domain describes knowledge and skill attributes demonstrated by competent practitioners in their ability to work across boundaries. The attributes represent an advanced understanding and application of key behaviors in cross-cultural awareness, organizational structures, and social and business mores. Attributes define key behaviors in understanding and accommodating cross-cultural differences at the organizational, regional, national, and global level. Competent practitioners will be influential in accomplishing business objectives, even when they do not have the direct authority to enact change.

Levels in the Model

Blooms Taxonomy (1956) is a widely used descriptor of functional levels in competency modeling and in the translation of these models to educational objectives. In addition to its widespread use, a significant advantage of Blooms Taxonomy is its flexibility to be translated to specific terms for a particular industry or field. The chart below shows the terms that we will use in this EEAM Competency model.

Blooms Taxonomy	Facilities Management Terms
Create	Design, Specify
Evaluate	Evaluate, Audit
Analyze	Analyze, Audit,
Apply	Implement
Understand	Understand, Describe, Quote
Remember	Remember, Identify,

Technical References

The competency model describes knowledge and skill attributes that define consistent, competent practice at a concept level. It would be impossible to inventory all of the details of every knowledge and skill attribute desirable in an EEAM practitioner. Though we believe that competent practitioners possess a wide and varied knowledge and skill set, we also understand that these sets are relevant to the practitioner's role, location, education, and myriad other factors.

In creating this model, we employ commonly available, and well-known references to define specific technical knowledge sets. These may be codes and standards, handbooks, industry best practices, society and organizational certifications, or other skill set models. The references are listed in the bibliography.

Science and Technology

1. Understanding of:
 - a. Energy issues and trends on a local, regional, national, and global scale.
 - i. Sources
 - ii. Production and Consumption
 - iii. Economics
 - iv. Trends
 - v. Technologies
 - b. Environmental issues and trends on a local, regional, national, and global scale.
 - i. Climate
 - ii. Carbon
 - iii. Water and Land Resources
 - iv. Economics
 - v. Trends
 - vi. Technologies
 - c. Facility energy use, impacts, and interrelationships of key systems
 - i. Envelope
 - ii. HVAC
 - iii. Lighting
 - iv. Heated and Chilled Water
 - v. Electrical Service / Plug
 - vi. Exterior and Site
 - d. Facility environmental impacts and interrelationships of key elements
 - i. Site impacts (greenfield and brownfield)
 - ii. Facility and Building Systems
 - iii. Refrigerant management
 - iv. Water management
 - v. Solid and hazardous waste
 - vi. Air quality
 - vii. Transportation
 - viii. Society and community
 - e. Contemporary energy and environmental impact asset management strategies
 - i. Design, Create, Acquire
 - ii. Use and Operate
 - iii. Maintain
 - iv. Renew, Recycle, Repurpose, Retire
 - f. Contemporary energy and environmental impact asset management standards and practices
 - i. Regulatory standards and practices – codes and regulations
 1. Energy
 2. Environmental
 - ii. Voluntary standards and practices
 1. ASHRAE

2. Energy Star
3. Green Star
4. ISO
5. USGBC – LEED

g. Applications and implications of key alternative and energy efficiency technologies

- i. Solar (PV and Thermal)
- ii. Wind
- iii. Geothermal
- iv. Conservation and energy management

2. Application of:

- a. Employs industry accepted standards and practices and advanced concepts in energy measurement in assessing and auditing energy performance of commercial facilities
- b. Employs industry accepted standards and practices and advanced concepts in energy measurement in assessing and auditing environmental performance of commercial facilities, including advanced and integrated monitoring and validation.
- c. Employs industry accepted standards and practices and advanced concepts in integrated control strategies for major building systems at the site, campus and enterprise level.
- d. Employs industry accepted standards in the planning, design, and construction of commercial facilities relative to lifecycle energy use and environmental impact.
- e. Employs industry accepted standards in the design, operation, management and operation of commercial facilities relative to occupant comfort and indoor air quality.
- f. Employs industry accepted standards in the management and operation of commercial facilities relative to lifecycle energy use and environmental impact.
- g. Employs industry accepted standards in the maintenance of commercial facilities relative to lifecycle energy use and environmental impact.
- h. Employs industry accepted standards in the end-of-life management and disposition of commercial facilities relative to lifecycle energy use and environmental impact.
- i. Employs appropriate technologies and systems engineering concepts to integrate energy, environment and asset management in a facility, campus, or enterprise. Effectively manages and balances while balancing conflicting interests and trade-offs between organizational priorities.

Economics and Business

1. Understanding of:
 - a. Advanced concepts of energy economics at the international, national, regional and local level
 - b. Advanced concepts of environmental economics at the international, national, regional and local level
 - c. Advanced concepts of carbon economics at the international, national, regional and local level
 - d. Advanced concepts of asset management and the use of economic measures across the asset lifecycle
 - e. Content and concept of Department of Energy definitions of Commercial Building Sector
 - f. Economic fundamentals of the facilities business including, sources of revenue, operating budgets, and occupants and occupancy.
2. Application of:
 - a. Employs industry accepted economic strategies and methods to asset development and acquisition processes
 - b. Employs industry accepted economic strategies and methods to asset operations and management processes
 - c. Employs industry accepted economic strategies and methods to asset maintenance and reliability management processes
 - d. Employs industry accepted economic strategies and methods to end-of-life asset disposition processes
 - e. Employs industry and organizational accepted budgeting and financial management strategies and methods in daily business operations
 - f. Tracks and engages economic incentive programs related to energy and environment

Analysis, Modeling and Design

- 1. Understanding of:**
 - a. Advanced concepts and practices associated with Design for Environment and Design for Energy
 - b. Advanced concepts and practices associated with statistical analysis and modeling of facilities and systems
 - c. Criteria and standards for design and operation of energy efficient facilities
 - d. Contemporary energy and environmental impact asset management strategies
 - e. Contemporary energy and environmental impact standards and practices
 - f. Understands principles of Eco Design as applied to facilities and facility systems design, construction, and deconstruction
 - g. Assumptions and performance characteristics of common energy and environmental modeling and simulation software packages
 - h. Assumptions and performance characteristics of common energy and environmental benchmarking and performance reporting databases
- 2. Application:**
 - a. Employs industry accepted economic strategies and methods to gather energy consumption and environmental performance data from a variety of sources within commercial facilities.
 - b. Employs industry accepted strategies and methods to analyze facility energy use and by source and function/activity
 - c. Employs industry accepted strategies and methods to analyze facility environmental impact by source and function/activity
 - d. Employs industry accepted risk analysis strategies and methods to analyze energy and environmental impact risks across the facility lifecycle
 - e. Employs industry standard tools and software packages to model energy and environmental performance of design, operations, maintenance, and disposition alternatives.

Management and Planning

1. Understanding of:
 - a. The role and facility of various management systems models.
 - i. Lean
 - ii. Six-Sigma
 - iii. Deming Cycle (PDSA)
 - b. Advanced concepts, systems and management applications associated with:
 - i. Project Management
 - ii. Asset Management
 - iii. Change Management
 - c. Key components and requirements associated with International Organization for Standardization (ISO) standards for:
 - i. Energy (ISO 50000)
 - ii. Environment (ISO 14000)
 - iii. Asset Management (ISO 55000)
 - iv. Quality (ISO 9000)
 - v. Systems Engineering (ISO 15288)
 - d. Relationships and interaction between physical facilities, operations, management structures, and ownership models in relationship to energy efficiency and environmental impact.
 - e. Reliable sources (official and voluntary) for regulatory codes, standards, and current best practices at local, state, and national level.
2. Application of:
 - a. Employs industry accepted project management systems and practices to plan, organize, secure and manage resources throughout all project phases.
 - i. Initiation
 - ii. Planning and design
 - iii. Execution
 - iv. Monitoring and control
 - v. Completion
 - b. Employs industry accepted change management systems and practices to transition an organization from current state to desired future state in an efficient and reliable manner.
 - c. Employs industry accepted asset management systems and practices in the management of an organization's physical assets throughout each phase of the asset lifecycle.
 - i. Design, Create, Acquire
 - ii. Use and Operate
 - iii. Maintain
 - iv. Renew, Recycle, Repurpose, Retire

- d. Employs industry accepted processes and procedures to assure adherence to applicable regulatory (codes) and voluntary (standards) compliance standards.
- e. Employs appropriate lifecycle economic analysis and contracting principles in every phase of physical asset management
 - i. Design, Create, Acquire
 - ii. Use and Operate
 - iii. Maintain
 - iv. Renew, Recycle, Repurpose, Retire
- f. Employs appropriate information systems and decision support technologies in:
 - i. Project management
 - ii. Change management
 - iii. Asset management
 - iv. Energy management
 - v. Environmental impact management
 - vi. Regulatory compliance
- g. Employs a systematic approach to continuous improvement
- h. Employs a systematic approach to employee training and professional development, based on organizational and individual learning needs and institutional requirements.

Standard Tools and Support Systems

1. Understanding of:
 - a. The structure and functionality of enterprise-wide and departmental Information Technologies.
 - i. Enterprise Resource Planning Systems
 - ii. Asset Management (including maintenance management) Systems
 - iii. Engineering Systems
 - iv. Document Management Systems
 - b. The structure, functionality, and applicability of building information systems across the lifecycle of the facility
 - i. Design / Construction
 - ii. Operations
 - iii. Maintenance
 - iv. Retire / Reuse / Repurpose
 - c. The structure, functionality, and applicability of discrete building information management (BIM) and control systems (e.g. security, fire, lighting)
 - d. The structure, functionality, and applicability of geographic information systems (GIS) across the lifecycle of the facility
 - i. Design, Create, Acquire
 - ii. Use and Operate
 - iii. Maintain
 - iv. Renew, Recycle, Repurpose, Retire
 - e. Sources and quality characteristics of energy and environmental impact data.
 - f. Statistical tools and techniques for the collection, analysis, organization, analysis and interpretation of data.
2. Application of:
 - a. Employs industry accepted and rigorous approach to observational and experimental data collection and analysis.
 - i. Design and planning
 - ii. Design of experiments
 - iii. Controlling of variables
 - iv. Application of appropriate statistical tools
 - b. Employs organizational information systems, common tools, and approaches to:
 - i. Data collection
 - ii. Data analysis
 - iii. Interpretation of results
 - iv. Reporting of findings

- c. Employs industry-accepted finance and accounting tools and practices in the economic interpretation of energy and environmental impact data.
- d. Employs industry-accepted planning and risk management tools and practices in the management of information systems.
- e. Employs organization's asset management information systems and practices in the management of physical assets throughout each phase of the asset lifecycle.
 - i. Design, Create, Acquire
 - ii. Use and Operate
 - iii. Maintain
 - iv. Renew, Recycle, Repurpose, Retire
- f. Employs industry accepted processes and procedures to assure adherence to applicable regulatory (codes) and voluntary (standards) compliance standards.
- g. Employs appropriate information systems and decision support technologies in:
 - i. Project management
 - ii. Change management
 - iii. Asset management
 - iv. Energy management
 - v. Environmental impact management
 - vi. Regulatory compliance
- h. Employs a systematic approach to continuous improvement
- i. Employs organization-specific and industry standard reporting and documentation.
- j. Employs a systematic approach to employee training and professional development, based on organizational and individual learning needs and institutional requirements.

Ideas and Innovation

1. Understanding of:
 - a. Methods and processes by which to evaluate novel technologies and approaches to energy and environmental management for facilities
 - b. Concepts, methods and practices in modeling and analysis of buildings and building systems
 - c. Advanced concepts, systems and management applications associated with:
 - i. Facilities energy management
 - ii. Facilities environmental management
 - iii. Asset management for facilities
 - d. Statistical tools and techniques for the collection, analysis, organization, analysis and interpretation of facilities and associated utility data.
 - e. Industry codes, standards, and guidelines related to commercial buildings (energy standards, environmental standards, comfort standards, indoor air quality standards, etc.)
2. Application of:
 - a. Employs industry accepted and rigorous approaches to observational and experimental data collection and analysis.
 - b. Employs a systematic approach to the analysis of competitive and alternative technologies for building mechanical systems, lighting technologies and other infrastructure related to buildings
 - c. Creates an environment of innovation and exploration
 - d. Employs industry accepted processes and procedures to translate technical opportunities into competitive service offerings
 - e. Challenges established practices and proactively finds creative solutions to engineering challenges
 - f. Employs rigorous standards to engineering documentation and technical communication of the discovery and design process,
 - g. Employs a systematic approach to innovation and development through multi-generational product planning

Working Across Boundaries

1. Understanding of:
 - a. Impact of national, regional, local, and organizational cultures on business and operations
 - b. Organizational systems, structures, and boundaries, and their impact on interpersonal and business relationships
 - c. Potential cross-cultural conflicts and their impact on business and social codes and mores
2. Application of:
 - a. Manages the complexity of working across multiple countries, functions, entities, and cultures
 - i. Employs systems and processes that enable management of geographically distributed teams
 - ii. Communicates in unambiguous terms that enable global understanding
 - iii. Employs practices and processes that support technical and business activities across functional units and across organizational boundaries
 - b. Incorporates international national, regional, and local standards and regulations in design and implementation
 - i. Consistently researches, interprets and incorporates engineering and technical standards across multiple jurisdictions
 - ii. Manages and mitigates conflicting standards and requirements to optimize organizational performance
 - iii. Communicates with appropriate local regulatory agencies to proactively manage design, development and deployment
 - c. Adapts personal mannerisms, styles, and communication practices to accommodate various cultures
 - i. Demonstrates respect and understanding and consideration of local language, custom, and social mores in engineering and business practice
 - ii. Modifies technical and business methods based on a comprehensive understanding of local practice and customs
 - d. Incorporates organizational values into the requirements of local culture
 - i. Maintains commitment to corporate values – even when in conflict with local custom
 - ii. Mitigates risk to corporation when local standards and practice are in conflict with legal, technical, and moral considerations
 - iii. Communicates corporate values and practices to customers and other external constituents

Personal Effectiveness

1. Understanding of:
 - a. The role and importance of personal commitment to individual professional practice and ethics and the value of compliance to recognized professional standards.
 - b. The role and importance of lifelong learning and the value of personal development with regard to professional practice
 - c. The role and importance of accountability and the value of personal responsibility with regard to organizational performance
2. Application of:
 - a. Employs proven strategies and methods to build and lead high-performing technical teams
 - b. Demonstrates commitment to personal integrity in words and deeds
 - c. Embraces concepts and practice of sustainability in products, practices, and processes
 - d. Develops and maintains a personal development plan, and engages leadership in achieving plan objectives
 - e. Employs proven strategies and methods to find, vet, organize, store and communicate reference information and materials
 - f. Employs proven practices and processes to conduct research in support of engineering and management activities
 - g. Communicates effectively
 - i. Listens actively
 - ii. Seeks and welcomes alternative and/or conflicting points of view
 - iii. Provides clear, concise and consistent direction to others, verifies the content and context of communication has been successfully delivered
 - iv. Communicates complex technical and business information to customers, business partners, and other external constituents
 - h. Creates a culture of accountability; fosters ownership of results
 - i. Establishes clear goals and activities that support organizational objectives, while optimizing the use of organizational resources and capital

Appendix A: Bibliography

Bloom, B. S., Engelhart, M. D., Furst, E. J., Hill, W. H., & Krathwohl, D. R., Taxonomy of educational objectives: the classification of educational goals; Handbook I: Cognitive Domain New York, Longmans, Green, (1956).

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Appendix B: Course Titles, Descriptions, Contact Hours

Core Curriculum

The following represents the core TE²AM™ curriculum and includes course categories, course titles, contact hours and descriptions. The total core curriculum includes:

- For all courses
 - 36 total courses
 - 76.5 total contact hours
- Asset Management courses
 - 4 courses
 - 6 total contact hours
- Change Management courses
 - 9 courses
 - 13 total contact hours
- Implementing Asset Management courses
 - 6 courses
 - 8 total contact hours
- Energy Management courses
 - 11 courses
 - 23 total contact hours
- Environmental Management courses
 - 5 courses
 - 10.5 total contact hours
- Energy Modeling courses
 - 1 course
 - 16 total contact hours

Asset Management Courses:

Just Enough Asset Management

1 Contact Hour

Asset management has been around for 20+ years. It is newly emerging as a favored topic in management and will be applied to commercial facilities.

What does an operator or contract employee need to know about asset management: what it is, how it is viewed, how affects employees, how it can affect the business they serve.

The Asset Management Framework

2 Contact Hours

This course describes asset management and the management systems approach to asset management. It then describes the ways in which asset management can incorporate energy and environmental management programs and improve their long-term effectiveness. An integration model, across time and function is provided. The use of asset data and the need for asset data management is also described, as is the need for new measures of asset effectiveness.

The New Asset Management Paradigm

2 Contact Hours

Course content focuses on:

- Concept/Theory of Asset Management
- ISO Standard for Asset Management

Your Role in Asset Management

1 Contact Hour

The new concept of effective asset management incorporates three fundamental elements: it is strategic, comprehensive and data driven. This new concept separates current asset management from previous concepts and provides a set of directions for those involved in asset operations.

Individual roles are discussed in relation to asset stages, and asset systems integration.

Change Management Courses:

Introduction to Change Management

1.5 Contact Hours

This learning module provides an overview of change management, with a focus on the business imperative for managing change in a systematic and predictable way. In addition, the module includes a discussion of contemporary change management models and a discussion of the change management process that is the foundation for this series.

Setting the Stage

1.5 Contact Hours

This learning module describes the key roles and responsibilities of the change agent and project team. In addition, the model describes the activities that must be completed in preparation for a change management initiative. Learners are provided with tools and strategies that can be employed during this phase of the change management process.

Unsettling the Status Quo

1.5 Contact Hours

This learning module describes the importance of challenging the status quo in supporting a change management initiative. The model describes key strategies and activities that create momentum and mitigate resistance to a change management initiative. Learners are provided with tools and strategies that can be employed during this phase of the change management process.

Creating a Vision

1.5 Contact Hours

This learning module describes the importance of creating a compelling shared vision that supports a change management initiative. The model describes key strategies and activities that create momentum and mitigate resistance to a change management initiative. Learners are provided with tools and strategies that can be employed during this phase of the change management process.

Making Change Happen

2 Contact Hours

This learning module describes a systematic approach to implementing a change initiative. The model describes key communication and resistance management strategies and activities that support a change management initiative. Learners are provided with tools and techniques that can be employed during this phase of the change management process.

Sustain the Gain

1 Contact Hour

This learning module describes the importance maintaining the gains of a change initiative. The model describes strategies that capture change benefits and prevent organizational backslide. Learners are provided with tools and techniques that can be employed during this phase of the change management process.

Monitoring Progress

1 Contact Hour

This learning module describes the importance of establishing ongoing monitoring and measurement in maintaining the gains of a change initiative. The model describes tools and techniques that are crucial to establishing a monitoring system that delivers business results. Learners are provided with tools and techniques that can be employed during this phase of the change management process.

Aligning the Organization

1.5 Contact Hours

This learning module provides an overview of change management, with a focus on the need to align organizational systems and infrastructure so they support the change initiative in a rational and predictable way. The model describes critical organizational infrastructure that should be considered for realignment. Learners are provided with tools and techniques that can be employed during this phase of the change management process.

The Role of Leadership

1.5 Contact Hours

This learning module provides an overview of change management, with a focus on the role of leadership in the change initiative. The model describes critical leadership and management roles in change initiatives. Learners are

provided with tools and techniques that can be employed during this phase of the change management process.

Implementing Asset Management Courses

Implementing Asset Management – Module One

1.5 Contact Hours

This learning module provides an overview of implementing asset management, with a focus on how proven change management practices can improve the likelihood of a successful implementation.

Implementing Asset Management – Module Two

0.5 Contact Hours

This learning module describes the common implementation strategies. Learners are provided with tools and techniques that can be employed to assure effective implementation of an asset management system.

Implementing Asset Management - Module Three

1 Contact Hour

This learning module describes the common implementation strategies. Learners are provided with tools and techniques that can be employed to assure effective implementation of an asset management system.

Implementing Asset Management – Module Four

2 Contact Hours

This learning module describes the key activities in preparing to implement asset management. Learners are provided with tools and strategies that can be employed to assure effective implementation of an asset management system.

Implementing Asset Management – Module Five

2 Contact Hours

This learning module describes a systematic approach to implementing a change initiative. The model describes key communication and resistance management strategies and activities that support a change management initiative. Learners are provided with tools and techniques that can be employed during this phase of the change management process.

Implementing Asset Management – Module Six

1 Contact Hour

This learning module provides an overview of implementing asset management, with a focus on the need to align organizational systems and infrastructure to support the asset management system. The material includes critical organizational infrastructure that should be considered for

realignment. Learners are provided with tools and techniques that can be employed to enhance asset management.

Energy Management Courses

Building Automation Systems

2 Contact Hours

Ensuring that operations are optimized through implementing various operating strategies can reduce energy consumed by building systems. Control and optimizing strategies can be implemented using the various functions and features of building automation systems.

Introduction to Building Energy Related Codes and Standards

2 Contact Hours

Hours Building energy codes play a key role in reducing building energy costs, our nation's reliance on foreign oil, and carbon emissions. This module introduces the student to baseline building energy codes and current beyond code programs.

Intro to Building Energy Use and Environmental Impact of Building Operations

2 Contact Hours

This module will educate the student on energy use in commercial buildings, the type of energy used and the environmental impact of building operations.

Energy Efficient Building Envelopes

1.5 Contact Hours

The building envelope, which consists of walls, roof, windows, doors, and floor, acts as the barrier between the outdoor environment and the conditioned indoor environment. High performing building envelopes minimize the load on HVAC systems used in buildings to condition the indoor environment. HVAC systems account for a significant portion of the total energy consumed in buildings. Therefore, improving the thermal design of building envelopes can reduce the overall energy consumption of buildings.

Energy Efficient Equipment and Systems - Air Handling and Distribution

2 Contact Hours

With rising energy costs and corporate initiatives to be "green and sustainable," facility managers are under increasing pressure to operate their buildings at peak efficiency. This module will identify easy to implement, low cost strategies for building air-handling systems that will deliver real energy cost savings without sacrificing comfort and productivity.

Energy Efficient Equipment and Systems - Boiler Systems Two

1.5 Contact Hours

With rising energy costs and corporate initiatives to be “green and sustainable,” facility managers are under increasing pressure to operate their buildings at peak efficiency. The student will learn easy to implement, low cost strategies for building boiler systems that will deliver real energy cost savings without sacrificing comfort and productivity.

Energy Efficient Equipment and Systems - Central Chilled Water Systems

2 Contact Hours

With rising energy costs and corporate initiatives to be “green and sustainable,” facility managers are under increasing pressure to operate their buildings at peak efficiency. The student will learn easy to implement, low cost strategies for central chilled water systems building that will deliver real energy cost savings without sacrificing comfort and productivity.

Energy Efficient Equipment and Systems – Lighting

2 Contact Hours

With rising energy costs and corporate initiatives to be “green and sustainable,” facility managers are under increasing pressure to operate their buildings at peak efficiency. The student will learn easy to implement, low cost strategies for lighting systems that will deliver real energy cost savings without sacrificing comfort and productivity.

Energy Efficient Equipment and Systems - Pumping Systems

2 Contact Hours

With rising energy costs and corporate initiatives to be “green and sustainable,” facility managers are under increasing pressure to operate their buildings at peak efficiency. The student will learn easy to implement, low cost strategies for building pumping systems that will deliver real energy cost savings without sacrificing comfort and productivity.

Fundamentals of Energy Efficient HVAC Design

2 Contact Hours

Student will learn that employing high-performance HVAC equipment in conjunction with whole building design can result in significant energy savings. Furthermore, this process requires more effort and more collaboration from the design team than a conventional, sequential approach.

Energy Use and Management

4 Contact Hours

The student will learn the principles of an effective energy management process.

Environmental Management Courses

The Big Picture--Your facility in an Environmental Context

2 Contact Hours

The module sets the stage for the following environmental modules. The course focuses on the student's ability to name and understand ecosystem services and brief introduction to sustainability. The module builds capacity and perspective for decision-making. The student should be able to describe in a general sense the affect of the asset on the environment.

Why - Asset Management and the Environment

2.5 Contact Hours

This module develops a student's ability to understand the capital model as a frame for understanding environmental issues. In addition they will be able to describe why location is important to environmental issues and understand air, water and solid waste impacts of their assets. By the end they will be able to describe the connection between asset management, environment and productivity.

How - Linking Environmental Measurement and tools to asset management

2 Contact Hours

The module links Environmental Management to Building Assets and addresses the use environmental measurement and tools to manage assets

How - Linking Environmental Standards to Asset Management

1 Contact Hour

This module generally connects the value of standards to environmental performance. It reviews ISO 14001 in a general way, since other standards are covered elsewhere.

How – Eco-design Tools

3 Contact Hours

This module makes the linkage between environmental design and asset management. You will learn concepts and practices associated with Design for Environment. You will understand principles of Eco-design as applied to facilities and facility systems design, construction, and deconstruction. You will develop the ability to understand and describe the life cycle context of building application.

Energy Modeling Course

Energy Modeling for High Performance Buildings

16 Contact Hours

Created for design engineers, architects, and related project team members, this course provides practical knowledge on how to implement energy modeling to create high efficiency buildings. This interactive course highlights the real-world needs of LEED projects and explores the opportunities and challenges of eQuest software.

Appendix C: Certification / Accreditation Plan

TE²AM™ Certificate*

Introduction

The goal of the TE²AM™ Certificate is to provide a credential that confirms the completion of an approved course of non-credit study, related to an individual's professional development aspirations.

Certificate Structure:

As proposed, the certificate includes 80 contact hours, comprised of an approved course of study proposed by the certificate candidate. The certificate proposal must satisfy breadth course requirements and relate to the candidates "Goals and Objectives Statement". The certificate would be valid for five years, and is renewable through completion of approved continuing professional development activities.

Certificate Requirements:

The following requirements must be satisfied to receive the TE²AM™ Certificate

1. Meet minimal professional / educational qualifications:
 - a. High School Diploma and four years experience, or;
 - b. Associate Degree and two years experience, or;
 - c. US Military School and honorable discharge, or;
 - d. Bachelor's Degree
2. Acceptance of a completed application including:
 - a. "Statement of Goals and Objectives"
 - b. "Proposed Program of Study"
 - c. "Proposed Capstone Project" (elective)
 - d. Maintain personal / professional information
3. Successful completion of 80 contact hours of the approved "Proposed Program of Study"
4. Financial accounts current and paid in full

Application Process:

The TE²AM™ Certificate Application Process includes

1. Completing the web-based application
 - a. Demographic information
 - i. Name
 - ii. Home address
 - iii. Business address
 - iv. Telephone
 - v. Email
 - vi. Employer
 - vii. Job title

- viii. Highest level of education
- ix. Years of relevant professional experience
- b. Statement of Goals and Objectives: the applicant will provide a description of how the TE²AM™ Certificate will impact their personal and professional aspirations (limit 500 words)
- c. Proposed Program of Study: the applicant will identify a program of study that satisfies the program requirements.
- 2. Review / approval by EPD Program Director
- 3. With acceptance:
 - a. Candidate notification
 - b. Candidate entered into certificate tracking and management system

Proposed Program of Study / Minimum Requirements

The minimum program of study requirements for the TE²AM™ Certificate include:

- 1. Completion of a minimum of 80 contact hours from an approved program of study – to include:
 - a. A minimum of 20 contact hours of Energy Management and/or Energy Modeling coursework
 - b. A minimum of 5 contact hours of Environmental Management coursework
 - c. A minimum of 5 contact hours of Asset Management coursework
 - d. A minimum of 10 contact hours of Change Management and /or Implementing Asset Management coursework
- 2. Approved Proposed Program of Study may include:
 - a. At the discretion of the Program Director – up to 10 contact hours may be applied to a structured capstone project – additional application form required
 - b. Approved for-credit coursework from an approved provider – Program Director approves course and institution
 - c. Approved non-credit coursework from an approved continuing education provider - Program Director approves course and institution
 - d. Up to 20 contact hours of approved for-credit and non-credit coursework taken within two (2) years of application.
 - i. Candidate must provide certificate of completion.
 - ii. Courses must be from an approved continuing education provider
 - iii. Program Director approves course and institution
 - e. Approved courses may include courses in business and management, project management, real estate, environmental science, engineering, architecture, agriculture, biology, and other fields of study as appropriate - Program Director approves course and institution

**Pending EPD Executive Committee Approval*

Appendix D: Commercialization and Sustainability Plan

TE²AM™ Commercialization and Sustainability Plan

University of Wisconsin

College of Engineering

Department of Engineering Professional Development

December 2012

Overview:

The University of Wisconsin Department of Engineering Professional Development (EPD) will be offering a comprehensive curriculum and certificate program entitled *Total Energy, Environment and Asset Management (TE²AM™)*. The curriculum will develop core competencies of building operations professionals (managers and engineers) in the existing commercial building sector.

Market Opportunity:

The primary objective of the TE²AM™ program is to equip facility engineers and managers to effectively manage total building energy consumption and building environmental impacts within the context of a comprehensive asset management model. Curricula content builds the understanding of and application of new approaches, use of proven methods, and enable the adoption of proven energy saving strategies, while enhancing the environmental performance of the physical asset.

Currently, facility engineers and operators approach energy management and facility environmental performance as separate activities. In addition, key design decisions, which have tremendous impact on these management activities, are often made without systematic input from engineering and management professionals. As a result, opportunities to optimize the performance of the building over its lifecycle are often lost.

Currently, professionals in the target market do not have a unifying approach to energy and environmental performance management of commercial facilities. The concept of Asset Management has been advanced as a management system that provides for consistent approaches to the design and construction, operation, maintenance, and end-of-life disposition of a commercial building. Through the asset management paradigm, we can more efficiently and effectively manage the energy and environmental performance of a commercial building.

To achieve energy and environmental performance goals, facility engineers and operators must consider myriad performance standards and practices. Often the goals and practices are in conflict, making synergies difficult, if not impossible to achieve. This is complicated by an emphasis on the initial cost of the facility versus other costing models that look at total cost of ownership over the lifecycle of the asset.

Business Model:

EPD will incorporate the TE²AM™ program into the existing departmental continuing engineering education systems and structures. EPD has been providing continuing education and training in its current organizational structure for more than 50 years, and is the largest University-based provider of continuing education for engineers and technical professionals in the United States. Each year, more than 13,000 engineers, architects, and technical professionals attend one of more of EPD's more than 400 not-for-credit, continuing education courses.

While most of these courses are presented live, face-to-face, EPD also has a long history of providing courses via distance education technology. As an academic department, EPD now offers and/or manages seven Engineering Master's Degree Programs, three Master's Certificate Programs, and more than 50 credit courses, all offered entirely at a distance. The TE²AM™ program will employ a variety of instructional approaches to reach a broad segment of facility engineers and operators.

EPD would provide marketing communications through its existing systems and structures and employ a systematic approach to optimize participation in the TE²AM™ program while minimizing the negative environmental impact of the marketing strategies. EPD's staff of seven dedicated marketing and promotions professionals will support all marketing activities. EPD would develop, implement, and evaluate the effectiveness of its marketing activities. EPD has a demonstrated track record in marketing communications, and performs at consistently high levels in attracting the target audience to continuing education programs.

For the TE²AM™ program, EPD would engage in a variety of marketing communications strategies and tactics. These include the identification of target audiences from the facilities engineering community. It is our intent to work with the sponsor and representative groups within the commercial building industry to optimize our marketing communications with key constituents.

Our intent is to employ a variety of marketing vehicles and campaigns to achieve the attendance goals and objectives. Our primary vehicle will be electronic, and consist of a sequential email campaign, a dedicated web site landing page, and links to the EPD sites through key industry and professional organizations. We will augment our efforts in the electronic space with a direct mail campaign. The direct mail campaign will capitalize on EPD's experience and capability in effective direct to consumer marketing.

The goal of the TE²AM™ business plan is to generate revenues sufficient to cover operating and overhead costs, provide for continuous improvement and quality management, and provide for investment in the development and revision of course curricula. EPD will accomplish this through its current business structure. TE²AM™ courses and certificate programs will be managed through EPD's current organizational structure, and managed by program directors in the facilities market segment. Registration and enrollment, transcript management, learning technologies, production and logistics will all be managed through existing EPD systems and structures

Experience in Providing Continuing Education:

As a self-supporting business unit, our track record of successful commercialization of continuing education programs is testament to our instructional and business

management practices. EPD has been providing programs in energy auditing, commissioning, building systems, and related topics over its 60-year history as a department. In the past 5 years EPD has offered approximately 400 short courses, representing 70 titles, serving more than 7,000 clients in energy, commissioning, building systems and related topics.

EPD is a globally recognized leader in providing continuing education and certification of building commissioning, energy engineering, and building systems. EPD has seven faculty members representing five full-time equivalent (FTE) employees dedicated to this subject area. In addition, other dedicated EPD faculty provides programming in areas directly related to the topical area.

Go To Market Strategy:

Six key elements of the go-to-market strategy include:

1. Provide a regular schedule of TE²AM™ courses – designed so a facility engineer or operator could complete a certificate program within 2.5 years.
2. Scheduling TE²AM™ courses to allow professionals to attend more than one offering consecutively – enhancing their ability to achieve certification within a reasonable lead-time.
3. Examining alternative distance education technologies to enable professionals to complete a certificate program without significant disruptions to their work schedule.
4. Promoting the TE²AM™ certificate brand at professional meetings and industry conferences – enhancing the professional value of certification.
5. Providing certificates to individual businesses on a “custom course” basis. Tailoring course content to organizational goals and strategic imperatives.
6. Develop a community of practice among certificate holders – enable ongoing program engagement