DETERMINATION AND ANALYSIS OF CURRICULUM CONTENT FOR A DEGREE PROGRAM IN CONSTRUCTION MANAGEMENT

A Thesis

Presented to

the Faculty of the College of Science and Technology

Morehead State University

In Partial Fulfillment

of the Requirements for the Degree

Master of Science

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by

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April 23, 2010

Accepted by the faculty of the College of Science and Technology, Morehead State University, in partial fulfillment of the requirements for the Master of Science degree.

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7-15-2010
Date

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FOR A DEGREE PROGRAM IN CONSTRUCTION MANAGEMENT

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Morehead State University, 2010

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This study was an effort to align the curriculum of the construction management (CM) program at Morehead State University with the needs of the construction industry and that the program curriculum is comparable with other CM programs. The research found that Sustainability, Building Information Modeling and LEED practices ought to be introduced to students to make sure that they are well-versed in these concepts making them more marketable upon graduation. Students that graduate from the CM program at MSU are marketable and competitive in the local job market; however, aligning the curriculum to the current practices in the industry will improve their job prospects by making sure they meet the expectations of prospective employers. The survey used in the study helped to determine current key methods and concepts that should be taught at the University level according to construction professionals.

Accepted by: Ahmad Zargari, Chair

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Chapter I

Introduction

General Area of Concern

In the state of Kentucky, there are five state Universities as well as a private college system and the Kentucky Community College system that offer programs in the area of construction or Construction Management (refer to Table 1 below). Morehead State University in Morehead, KY offers a construction management program as an option of the Bachelor of Science in Industrial Technology Degree through the Department of Industrial and Engineering Technology (Morehead, 2010). The construction management option of the Industrial Technology program must have new courses added and current courses revised in an effort to stay up to date and relevant in their instruction related to the construction industry. This is also required to maintain compliance with the Department's accreditation through the Association of Technology Management and Applied Engineering (ATMAE). These new courses are added when asked for by the Department's Advisory Board; however, some relevant coursework needs to be added before required by the members of the Advisory Board. This is a means of showing that the department is progressive and that the Board does not need to ask for every change that should be made to keep the

Table 1.1 – Construction Management Programs at Kentucky Universities

Kentucky Universities with Construction Management Programs			
College/University	Major/Option	Degree Program	Degree(s) Offered
Morehead State University	Option	Industrial Technology	ASIT (CM Option), BSIT (CM Option)
Murray State University	Major	Construction Engineering Technology	BSCET
	Major	Civil Engineering Technology	BSCET
Northern Kentucky University	Major	Construction Management	ASCT, BSCM, BSCM (Surveying),
Western Kentucky University	Major	Construction Management	BSCM, BSAS
Eastern Kentucky University	Major	Construction Management	BSCM
ITT Tech	Major	Construction Management	BSCM
KCTCS	Option	General Occupational/Technical Studies	AAS

coursework relevant and cutting-edge. These preemptive changes to the courses in the program are the responsibility of the construction management faculty of the IET Department.

A study of the construction management programs available to the college students in the state of Kentucky would determine whether there is a need for the revision of the curriculum of the construction management program at Morehead State University. This study should include a comprehensive audit of the curricula of the five state Universities, the private college system, and the Kentucky Community College system that offer construction as a post-secondary educational program. Professional members of the construction industry should be surveyed to determine what the most important aspects are that should be taught at the University level. All of this information should be gathered, analyzed, and used to determine changes/additions that should be made to the curriculum of the Construction Management program at MSU. Once these changes/additions have been determined, the courses should be developed/adjusted to include the information that is determined to be relevant to the program. This should include prerequisites for the course, course outline, course objectives, learning outcomes, textbook recommendations, course competencies, and assessment techniques (Hauck, 1998).

At this very important time when the economy of not only the state of Kentucky and the United States of America, but the world as a whole is in a downturn, it is time for the Department of Industrial and Engineering Technology to take an in-depth look at the curriculum of the Construction Management Program.

This should be a concerted effort to make sure student learning is relevant and viable in the professional world (Hayles, 2006). This is even more important to the department due to the move of the construction industry toward sustainable construction, Building Information Modeling (BIM), and the requirements put on the construction industry to make sure that projects meet Leadership in Energy and Environmental Design (LEED) requirements.

Sustainable construction is an advancement in the construction industry that the Construction Management option should focus on as having major instructional value for the students in the program. This should be done in order to develop their professional knowledge in an area that is of importance in the industry. This topic involves using construction methods and materials that meets the needs of the present without compromising the ability of future generations to meet their own needs. In other words, sustainable construction means using less resources and materials or reusing and recycling materials in the standard construction processes that are in use in the industry. It can also involve developing new construction processes that will adhere to the principles of sustainability in the industry.

Building Information Modeling (BIM) is a process that incorporates the exploration of the key physical and functional characteristics of a project in a digital format, before the project is finished. BIM includes information about the building geometry, spatial relationships, and geographic information, as well as the quantities and properties of the building's components. Architects, engineers, and construction professionals are able to minimize environmental impacts while delivering projects

that are more economical in less time. Building Information Modeling requires the use of BIM software that makes possible a way of working collaboratively while using a model that has been created from design information that has been coordinated by the design team. This enables decision-making at earlier stages of the project, better, more efficient documentation, and the evaluation of alternatives before construction begins. By using BIM effectively, the owner and project team can save time and money through improved design, enhanced constructability, and an accelerated schedule (Bratton, 2009).

LEED is an acronym for Leadership in Energy Efficient Design Green Build Rating system that was developed by the United States Green Building Council. LEED is a third-party verification that a building or a community was designed and built with the purpose of improving performance in energy savings, water efficiency, carbon dioxide emissions reduction, improved indoor environmental quality, and sensitivity to the impacts of the resources being used in the project. Working throughout the building lifecycle, the system is the framework for identifying and implementing measurable green building design, construction, operations and maintenance solutions.

Objectives

The construction management option of the Industrial Technology program of the Department of Industrial and Engineering Technology in the College of Science

and Technology at Morehead State University must add new courses in an effort to stay up to date and relevant in their instruction related to the construction industry. The courses currently offered by the Construction Management option at MSU are relevant and have been approved by the construction industry members of the Advisory Board of the Department of Industrial and Engineering Technology. However, with the movement toward BIM, LEED, and sustainability in construction, it is important to bring acceptable courses to the program that deal extensively with these subjects. The development of Sustainable Construction, BIM and LEED related courses at the university level would allow the Construction Management program at MSU to remain on the cutting edge of the technology forefront as well as show the Advisory Board that the program is not content to stay with its current level of instruction.

The proposed comparative study of the Construction Management programs at Kentucky Universities and Colleges and surveys of Construction Management faculty at these institutions as well as surveys of construction professionals, will result in a revised curriculum for the Construction Management option of the Industrial Technology degree at Morehead State University. This will ensure that the program at MSU will remain relevant with the most current techniques used in the industry being taught in the program. The development of the curriculum for these subjects will include all relevant information including learning outcomes, assessment techniques, textbooks, etc.

Significance of the Study

This study has varying levels of significance to more than one entity. The significance of the study to Morehead State University is that it will improve and broaden the level of the instruction that is offered to students in the Construction Management program. It would also give the Advisory Board for the Department of Industrial and Engineering Technology some major cues that the University is determined to offer students relevant education covering current industry trends. The students would receive an education that is well rounded and the ability to offer employers a potential employee with some background into the ideals of sustainable construction, BIM, and LEED. Construction companies within Kentucky will receive notification that the faculty of the Construction Management program at Morehead State University are offering a top-notch program and are working to make sure that the program turns out well-prepared entry-level professionals.

Many other universities, colleges, and professional development workshops offer courses, degrees, and certifications in sustainable construction, BIM, and LEED. The Department of Industrial and Engineering Technology could use the development of these courses to work with organizations and companies that offer the professional development courses and certificates. The courses could be a springboard to help develop closer relations with industry specific professional organizations, such as Associated General Contractors and the Association of Builders and Contractors. These closer relations could be used to offer courses to professionals in the

surrounding area in an effort to promote the Construction Management program. Also, by implementing courses in these subject areas, students will have an advantage if they choose to pursue professional certifications in these areas through third party professional organizations.

Statement of the Problem

The Department of Industrial and Engineering Technology at Morehead State University in Morehead, KY offers an option of construction management program with its Bachelor of Science in Industrial Technology Degree. This option of the Industrial Technology program must add and/or revise courses to stay up to date and relevant in respect to the changes taking place in the construction industry. Additions/changes to the courses in the program are the responsibility of the construction management faculty of the IET Department. The students will receive an education that is well rounded and the ability to offer employers a potential employee with some background into the ideals of sustainable construction, BIM, and LEED. Construction companies within Kentucky will receive notification that the faculty of the Construction Management program at Morehead State University are offering a top-notch program and are working to make sure that the program turns out well-prepared entry-level professionals. The proposed comparative study of the Construction Management programs at Kentucky Universities and Colleges and surveys of Construction Management faculty at these institutions as well as surveys

of construction professionals, will result in recommendations of revised curriculum for the Construction Management option of the Industrial Technology degree at Morehead State University. This will ensure that the program at MSU will remain relevant with the most current techniques used in the industry being taught in the program. The development of the curriculum for these subjects will include all relevant information including learning outcomes, assessment techniques, textbooks, etc.

Definition of Terms

Sustainable Development – development that meets the needs of the present without compromising the ability of future generations to meet their own needs

Sustainable Construction – the application of sustainable development to the construction industry

Eco-friendly – goods and services considered to inflict minimal or no harm on the environment

LEED - The Leadership in Energy and Environmental Design (LEED) Green Building Rating System, developed by the U.S. Green Building Council (USGBC), provides a suite of standards for environmentally sustainable construction

ENERGY STAR - a joint program of the U.S. Environmental Protection Agency and the U.S. Department of Energy helping us all save money and protect the environment through energy efficient products and practices.

Green Building – an outcome of a design which focuses on increasing the efficiency of resource use — energy, water, and materials — while reducing building impacts on human health and the environment during the building's lifecycle, through better siting, design, construction, operation, maintenance, and removal

Bio-diversity –the variation of life forms within a given ecosystem, biome, or for the entire Earth. Biodiversity is often used as a measure of the health of biological systems.

Product Life Cycle – the life of a product in the market with respect to business/commercial costs, sales measures, and its reusability/recyclability

USGBC – United States Green Building Council; nonprofit organization that certifies sustainable businesses, homes, hospitals, schools, and neighborhoods. USGBC is dedicated to expanding green building practices and education, and its LEED® (Leadership in Energy and Environmental Design) Green Building Rating System (http://www.usgbc.org/).

Sustainability – The ability to meet the needs of the present without compromising the ability of future generations to meet their needs.

Building Information Model –

Assumptions

The construction industry professionals in the state of Kentucky have some knowledge of the concepts involved in sustainable construction and have worked on

projects that incorporate these ideas. Students graduating from the Construction Management program will need to have knowledge of sustainable design, Building Information Modeling, the LEED rating system, and ENERGY STAR certification in their employment. Potential employers will see the knowledge gained by the students as an important asset to their professional profile making the students more marketable. The same potential employers will see the offering of this information in the classes offered by Morehead State University as a valuable addition to the program and may increase their interaction with the Industrial and Engineering Department by becoming valued Advisory Board members.

Limitations

It is possible that there is limited knowledge of the concepts of sustainable construction, Building Information Modeling, and the Leadership in Energy and Environmental Design Green Building Rating System. Professionals and Professors must have some basic knowledge of these concepts for any type of research instrument to be an effective tool in the determination of the need for a course on this topic. Another shortcoming may be the involvement of professionals and students that are not aware of the movement within the industry toward energy efficiency and sustainability. This limitation may be avoided with the use of multiple surveys based on the status of the survey taker. One survey for construction industry professionals,

one for university professors, and another for students involved in the research sample would minimize the lack of knowledge about the subject.

Another limitation of this study may be the lack of willingness of the participants chosen for this study. Construction Industry professionals are usually very busy with their projects and may not feel as though the survey is of major importance to their company's interests. Professors at universities and colleges are prone to be very busy with their class preparation and research and may feel that this study is not important, as it may not hold any value to their own programs. Students will be busy with their classes and may not understand the value of this study as it relates to the construction management program at Morehead State University.

Chapter II

Background

Historical Background & Review

The term "Sustainable Development" was coined in 1987 in 'The Brundtland Report' as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Goldemberg, 2007). Sustainable development has an emphasis on environmental issues and an improvised approach to the structure of the subject, which hinders the development of knowledge in an organized way. The built environment is one of the major factors in determining whether a community is sustainable in the long term, while contributing significantly to the environment (Haselbach, 2008).

Sustainable design requires the adoption of more sustainable practices within the construction industry. To incorporate sustainability, designs should be proficient in their use of resources and energy, while minimizing waste, and at the same time considering other environmental issues. Some of these other issues are the construction process, the preservation of bio-diversity with respect to building materials, the product life cycle and its ability to be recycled. The evaluation of a product's sustainability qualifications requires consideration of the lifetime of that product.

To evaluate a particular product for its sustainability, consideration of both the sustainable loop and the three dimensions of sustainability is a sensible starting point.

The sustainable loop gives an overview of the life of a product from raw materials to its use in a building and the end of the product life. To estimate the sustainable qualifications of a building product, it is important to consider the three sustainability dimensions over the whole lifecycle of the building and throughout the sustainable loop. The three dimensions of sustainability of building and the products in it are improving social welfare, economic viability, and protecting the environment.

Improving social welfare is a commitment to health and safety in designing a structure. Economic viability distinguishes best value from lowest price and offers details of the costs of the product over the lifetime of a building. Protecting the environment means that a product or process must be 'environmentally friendly'. This is to say that any statement on environmental performance needs to be demonstrated by quantitative results.

Everyone involved in the construction process needs information to aid in decision-making. This information should include environmental data on operations, products, and services. Speed of construction is a factor in realizing the economic development of the building. The construction of the building should be managed to cause the least amount of disruption to the economic activities around the site. Efficient delivery of materials and labor should be built into project management milestones.

Architects and building designers should consider materials that allow flexibility and adaptability providing the ability to change a building's functionality in the future. They should also design the building for ease of re-use and recycling of

materials at the end of their life cycle. This will aid the economic impacts and the practical use of resources throughout the life cycle of the building. Building designers and architects should also consider the environmental impacts of the stages of the construction process. These environmental impacts should be minimized by the implementation of adequate controls and environmental management systems. Building Information Modeling is one of the newest tools used to manage the environmental impact of a building. BIM can be used a number of different ways beginning with the use within one organization only to sharing the information between organizations (Fox and Hietanen, 2007). Another example of the use of BIM to manage environmental impacts are through project scheduling and cost estimating through the facilitation of informed decisions in the product life cycle (McCuen, 2008).

When choosing materials for a home, a designer should suggest environmentally sound materials. Reducing the use of resources like trees can be achieved by using veneers over formaldehyde-free backings instead of traditional solid wood cabinetry. Wood should come from certified and managed forestry companies such as The Collins Companies, who are Forest Stewardship Council (FSC) certified. The Forest Stewardship Council is a non-profit organization that encourages the forests of the world be responsibly maintained. Standards have been set that make certain forestry is practiced in a socially responsible, eco-friendly and economical way. Companies that are certified are supported by environmental organizations. This ensures the companies are not disrupting the normal cycle of the

environment. The trees are managed in a natural forest setting that allows balance of the ecosystem to be maintained. When trees are logged, replacement trees are planted to ensure the balance is not disturbed.

Lightweight steel structures require fewer and lighter foundations to support them, while the long-spans that are possible mean that the building can provide an open and flexible space. This leads to an area that is easy to reconfigure according to changes in the usage of the space. In addition, pre-finished steel is easily refurbished to extend a buildings functional lifetime and is suited to renovation and restoration projects. Adding to the sustainability properties of steel is the fact that the energy used in the production of steel has fallen by 40% since 1970.

It is important when specifying metals such as steel to make certain the products are produced in an environmentally safe manner. Research can be obtained from organizations such as the American Iron and Steel Institute. The Institute conducts extensive research programs on manufacturing technology, basic materials, environmental quality control, energy, and fuels consumption. In addition to technical manuals and pamphlets, the Institute also publishes the *American Iron and Steel Institute-Annual Statistical Report*, with the latest available version being the *2008 Annual Statistical Report.* "The vision of the Institute and its members is for a sustainable North American steel industry committed to manufacturing innovative products that answer society's needs."

Businesses should adopt policies with consideration of the social well-being, safety, and training of employees, and local communities. In order to monitor and set

targets for improvements, policies, and procedures should be in place. Examples of these policies include employee rights, staff retention rates, equal opportunities, the provision of adequate pension schemes, and involvement with community initiatives and environmental groups.

Strategies to improve the sustainability of a building may center on key themes. Choice of construction material is. The minimization of environmental impact in use includes designing for low-energy consumption. An example of the restriction of social disruption is the use of off-site construction, such as modular building. Another frequently cited theme of sustainability is flexibility of design. This is to allow for future adaptation with minimal extra cost or disruption.

It is everyone's social and ethical responsibility to educate themselves as well as everyone around them about sustainability in construction. Everyone holds a key place in the chain of product usage. Looking at material use in general should be more about being conscious of the impact on the environment regardless of whether it is natural or manmade. What is important at the end of the day is whether the impact is good or bad and knowing that sustainability in construction is possible.

Often, cost has the final deciding vote, and eco-friendly materials are sometimes more expensive in the beginning. This causes the average consumer to avoid green products. Construction professionals must be informed enough to step in and explain that in the end, these products actually save money as well as resources. For example, while an appliance with an extremely high-energy star rating may cost more than a lower rated appliance, it should be acknowledged that after a period of

use, the energy saved would actually pay for the product itself. It should also be pointed out that even small things make a huge difference.

While choosing natural resources carefully is important, it is also very important to conserve what is in use. Conserving means to use only what is necessary, which in turn requires less. Waste requires more natural resources, labor, and time to be used to keep up with demand. Items such as toilets, washers, dryers, etc., should be energy efficient as well as water efficient. Showers should be recommended over bathtubs. Low-flowing showerheads, faucets, and aerators should be recommended whenever possible. This practice helps to conserve water.

Paints, caulks, stains, and adhesives and the impact these products have on the environment must be understood. Low Volatile Organic Compound (Low-VOC) finishes, a highly evaporative, carbon-based chemical substance, and water-based finishes are the best choice for the environment and still acquire the sought after look. Unused finish products must be disposed of properly. Any materials containing, polyvinyl chloride (PVC), should be avoided. During manufacturing, these products create toxic by-products. This results in severe off-gassing from VOCs.

For power sources, alternate routes include sources that use little or no fossil fuels. Solar energy turns the sun's rays into energy for heating and power. Wind power uses a turbine that converts wind power into electricity. Hydropower is an option that produces electric through the power of moving water. Lighting is a critical consideration throughout a building, whether a house or hospital. Dimmer switches, low-voltage lighting, and fluorescent lighting help conserve energy. By using zoned

lighting, residents have light just where they need it instead of lighting up entire rooms. Closet lights that turn off automatically when the door shuts are another solution. Properly placed windows can help homes take advantage of natural light, as can skylights. Window placement also has an impact on heating and cooling efficiency. Window films can block heat transfer while still letting in light.

It is a construction professional's social and ethical responsibility to educate themselves as well as everyone around them about green design as they hold a key place in the chain of product usage. It is their job to know about eco-friendly design just as it is their job to know about the construction processes. Looking at material use in general should be more about being conscious of the impact on the environment because regardless of whether it is natural or manmade, what is important at the end of the day is whether the impact is good or bad. The construction process can be achieved while being environmentally conscious. It may be appropriate to say any construction project that is not environmentally conscious is bad construction - bad for plants, animals, humans and the earth we live in.

Standard construction practices involve using readily available materials and construction processes and methods that are the quickest and easiest for the builder, workers, and owner. These materials and processes are usually the most cost-efficient available to all parties involved. Some of the standard building components used for general construction projects are clear-glass windows, basic steel doors, standard shingles or fibered materials for the roof, and fiberglass insulation. While all of these standard components are acceptable, information is available on affordable products

that allow construction at an affordable cost while also being environmentally friendly (BRE, 2009).

Sustainable, or green, construction requires the adoption of more sustainable practices within the construction industry. One of the main goals of sustainable construction is to improve awareness of environmental and sustainability issues facing contractors and their projects (Sustainability, 2010). To incorporate sustainability, designs should be efficient in their use of resources and energy, while minimizing waste, and at the same time considering other environmental issues (AggRegain, 2009). Some of these other issues are the construction process, the preservation of bio-diversity with respect to building materials, the product life cycle and its ability to be recycled. The evaluation of a product's sustainability qualifications requires consideration of the lifetime of that product. It is important to make sure that while incorporating sustainability into a project all of the applicable state and local building codes are followed by the contractor/builder (Ching & Winkel, 2009).

The U.S. Environmental Protection Agency and the U.S. Department of Energy designed the ENERGY STAR program to protect the environment and help everyone save money through energy efficient products and practices (ENERGY STAR, 2010). This joint venture is recognized as the government-backed symbol for energy efficiency. ENERGY STAR identifies new homes, buildings, and more than many other products that are energy efficient. These products offer the features, quality, and performance of standard building materials and products but with a lesser

impact on the environment. Products that earn the ENERGY STAR are considerably more efficient than standard products (Purchasing, 2009).

Building Information Modeling, or BIM, is defined by some entities as a digital process that is a model-based technology linked with a database of project information. The connection between sustainability and Building Information Modeling (BIM) is that BIM is a facilitator of green technology and energy efficiency (Ireland, 2009). It is a type of building design and documentation methodology that is characterized by coordinated, internally consistent, computable information used to describe a building project in all stages of construction from the design, through the construction and finally the post-construction stages. One major factor in the rise of Building Information Modeling is The U.S. General Services Administration's encouragement of the use of BIM (Yoders, 2008). Significantly, green building projects are performed by Building Information Modeling users who find BIM tools helpful with those projects (Report, 2009). The current capabilities of the use of BIM include space coordination studies by assisting engineers, architects, and contractors to fit building components into limited space, thereby eliminating time, money, and heartache spent in the Request for Information (RFI) and similar processes (Kraus, 2007).

BIM is dependent upon collaboration and a vision from a complete team. It is a shared model, which incorporates all of the components of the project. The geometry of the building and most importantly its spatial relationships as well as the material properties and quantities are contained in the Building Information Model

for the project. BIM also integrates information relating to the services and equipment necessary for life cycle management of the project. The software market now offers three fully equipped BIM tools. This software includes ArchiCAD by Graphisoft, Bentley Systems, and Autodesk Revit, which has multiple titles available (Hasan, 2009). Autodesk first used the term "BIM" in 1997 upon introducing Revit Architecture software. Building Information Modeling relies on a digital database in which objects, spaces, and characteristics of a project are all defined and stored. This allows for the creation of better models for the design, construction, and lifecycle of a project (Craig, 2009).

The introduction of Building Information Modeling concepts and tools into the construction industry has opened doors and allows each project to be conceptualized and completed virtually, while considering the entire lifecycle of the building (Popov, 2006). These projects can then be coordinated among the sub-contractors and specialty contractors before the start of the on-site construction allowing for all pre-existing problems to be worked out in advance. The benefits that companies can expect to receive when adopting the use of BIM for their projects are extensive. When using BIM for projects, a company's design team has the ability to look at their project and interact with each other directly in the 3-D model. This makes the work completed with 2-D drawings more for the visual aspect, as most of the project revisions will be accomplished in the model and allows changes by all of the team's members to be tracked. As-built drawings will be lessened as conflicts between building elements will be detected earlier with the use of the 3-D model. The

demand from clients of the construction industry who require easy-to-manage buildings that must be delivered on schedule and on budget are a major factor in the emergence of BIM as a necessary tool in the industry (Winston, 2008).

The Leadership in Energy and Environmental Design began its initial development in 1994 spearheaded by the Natural Resources Defense Council (NRDC). Although it began as one standard for new construction, within twelve years, between 1994 and 2006, the initiative grew into a comprehensive system of six interrelated standards that covered all aspects of the development and construction process.

LEED was created to define "green building" using an established common standard of measurement, promote integrated design practices for whole buildings, and recognize environmental leadership within the building industry (About LEED, 2009). The program also stimulates green competition, raises awareness of the benefits of green building, and helps to transform the building market into an environmentally aware and rewarding area.

The members of the Green Building Council, which implements the LEED rating system, represent every sector of the building industry. They continue to refine the LEED system while addressing six major areas:

1. Sustainable sites
2. Water efficiency
3. Energy and atmosphere
4. Materials and resources

5. Indoor environmental quality
6. Innovation and design process (US Green, 2010)

The U.S.G.B.C. has a stated goal of attaining 10,000 LEED-certified buildings by the end of the year 2010 (Cassidy, 2009). Buildings that are LEED certified use resources more efficiently than conventional buildings that are built to code. The United States Green Building Council has assembled a list of the many benefits of implementing a LEED strategy. These benefits range from making improvements in the quality of air and water to reducing solid waste. These changes, from standard buildings, benefit owners, inhabitants, and society.

Pursuing LEED certification will most certainly increase the cost of design and construction. One of the main reasons this increase happens is that the designers may not understand the principles of sustainable construction. Delays may be incurred due to misunderstandings between the design team, construction team, and client caused by the finer points of LEED certification. There could also be a short supply of manufactured building components that meet LEED certification standards. Pursuing LEED certification adds cost due to USGBC correspondence, LEED design-aide consultants, and hiring a required Commissioning Authority. The good news is that these higher initial costs can be diminished by the savings that can be expected over a period of time because of the lower operational costs typical of a LEED certified building.

Many universities, colleges, and professional development workshops offer courses, degrees, and certifications in sustainable construction. The movement in the

industry toward sustaining the environment through green construction is evidenced through the courses being offered at the university and the professional development levels. The following are some of the notable courses being offered nationwide regarding sustainable construction, building information modeling, and LEED.

1. **University of Florida** – College of Design, Construction, and Planning – School of Building Construction

   Certificate in Sustainable Construction

   With the tremendous growth in the international construction market, more and more companies are doing business across the international dateline. Under the World Trade Organization and Washington Accord treaties, construction industry professionals can practice their profession outside their country of citizenship. These agreements present corporations and individuals with ever-expanding national and international construction opportunities, but they need to understand how the construction industry operates on a global basis. Certificates in International Construction Management are uniquely designed concentration of 12 credit hours (4 courses) and are available to individuals desiring to focus on a particular skill or knowledge area in international construction management (UF1, 2010).

2. **University of Florida** – College of Design, Construction, and Planning – School of Building Construction

   Sustainable Construction Concentration in the MBC/MSBC Program

The Sustainable Construction Concentration (SCN) has the goal of helping the student connect the activities of planning, designing, building, operating, and demolishing the built environment to their impacts on the environment and natural systems function. Its objectives are to address: (1) Issues of resource efficiency, waste, human health, ecological economics, ethics, environmental justice, and industrial ecology; (2) Alternative practices that can significantly reduce the environmental impacts of the built environment, and (3) Exploring past and present thinking by leading theorists and practitioners in this newly emerging discipline. The resulting degree awarded upon successful completion of the program is a Masters of Building Construction (non-thesis) or a Master of Science in Building Construction (thesis) with a concentration in Sustainable Construction (SCN). The concentration in Sustainable Construction requires the student take two courses offered by the Rinker School (BCN 6584 and BCN 6585). In addition, the student is required to take a minimum of 6 Credit hours of courses from those indicated in the list shown below. Each course indicated below contains the course number, course name, number of credit hours (Cr.), and the prerequisites (UF2, 2010).

3. **North Carolina Agricultural and Technical State University** - Construction Management & Safety Department

CM 256 - Intro to Building Information Modeling

This course is a study of BIM technology as it is applied to various building types and their respective building systems. Emphasis is placed on research and

integration of architectural, structural, MEP, specifications, and cost estimating of building systems for decision modeling using BIM. Prerequisites: CM 310 or Permission by Instructor (NCAT1, 2010).

LAND 682 – Sustainable Development and Construction - Construction Managemt & Safety Department

This course focuses on the principles and practices of sustainable development and construction. Topics to be covered includes an overview of the historical development of sustainable movement as it relates to construction practices, an in-depth analysis of green building systems, planning, assessment, and implementation (NCAT2, 2010).

4. **Middle Tennessee State University** – Engineering Technology – Construction Management

   3195 – Sustainable Construction. Three credits. Prerequisite: CMT 3190 or permission of department. Current green building technologies with an introduction to LEED (Leadership in Energy and Environmental Design) and NAHB (National Association of Home Builders) Green Building Guidelines and other green build programs. Also covers the impact of the building industry on the environment and how that impact can be minimized by the use of green technology (MTSU, 2010).

5. **Texas Southern University** – Industrial Technology – Construction Management

   CONS 243 – Energy Efficiency and Construction (3)

Sizing, designing, and laying out of electrical and mechanical systems for maximum efficiency in residential and light commercial buildings. Solar and alternative energy emphasized. One hour of lecture and four hours of lab per week. Prerequisite: CONS 242 (TSU, 2010).

6. **Corporate College** – Construction & Building Technologies – Construction Industry Training

   ZGRA 1003 Basics of Sustainable Construction

   Discover what has inspired the sustainable/green building movement, how it affects the construction industry from design to maintenance, how to develop ROI measurements (CC1, 2010).

   ZGRA 1052 LEED v3 Energy & Atmosphere

   Two hour evening program will highlight changes in LEED v3 from professionals currently working on projects registered under LEED v3. Energy and atmosphere may be one of the hottest topics in green building right now, due to the cost savings associated with reduction of dependence on fossil fuels and the media's glamorization of solar voltaic panels and windmills. Regional Priority Credit for Energy and Atmosphere credit 2 – On Site Renewable Energy will be discussed thoroughly (CC2, 2010).

7. **Stanford University** – Civil and Environmental Engineering

   CEE 224A Sustainable Development Studio

   Sustainable design, development, use and evolution of buildings; connections of building systems to broader resource systems. Areas include architecture,

structure, materials, energy, water, air, landscape, and food. Projects use a cradle-to-cradle approach focusing on technical and biological nutrient cycles and information and knowledge generation and organization (SU, 2010).

8. **University of Washington** – College of Built Environments – Construction Management

   CM 540 Sustainable Construction

   Study of sustainable construction techniques and best practices. Focuses on use of US Green Building Council's Leadership in Energy and Environmental Design standards to evaluate alternatives and select techniques for constructing sustainable projects (UW, 2010).

9. **Southern Polytechnic State University** – Construction Management Department

   CM 3190 Sustainable Construction

   This course will emphasize the techniques and methods of sustainable construction/development. Importance of a collaborative team effort from owner, developers, architects, engineers, constructors, and consultants will be integrated into the course. Influences on the cost and schedule due to a sustainable construction/development project will be analyzed. Topics will include performance certification techniques for sustainable sites, water efficiency, energy & atmosphere, materials & resources, indoor environmental quality, innovation and design. MEP systems such as ventilation, air

conditioning, heating, electrical lighting and building control systems will be covered from a sustainable perspective (SPSU, 2010).

Review of Literature

The construction industry, much like all other aspects in life, is making a concerted move toward sustainability. This is evidenced by the increase in the number of LEED Associate Professionals as well as the emergence of the ENERGY STAR rating for complete building systems. There are an ever-increasing number of papers and books detailing the emergence of sustainability, Building Information Modeling, and LEED practices in the construction industry. Along with this information, there are also a number of papers that detail how construction management programs have made the transition to sustainability in their coursework. Construction programs in the United States have a vital role in sustainable education because they produce construction professionals having knowledge related to sustainable construction (Ahn, Kwon and Pearce, 2007). Understanding the basic model for preparation of instructional objectives and educational goals for any given construction management course is key to the success of a program in their implementation of sustainability (Adcox, 2003). Another important factor to consider when determining the objectives and goals are that construction education needs to emphasize practical knowledge and efficient tools enhancing the students' thinking, problem solving and interpersonal skills (Park, Chan, and Verma, 2003).

One of the first books offering an in-depth explanation of Building Information Modeling concepts, tools, and techniques as applied to both new and retrofit construction projects, "*BUILDING INFORMATION MODELING. Planning and Managing Construction Projects with 4D CAD and Simulations*" was released by McGraw Hill in 2008. The book details how using a combination of 3D CAD and 4D animations can reduce risks and costs, while greatly improve communication, coordination, and planning of construction projects (Klymmel, 2008). Another recently published book, "*BIM and Construction Management. PROVEN TOOLS, METHODS, AND WORKFLOWS*", offers an introduction to what is considered proven tools, methods, and workflows on successfully integrating building information modeling into construction projects. Estimating, sustainability, in-field requests for information (RFI), and facility management of the completed project, the book delivers information regarding the implementation of BIM throughout the entire construction life cycle. Implementing BIM is more than just using the correct software and using the right people during the project phases, but it also using the right contracts, the right processes, and the right technology. BIM has the potential to become the sole source of information regarding the facilities management and planning stages of construction projects (Goedert, 2008).

Implementing BIM into construction projects also includes using the right preconstruction tools for site and constructability evaluation in an effort to improve the accuracy of estimates while enhancing communication within the team and with outside trades and vendors (Hardin, 2009). The BIM process also allows for the

merging of civil, structural, mechanical, electrical, plumbing, and LEED standards with sustainability data to create effective BIM workflows. Building Information Modeling is more than a tool for just the building project itself, as its capabilities include creating a plan model for site logistics and staging while delivering exceptional 4D animations and stills for clients, team members, and construction personnel. BIM enables a higher level of environmental sustainability by allowing designers to model the energy efficiency of a facility earlier in the design process (Brown, 2009). Previously, most of the computer use by architects and construction professionals has been geared toward computer-aided drafting, the industry, through BIM, is moving toward more computer-aided design detailed work (Davies, 2009). The use of BIM technology assists with the management of projects and allows the project team to develop solutions with a greater level of significance (Hendricks, 2009).

Along with the move toward sustainability, BIM, and LEED there has been a significant rise in the popularity of the design-build method of delivering projects to customers. There are some significant differences between the design-build method and the traditional method of design-bid-build construction projects (Ellingson, 2002). Part of the reason for the rise in the popularity of this method, and one major difference between the project delivery methods, is the fact that one entity can take care of all aspects of the project, reducing the necessary amount of coordination between entities for project completion. Important to this method of project delivery is the proper use of contracts. There are professional organizations that publish

standardized contracts to assist their members in the creation of accurate, comprehensive contracts that pertain to all aspects of the building involved, including sustainability and LEED principles.

Within the traditional construction education program in the United States, the focus is primarily on the management, materials, methods and technical aspects related to construction projects. The architect usually takes care of the environmental concerns of construction projects, as the role of the construction company was to build the project according to the project specification requirements. However, construction companies have a major impact on the environment through waste management techniques, design-build contributions and through the practices and philosophy of their company (Tinker and Burt, 2004). The implementation of LEED practices, as well as the incorporation of sustainability in many governmental agencies and private owners demands that sustainability be key to the success of any company's design and construction processes.

One of the foundation courses of any construction management program is a Construction Estimating course as it is a critical component of construction curriculum (Fuller and Kahn, 2003). The student should understand the basics of estimating in order to move into advanced estimating techniques that are required when incorporating sustainability, BIM, and LEED into projects. BIM changes the way that estimators perform their job function by allowing the extraction of quantities from the model. However, the estimator must identify and map the objects in the facility model formatting the results to ensure that traditional estimators are

comfortable (Hannon, 2007). Another important consideration for the construction management program is the incorporation of sustainability, BIM, and LEED into the structural analysis/design curriculum. Construction management professionals need to know and understand codes and regulations that have any effect on the engineering aspects of the structures. When implementing sustainability, BIM, and LEED, the amount of knowledge of codes and regulations necessary for these projects increases dramatically (Senior & Hauck, 2001).

Review of Kentucky Universities & Colleges

Morehead State University – Industrial Technology (Construction Management Option)

Morehead State University in Morehead, KY offers a construction management program as an option of the Bachelor of Science in Industrial Technology Degree through the Department of Industrial and Engineering Technology. The bachelor degree program has a requirement of 36 semester credit hours of construction management core courses, while the associate degree program requires 24 Semester credit hours of construction management core courses. The program also offers students the chance to join as student members of two professional organizations: the Associated General Contractors of America (AGC) and the Associated Builders and Contractors of America (ABC).

The curriculum of the option in Construction Management Technology at MSU is geared toward the management, engineering, technology, and production analysis of the residential, commercial, and highway construction sectors. The courses combine classroom work and lectures with field laboratories to teach students the practices within the industry. The courses taught in this program include excavation methods, surveying, estimating, construction equipment, material testing, and structural analysis. Practical application is taught by offering students a background in commercial explosives, highway and bridge development, hydrology, 3-D surface modeling, and site layout. Completion of this construction management technology option will prepare students to begin their careers as production engineers, engineering technologists, estimators, surveyors, or project managers (Morehead State, 2010).

Murray State University – Construction Engineering Technology

Murray State University in Murray, KY offers a bachelor degree in Construction Engineering Technology (CET). This program is loaded with courses in mathematics, science, business, technical studies and construction. The curriculum blends technical knowledge, knowledge of construction methods and materials, problem-solving ability, communication skills and classwork to prepare students to be able to complete large-scale construction projects. The CET program prepares students for a variety of management positions in the construction industry after graduation (Construction Engineering Technology, 2010).

Murray State University also offers a related degree in the field of Civil Engineering Technology, a program to provide students experiences in surveying, Computer Aided Drawing (CAD), construction materials, structural steel design, and reinforced concrete design. Graduates of the Civil Engineering Technology program are able to be placed in a variety of jobs such as project manager, construction project engineer, designer, estimator, sales engineer, field engineer, or surveyor (Untitled, 2010).

Northern Kentucky University – Construction Management

Northern Kentucky University in Highland Heights, KY offers two bachelor degrees in the Department of Construction Management: Bachelor of Science in Construction Management and Bachelor of Science in Construction Management – Surveying. The Bachelor of Science in Construction Management (CMGT) is drawn from multiple disciplines relating to the instruction industry. This program, accredited by the American Council for Construction Education, teaches students the knowledge of materials and construction processes, principles of design, and concepts of supervision and human relations. The program offers additional experiences that promote development of communication and technical competencies enabling students to stand out in technical, managerial, entrepreneurial, and production challenges. This degree program requires students to complete requirements for general education, core requirements, technical support, and one of the following: the

Business and Management Component or the minor in Entrepreneurial Studies offered by NKU's Department of Management and Marketing (BS CMGT, 2010).

The Bachelor of Science in Construction Management – Surveying degree is a partnership program between Cincinnati State Technical and Community College (CSTCC) and Northern Kentucky University (NKU). Students must complete the associate degree in Civil Engineering Technology - Surveying and the Advanced Surveying Certificate program from Cincinnati State Technical and Community College. The latter requiring five additional courses beyond the associate degree program for completion. The student must then transfer to NKU and complete the requirements for the degree including general education and other university-wide degree requirements. Students graduating from this program will qualify to sit for the Professional Surveyors Registration Test in Kentucky, Ohio, and Indiana after completing a residency under a licensed surveyor (BS Surveying, 2010).

Eastern Kentucky University – Construction Management

Eastern Kentucky University in Richmond, KY offers a bachelor degree in Construction Management. The program prepares students for careers in a variety of management positions including assistant project manager, estimator, superintendent, project scheduler, cost engineer and field engineer. The Construction Management program at EKU is accredited by the American Council for Construction Education (ACCE) and is a member of the Associated Schools of Construction (ASC). The American Council for Construction Education first accredited the program in 1993,

making it one of 38 programs in the nation accredited by ACCE at that time, and the first in Kentucky. The program achieved re-accreditation for a second time in 2004 (Construction Management, 2010).

Western Kentucky University – Construction Management

Western Kentucky University, WKU, in Bowling Green, KY offers a Bachelor of Science degree in Construction Management. The courses taught in this program include surveying, construction management construction estimating and bidding, and construction law. The construction program also offers students the chance to become members of professional organizations including the National Association of Home Builders, the Construction Management Association of America, and the Associated General Contractors of Kentucky (AMS, 2010).

ITT Technical Institute – Construction Management

ITT Technical Institute, headquartered in Carmel, Indiana, has been involved in higher education in the United States since 1969. ITT Educational Services, Inc. is a private college system that focuses on technology-oriented programs that operates over 105 Institutes in 37 states and offers a construction management program at its Lexington, KY campus. The CM program focuses on teaching the fundamentals of construction management, construction techniques, and legal issues in construction management. Courses taught in the program include building codes, site construction and measurement, construction documents, construction project management and

construction safety management. Students graduating from this program enter into the industry as estimators, construction safety professionals, project managers and building code compliance inspectors (ITT, 2010).

Kentucky Community and Technical College System – Construction Technology

While not a four-year University/College, the Construction Technology program of the Kentucky Community and Technical College System (KCTCS) prepares students for entry-level positions in the construction industry. The program focuses more on residential and light commercial construction applications by combining lecture and practical experience in the lab or on-site projects. The courses taught in this program include blueprint reading, building site layout procedures, foundation systems, light framing construction methods, exterior and interior finish systems, concrete forming systems and construction safety.

The program, available at many of the KCTCS campuses, is an excellent option for students planning a career in areas such as construction management, civil engineering or architectural design. The KCTCS system offers more than just a two-year program of Associate in Applied Science in Construction Technology. The program also offers a diploma for Construction Carpenter and certificates for Basic Carpenter, Carpenter Helper, Rough Framing Carpenter, Construction Forms Helper, Residential Carpenter, Residential Roofer, and Residential Site Layout Assistant (Ashland, 2010).

Curriculum Review

Morehead State University – Industrial Technology (Construction Management Option)

The curriculum of the construction management option at Morehead State University consists of 128 semester credit hours of coursework. Of these requirements, 36 hours are construction management core courses, 48 hours are general education coursework, and 39 hours are Industrial and Engineering Technology core courses. The courses included in the construction management core are:

1. Introduction to Construction Technology
2. Structural Design
3. Construction Methods and Equipment I
4. Codes, Contracts, and Specifications
5. Estimating and Construction Costs
6. Interpretation of Technical Drawings
7. Residential Architectural Design
8. Hydrology
9. Principles of Surveying
10. Construction Methods and Equipment II
11. Construction Surveying
12. Civil Drafting

The courses in the program that offer information on the subjects of sustainability, Building Information Modeling, or LEED practices are those where the faculty incorporates the information. The Residential Architectural Design class uses the BIM software ArchiCAD by Graphisoft, but only as a tool for drawing Residential building plans (Morehead State, 2010).

Murray State University – Construction Engineering Technology

Murray State University's Construction Engineering Technology degree program consists of 46 to 48 semester credit hours of general education requirements, 67 semester credit hours in construction engineering technology courses (38 hours in civil engineering technology and 29 hours in construction engineering technology) and 11 to 13 hours in construction engineering technology support courses. The Civil Engineering Technology courses required as the core for the Construction Engineering Technology degree are:

1. Plane Surveying
2. Strengths of Materials
3. Anatomy of Buildings
4. Building Construction Cost Estimating
5. Freshman Orientation
6. Introduction to Environmental Engineering Technology
7. Statics for Technology
8. Hydraulics

9. Engineering Economy
10. Applying the National Electric Code
11. Introduction to Technical Drawing & CAD
12. Electrical Systems

The Construction Engineering Technology core courses include:

1. Principles of Accounting I
2. Heavy Construction Cost Estimating
3. Construction Planning & Management
4. Structural Steel Design or Reinforced Concrete Design
5. Construction Materials
6. Soil Mechanics & Foundations
7. The Legal Environment of Business
8. Fundamentals of Management
9. OSHA Standards for General Industry and Construction

The Murray State curriculum offers a course devoted to sustainability in construction with the course titled "Introduction to Environmental Engineering Technology" (Construction Engineering Technology, 2010) (Untitled, 2010).

Northern Kentucky University – Construction Management

The core requirements for the Construction Management degree at Northern Kentucky University consist of 129 semester credit hours. These hours consist of the following courses:

1. Introduction to Construction Management
2. Construction Materials
3. Construction Processes
4. Architectural Drafting and Design
5. Plane Surveying
6. Architectural CAD I
7. Cooperative Education (6 hours required)
8. Construction Specifications & Estimating
9. M/E/P Systems I
10. M/E/P Systems II
11. Construction Estimating
12. Structural Design
13. Construction Scheduling
14. Construction Safety
15. Soil Technology & Foundation Design
16. Construction Management
17. Construction Cost Control
18. Civil Design

The student should choose one Capstone Elective from the two courses:

1. Construction Renovation & Restoration
2. Commercial & Residential

The student should also select two technical support courses from

1. Land Planning & Development
2. Building Codes
3. Heavy Construction
4. Construction Law and Legal Contracts
5. Design Build
6. Seminar in Construction Management

There are also three Support Requirements for this program including

1. The Dangerous Earth with lab
2. General Physics with lab
3. Pre-Calculus Mathematics

One mathematics course must be chosen from:

1. Calculus for Business Applications
2. Calculus IA
3. Introduction to Statistical Methods

The degree also requires students to choose either the business and management component or the Minor in Entrepreneurial Studies. The requirements for the business and management component include:

1. Legal Environment
2. Principles of Macroeconomics OR Principles of Microeconomics
3. Overview of Accounting
4. Introduction to Business & Management

This component also requires students to choose two courses from the following:

1. Principles of Macroeconomics OR Principles of Microeconomics
2. Principles of Marketing
3. Introduction to Labor Relations
4. Human Relations in Organizations
5. Leadership in Organizations
6. Personnel Management
7. Total Quality Teamwork

The requirements for the Minor in Entrepreneurial Studies include:

1. Overview of Accounting (or ACC 200 and ACC 201)
2. New Venture Creation
3. New Venture Management
4. Senior Portfolio: Writing the Business Plan

Students are also required to complete two or more of the following electives:

1. Marketing Strategies for Entrepreneurial Businesses
2. New Venture Financing
3. Family Business Management
4. Emerging Enterprise Law
5. Corporate Entrepreneurship
6. Field Studies in Entrepreneurial Firms (BS CMGT, 2010)

The Bachelor of Science in Construction Management – Surveying degree is a partnership program between Cincinnati State Technical and Community College (CSTCC) and Northern Kentucky University (NKU). Students must complete the

associate degree in Civil Engineering Technology - Surveying and the Advanced Surveying Certificate program from Cincinnati State Technical and Community College. The latter requiring five additional courses beyond the associate degree program for completion. The student must then transfer to NKU and complete the requirements for the degree including general education and other university-wide degree requirements.

Once the student has transferred to NKU, the Core Requirements for the Construction Management – Surveying degree include:

1. Construction Safety
2. Cooperative Education
3. Capstone-Surveying.

As with the Construction Management degree, students must choose either the business and management component or the Minor in Entrepreneurial Studies, which have been previously detailed. If the business and management component is chosen, the student is required to complete the course titled "Construction Management" (BS Surveying, 2010).

Eastern Kentucky University – Construction Management

The Bachelors of Science in Construction Management at Eastern Kentucky University requires students to complete a minimum of 128 semester credit hours. There is a university-wide requirement for students to complete Academic Orientation for one credit hour. The general education requirement for this degree is a

total of 30 credit hours. There is also a College Requirement for students to complete two Professional Skills Seminars, one as a Junior and another as a Senior. The Supporting Course Requirements are a total of 39-40 hrs and include accounting, communication, higher mathematics, and business classes.

The Construction Management Major Requirements are 57 semester credit hours and includes the following courses:

1. Introduction to Construction
2. Materials & Methods of Construction I
3. Materials & Methods of Construction II
4. Plane Surveying
5. Construction Graphics
6. Statics & Strength of Materials
7. Soils & Foundations
8. Construction Surveying
9. Construction Structural Design
10. Estimating I
11. Mechanical/Electrical Systems
12. Cooperative Study: Construction Management (6 credit hours)
13. Engineering Economy
14. Construction Contracts
15. Estimating II
16. Project Organization & Supervision

17. Scheduling

18. Principles of Occupational Safety & Health

There are no courses in the course list at EKU that deal specifically with sustainability, Building Information Modeling, and LEED requirements (Construction Management, 2010).

Western Kentucky University – Construction Management

The semester credit hour requirement for the Bachelor of Science in Construction Management degree at Western Kentucky University is 128 credit hours. Seventy-seven of these credits belong to the Construction Management Major core. The core classes from the Architectural and Manufacturing Sciences portion degree include:

1. Introduction to Occupational Safety
2. Architectural Drafting
3. Construction Methods & Materials
4. Construction Laboratory
5. Industrial Statistics
6. Survey of Building Systems
7. Internship
8. Technology Management/Supervision/Team Building
9. Senior Research

From the Construction Management portion of the core for the degree are the courses:

1. Applied Statics
2. Contract Documents
3. Applied Strength of Materials
4. Applied Soil Mechanics & Foundations
5. Construction Estimating & Bidding I
6. Construction Administration
7. Construction Law
8. Construction Scheduling
9. Construction Estimating & Bidding II

The core also incorporates the following courses from the Civil Engineering Department:

1. Surveying I with Lab
2. Construction Management with Lab
3. Equipment & Methods

The final four core courses come from the Accounting and Business programs at WKU:

1. Introductory Accounting Financial
2. Introductory Accounting Managerial
3. Business Law
4. Human Resources Management.

The final required credit hours are achieved through 6 credit hours of program electives. There are no courses that are listed at WKU that deal with sustainability, Building Information Modeling, or LEED Practices (AMS, 2010).

ITT Technical Institute – Construction Management

The Construction Management program covers the fundamentals and offers a foundation in construction management requiring 180 total credit hours with 28 credit hours of unspecified general education courses and a total of 60 credit hours in general education. The construction management core requires 56 credit hours of unspecified core courses and an overall total of 108 credit hours. The specified Construction Management core courses include:

1. Commercial Construction Methods
2. Principles of Building Construction Management
3. Statics and Strength of Materials
4. Building Codes
5. Site Construction and Measurement
6. Construction Management Information Systems
7. Construction Documents and Contracts
8. Mechanical Systems
9. Construction Project Scheduling
10. Cost Estimating and Analysis
11. Legal Issues in Construction

12. Construction Safety Management

13. Introduction to Project Management

The remaining 12 credit hours are filled by unspecified elective courses. There are no courses at ITT Technical Institute that deal specifically with sustainability, Building Information Modeling, or LEED Practices (ITT, 2010).

Kentucky Community and Technical College System – Construction Technology

The KCTCS system offers more than just a two-year program of Associate in Applied Science in Construction Technology. The program also offers a diploma for Construction Carpenter and certificates for Basic Carpenter, Carpenter Helper, Rough Framing Carpenter, Construction Forms Helper, Residential Carpenter, Residential Roofer, and Residential Site Layout Assistant. The Construction Technology associates degree requires a total of 60 to 63 semester credit hours with 18 to 21 credit hours of general education courses.

The remaining 42 credit hours of Construction Technology core courses includes courses in Blueprint Reading For Construction, Introduction to Construction with Lab, Surveying & Foundations with Lab, Light Frame Construction I with Lab, Light Frame Construction II with Lab, Light Frame Construction III with Lab, Practicum in Construction OR Co-op in Construction, Industrial Safety and ten semester credit hours in technical electives. Some of the available technical electives for the program include Basic Blueprint Reading, Construction Formwork with Lab, Special Topics in Construction, and Light Frame Construction IV with Lab. There are

no courses in the KCTCS system that deal specifically with sustainability, Building Information Modeling, and LEED Practices (Ashland, 2010).

Chapter III

Methodology

Restatement of the Problem

The Department of Industrial and Engineering Technology at Morehead State University in Morehead, KY offers an option of construction management program with its Bachelor of Science in Industrial Technology Degree. This option of the Industrial Technology program must add and/or revise courses to stay up to date and relevant in respect to the changes taking place in the construction industry. Additions/changes to the courses in the program are the responsibility of the construction management faculty of the IET Department.

By changing the courses required for the construction management option of the Industrial Technology degree, the students would receive an education that is well rounded and the ability to offer employers a potential employee with some background into the ideals of sustainable construction, BIM, and LEED. Construction companies within Kentucky will receive notification that the faculty of the Construction Management program at Morehead State University are offering a top-notch program and are working to make sure that the program turns out well-prepared entry-level professionals.

The proposed comparative study of the Construction Management programs at Kentucky Universities and Colleges and surveys of Construction Management faculty at these institutions as well as surveys of construction professionals, will

result in recommendations of revised curriculum for the Construction Management option of the Industrial Technology degree at Morehead State University. This will ensure that the program at MSU will remain relevant with the most current techniques used in the industry being taught in the program. The development of the curriculum for these subjects will include all relevant information including learning outcomes, assessment techniques, textbooks, etc.

Research Instrument and Procedure

Surveys are used when researching any topic to collect facts and opinions (VanderMey, 2004). The Likert Scale, named after its inventor, psychologist Rensis Likert, is the most widely used scale in survey research (Cooper and Schindler, 2008). When responding to an item, respondents of a Likert questionnaire are asked to specify their level of agreement to a statement. The respondent of a Likert statement is asked to evaluate their agreement level according to specified subjective or objective criteria. Multiple response levels could be chosen for a Likert scale survey, although it is most often that five ordered response levels are used. The format of a typical five-level Likert item is: (1) Strongly disagree, (2) Disagree, (3) Neither agree nor disagree, (4) Agree, and (5) Strongly agree.

The methodology will be comprised of primary and secondary research techniques (Nadell, Langan, & Comodromos, 2009). The instruments for this series of surveys will consist of a Modified Likert scale. The modification of the Likert

scale will involve using a point system of 1 to 5 rather than agreement levels. The lower the number chosen by the respondent, the importance of the subject being asked of the respondent is lower also. This will allow the return of the data to be basically the same, but will return data that is more easily analyzed statistically.

Surveys for industry professionals (see Appendix B) and a faculty pilot survey (see Appendix B) should be created to determine the courses/topics that need to be developed/revised for the Construction Management program. The weighting criteria for the available answers should also be determined according to acceptable standards and through a validation process. The intention is to create surveys whose answers are listed with a ranking system of zero through four. Once all of the surveys that have been received by the ending survey date have been collected, the rankings will be ordered and analyzed to determine the topics that professionals feel should be developed for a construction management program. These surveys will also be used to develop the information to be covered and the materials that will be used to teach and promote the courses. Sample surveys are included in the index of this research proposal.

A survey consisting of fifty construction topics was developed using research of current construction management programs in Kentucky. Dr. Beverly Klecker validated the layout and style of the survey and the content of the survey was validated for its effectiveness in measuring construction concepts by two individuals; Dr. Denise Gravitt and Mr. Paul Mattingly.

Dr. Beverly Klecker, an Associate/Tenured Professor from the Department of Professional Programs in Education at Morehead State University validated the layout and style of the surveys to be used for this research. Dr. Klecker, a Licensed Professional Clinical Counselor (LPCC) in the state of Kentucky, was recognized as Morehead State University's 2008 Distinguished Researcher. The changes to the original surveys that were recommended by Dr. Klecker were changing the number ratings for the construction topics from 1 to 5 rather than 0 to 4, changing the answer format for the demographics to discrete data rather than ranges, and numbering the list of construction topics for easier data analysis.

Dr. Denise Gravitt, Assistant Professor in the Department of Architectural and Manufacturing Sciences at Western Kentucky University, is a Certified Construction Document Specialist (CCDS) and a Certified Construction Industry Technician (CCIT). Dr. Gravitt recommended a few changes to the survey issued for this research.

The changes recommended for the Construction Professionals Survey included the addition of demographic questions including MBE/WBE status and company specialization. Changes were recommended for some of the construction topics including changing Sustainable Construction to Green/Sustainable Construction, changing Quality Control to Quality Management or TQM and changing Statics to Statics and Strength of Materials. The final change recommended for this survey included the addition of the topics Construction Law, Ethics, Soils and Foundations, and Safety Management.

Mr. Paul Mattingly is a partner in BosseMattingly Constructors, Inc. in Louisville, Kentucky. Mr. Mattingly holds certification as a Certified Professional Constructor (CPC) with the American Institute of Constructors (AIC) and is a current Board Member and 2010 President of the Associated General Contractors of Kentucky (AGC). In the area of construction education, Mr. Mattingly participates with the American Council for Construction Education (ACCE) on Visiting Teams as an industry representative. He is also involved with Iroquois High School Magnet Career Academy in Louisville, Kentucky, Eastern Kentucky University, and Morehead State University as an industry advisor. The changes recommended by Mr. Mattingly were the additions of construction topics for the survey. These construction topics included (1) ethics in construction, (2) written and oral communication, and (3) labor relations.

The population for the research into the need for the development/revision of course(s) will be construction industry professionals from Kentucky and all bordering states. There is no requirement for previous knowledge of any of the concepts involved in sustainable construction, Building Information Modeling, and Leadership in Energy and Environmental Design, including the ENERGY STAR program and the LEED green building rating system.

Construction professionals in management positions, including alumni and Industrial and Engineering Technology Advisory Board members, whose companies hold membership in either the Associated General Contractors or the Associated Builders and Contractors will be the sample for this study. This sample will be all-

inclusive, as prior knowledge of sustainable construction concepts, Building Information Modeling, the ENERGY STAR program, and the LEED initiative are not required. Members of professional organizations that have a relationship with the Construction Management program at Morehead State University will also be included in the sample for the study.

Data Collection Methods

The research will be conducted using a survey to determine the information that needs to be added to the Construction Management program at Morehead State University. A pilot test survey will be conducted utilizing the knowledge of Construction Management faculty at universities and colleges accredited by third-party accreditation agencies such as ATMAE and ACCE. This is a pilot test that will simulate what professors at educational institutions feel should be offered in Morehead State's Construction Management program. The survey of construction industry professionals will attempt to determine what information should be revised/added to the construction management program based on the knowledge of professionals in the construction industry. Included in this data will be alumni of the construction management program at Morehead State University who are currently working in the construction industry. Once these surveys have been completed and the results analyzed, a determination will be made as to what courses need to be added/revised in the program such as the development of a sustainable construction

course. This study will also help to determine the material and information that would be introduced in the course additions/revisions.

The pilot test survey and the construction professional survey will be created using Survey Monkey.com. The surveys will be administered through a web link provided on the Survey Monkey website. The link to the construction professionals survey (http://www.surveymonkey .com/s/287FN5F) will be made available through e-mails to all of the intended respondent companies. The internet link to the Construction Faculty Pilot Survey (http://www. surveymonkey.com/s/2L7CQSN) will also bemade available through e-mail communications.

Chapter IV

Findings & Analysis

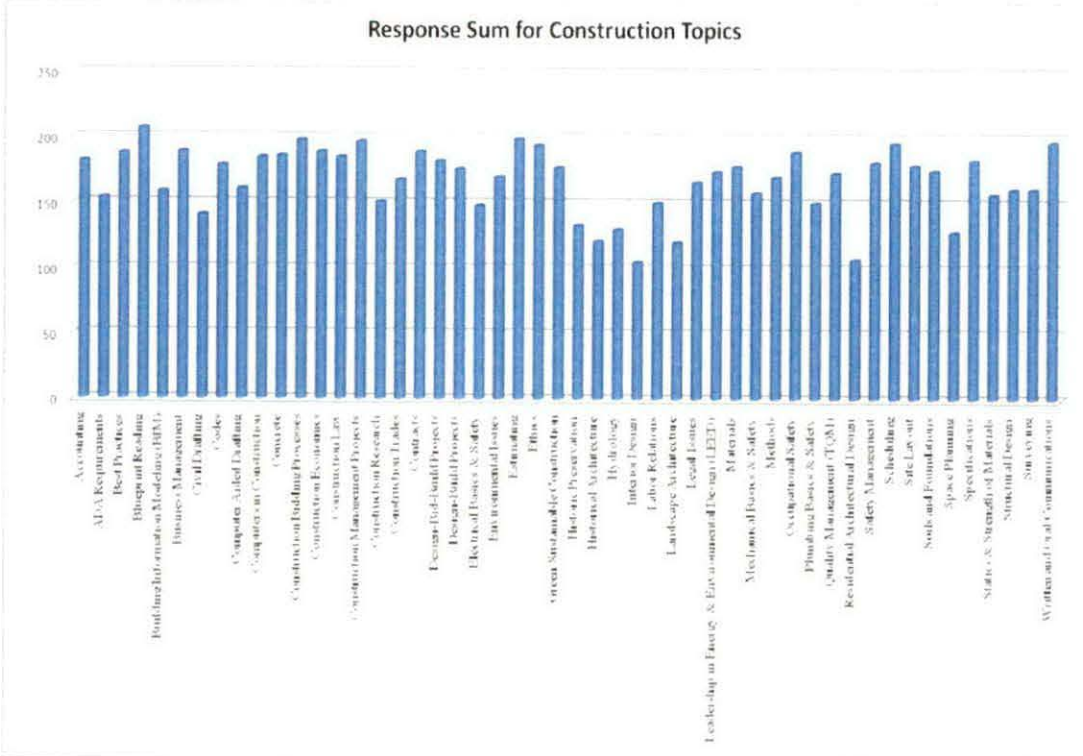
The primary purpose of the study was to determine the shortcomings, if any, of the construction management option of the Industrial Technology degree at Morehead State University. Along with a study of existing programs at other universities in Kentucky, a survey of professionals in the construction industry, including recent graduates of the program, was one of the main information sources for determining what should be added/revised in the MSU program.

The survey was administered completely through e-mail with the recipients being members of the Associated General Contractors of America in Kentucky and all of its bordering states. The survey was sent to members of seventy-five companies in Kentucky, Indiana, Illinois, Ohio, West Virginia, Tennessee, Virginia, and Missouri. The survey was returned by thirty-seven companies in nine (9) states, with five (5) companies returning multiple responses. The responses were returned by companies located in Florida, Illinois, Indiana, Kentucky, Minnesota, Missouri, Ohio, Tennessee, and West Virginia. The return rate of the companies receiving the survey was forty-nine and three tenths percent (49.3%).

Figure 4.1.0, a bar chart, displays the sum of the scores for each of the construction topics included in the survey administered to construction professionals. Topic number four (4), Blueprint Reading, received the highest total score with topic number twenty-nine (29), Interior Design, receiving the lowest total score. Thirty-six

(36) of the fifty (50) topics contained in the survey had total scores of at least two

Figure 4.1.0 Sum of Responses



hundred (200), with the remaining fourteen (14) topics receiving total scores of one hundred ninety-nine (199) or lower.

The first analysis performed on the data collected through this survey was the calculation of the mean ratings of the responses. The means Table 4.1 displays the mean ratings of the construction topics contained in the survey administered to construction professionals. The mean ratings in the table are ordered from the highest rating to the lowest.

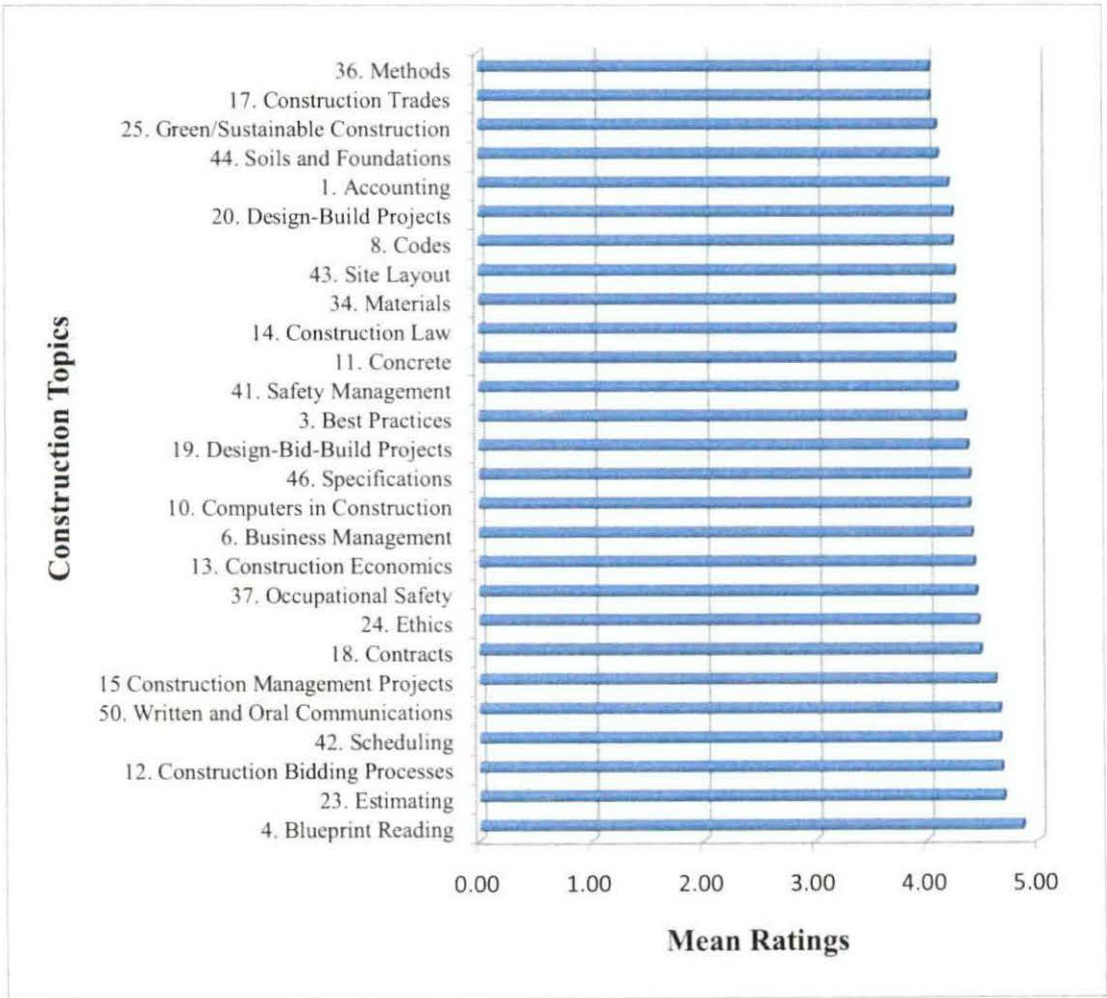
Table 4.1 – Mean Ratings of Construction Topics

Construction Topic Ratings		
Topic #	**Construction Topic**	**Rating Average**
1	Accounting	4.33
2	ADA Requirements	3.58
3	Best Practices	4.37
4	Blueprint Reading	4.81
5	Building Information Modeling (BIM)	3.70
6	Business Management	4.40
7	Civil Drafting	3.36
8	Codes	4.16
9	Computer Aided Drafting	3.74
10	Computers in Construction	4.40
11	Concrete	4.33
12	Construction Bidding Processes	4.60
13	Construction Economics	4.40
14	Construction Law	4.30
15	Construction Management Projects	4.58
16	Construction Research	3.51
17	Construction Trades	3.91
18	Contracts	4.40
19	Design-Bid-Build Projects	4.23
20	Design-Build Projects	4.19
21	Electrical Basics & Safety	3.52
22	Environmental Issues	3.95
23	Estimating	4.63
24	Ethics	4.62
25	Green/Sustainable Construction	4.12
26	Historic Preservation	3.09
27	Historical Architecture	2.81
28	Hydrology	3.02
29	Interior Design	2.50

30	**Labor Relations**	3.49
31	**Landscape Architecture**	2.79
32	**Legal Issues**	3.95
33	**Leadership in Energy & Environmental Design (LEED)**	4.05
34	**Materials**	4.14
35	**Mechanical Basics & Safety**	3.67
36	**Methods**	3.95
37	**Occupational Safety**	4.40
38	**Plumbing Basics & Safety**	3.49
39	**Quality Management (TQM)**	4.02
40	**Residential Architectural Design**	2.49
41	**Safety Management**	4.21
42	**Scheduling**	4.56
43	**Site Layout**	4.16
44	**Soils and Foundations**	4.07
45	**Space Planning**	2.98
46	**Specifications**	4.36
47	**Statics & Strength of Materials**	3.65
48	**Structural Design**	3.74
49	**Surveying**	3.74
50	**Written and Oral Communications**	4.69

Figure 4.1.2 is a bar chart that shows the survey responses with a mean average greater than four (4.0). The responses with a mean rating of greater than four (4.00) are considered to be important to the curriculum of a construction management program. Figure 4.1.3 is a bar chart that shows the construction topics receiving a mean rating above three (3.00) and less than four (4.00). This category of mean ratings would suggest that these topics are moderately important to a construction management program. Figure 4.1.4 is a bar chart that reveals the construction topics

Figure 4.1.2 - Topics with mean ratings above 4.0

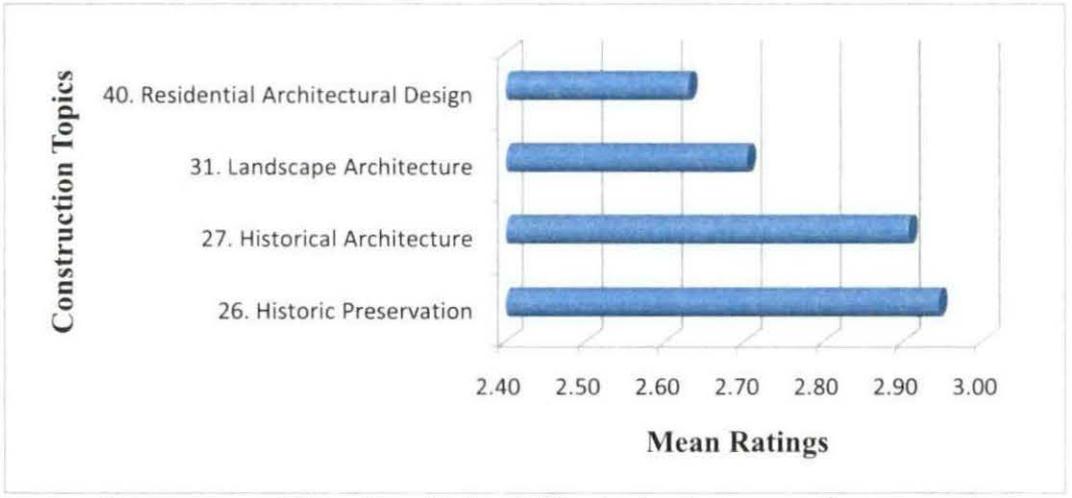


with a mean rating of less than three (3.00). This rating suggests that these construction topics are not very important to a construction management program according to the construction professionals that responded to this survey.

The mean ratings of each of the construction topics is how the determination of the content that should be covered in a construction management program. These ratings along with comments that construction professionals returned with their surveys can be used to determine which construction topics can be combined to form

Figure 4.1 3 – Construction topics with a mean rating between 3.00 and 4.00

Figure 4.1.4 - Construction Topics with mean ratings below 3.00



construction courses at the university level. The topics that received a mean rating above four (4.00) are considered important in a construction management program. These topics are, in order of importance:

1. Blueprint Reading
2. Estimating
3. Construction Bidding Processes
4. Scheduling
5. Written and Oral Communications
6. Construction Management Projects
7. Contracts
8. Ethics
9. Occupational Safety
10. Construction Economics
11. Business Management

12. Computers in Construction
13. Specifications
14. Design-Bid-Build Projects
15. Best Practices
16. Safety Management
17. Concrete
18. Construction Law
19. Materials
20. Site Layout
21. Codes
22. Design-Build Projects
23. Accounting
24. Soils and Foundations
25. Green/Sustainable Construction
26. Construction Trades
27. Methods

The topics that received a mean rating between three (3.00) and four (4.00) and are considered moderately important to the content of the curriculum of a construction management program are listed below in order of importance:

1. Leadership in Energy and Environmental Design (LEED)
2. Quality Management
3. Environmental Issues

4. Legal Issues
5. Surveying
6. Structural Design
7. Building Information Modeling
8. Computer Aided Drafting
9. Labor Relations
10. Mechanical Basics and Safety
11. Statics and Strength of Materials
12. ADA Requirements
13. Construction Research
14. Electrical Basics and Safety
15. Plumbing Basics and Safety
16. Civil Drafting
17. Hydrology
18. Space Planning
19. Historic Preservation

The survey topics that received a mean rating below three (3.00) and considered not very important to the curriculum of a construction management program are:

1. Historical Architecture
2. Landscape Architecture
3. Residential Architectural Design
4. Interior Design.

Twenty-six of the respondents to the survey left comments (see Appendix F) to be used to help determine what the core content of a construction management program should include. However, while some of the comments contained particular information regarding content, some of the comments that were given by the construction professionals were general with little relevant information to be used.

Chapter V

Summary, Conclusion, and Recommendations

Summary

This study was completed with the intent to determine how the curriculum of the CM program at Morehead State University compares to other CM programs available to students in Kentucky. It was also an attempt to align the program with the construction methods and concepts presently used by professionals in the industry. This curriculum audit will align the program with the industry and prepare students graduating from the program to knowledgeable in the current construction practices.

There were twenty-seven topics in the survey considered highly important to the curriculum of a construction management program; The curriculum of MSU's construction management program covers thirteen of the topics. Of the fourteen items that were not already covered in the curriculum, six could be covered in existing courses through revisions to the syllabi and content. Another two topics could be covered in existing Industrial and Engineering courses through the same revisions. Two of the topics, "Construction Law" and "Ethics", could be covered together with the development of one construction management course or through implementing these in each of the existing construction management courses in a way that is applicable to each course.

Two other topics, "Accounting" and "Business Management", could be covered by requiring construction management students to take existing courses through other departments at Morehead State. The final topic that is high importance

to a construction management program could be covered through the development of a sustainable (or green) construction course for the Construction management program.

Conclusion

The purpose of this survey was to evaluate the construction management program at Morehead State University to determine if there are any additions or revisions that were necessary for the program to be compatible with industry standards. This was to be completed through a comparison of the curriculum of the MSU construction management program with programs at other universities in Kentucky as well as a survey of construction professionals in Kentucky and its bordering states.

The information to do the curricula comparison was readily available on the Internet. The comparison showed that the universities in Kenucky, with the exception of Murray State University, with programs or options in construction management had relatively the same number of required credit hours in their construction management core.

Morehead State University requires thirty-six (36) credit hours in the construction management program. Murray State University requires sixty-seven credit hours in construction engineering technology courses (38 hours in civil engineering technology and 29 hours in construction engineering technology) and 11 to 13 hours in construction engineering technology support courses. Northern

Kentucky University requires sixty-four (64) credits in construction management courses. NKU also requires a Capstone course, two technical support courses, three support requirements and either the business and management component or the Minor in Entrepreneurial Studies. The Eastern Kentucky University Construction Management Major Requirements are fifty-seven (57) semester credit hours in construction core courses. Western Kentucky University requires twenty-seven (27) credit hours in architectural science core, another twenty-seven (27) credit hours from the construction management core, nine credit hours from civil engineering, and twelve (12) hours in Accounting and Business. The construction management core at ITT Technical Institute requires 56 credit hours of unspecified core courses and an overall total of 108 credit hours.

MSU has a thirty-nine (39) credit hour requirement for the Industrial and Engineering Technology core as a requirement for the construction management option of the Industrial Technology degree. The other universities in Kentucky have requirements that vary from business to accounting to civil engineering. The disparity in the number of courses in each university's construction management core is due to the difference in the types of programs that each university offers. Morehead State's program is an option, whereas the other programs are stand-alone. The courses that are offered as part of the MSU construction management core are also taught in each of the programs at the other universities in Kentucky. The number of courses available at each of the other universities in Kentucky that are not available at Morehead State are detailed in table 4.2.

Table 4.2 – Construction courses available at KY universities that are not available at MSU

Eastern Kentucky University	ITT Technical Institute	Murray State University	Northern Kentucky University	Western Kentucky University
Construction Graphics	Principles of Buidling Construction Management	Anatomy of Buildings	Construction Processes	Survey of Building Systems
Mechanical/Electrical Systems	Site Construction and Management	Intro to Environmental Engineering Tech	Cooperative Education	Internship
Cooperative Study: Construction Management	Construction Management Information Systems	Applying the National Electrical Code	Mechanical / Electrical / Plumbing Systems I	Technology Management / Supervision / Team Building
Estimating II	Mechanical Systems	Electrical Systems	Mechanical / Electrical / Plumbing Systems II	Construction Administration
Project Organization & Supervision	Legal Issues in Construction	Principles of Accounting I	Construction Safety	Construction Law
Principles of Occupational Safety & Health	Construction Safety Management	Construction Planning & Management	Construction Cost Control	Construction Estimating & Bidding II
		Structural Steel Design		
		Legal Environment of Business		
		Fundamentals of Management		
		OSHA Standards for General Industry & Construction		

Four of the five universities in the state offer courses in Mechanical systems, electrical systems, or both. Three of the five programs have courses in construction law or legal issues. Two of the universities offer a two courses in estimating, while Morehead State offers only one. Three of the universities require their students to have either a cooperative study or internship to earn their degree, while Morehead

State University offers theirs as an elective. Courses in safety management or occupational safety and health related specifically to construction are required by three of the universities.

The main difference in the core curricula of the programs of the universities in the state is the ability of the other programs to offer more courses in their construction management core because they are full-fledged construction management programs rather than a program option. Another deciding factor in the courses that are offered at each or the universities is the type of accreditation of the university. Each accrediting agency has guidelines for the content that should be included in the core of a university's construction management program or option.

The second part of the study of the construction management programs in Kentucky universities was the distribution of a survey among construction professionals in Kentucky and its bordering states. This survey consisted of a series of demographic questions regarding the company where each of the respondents worked and a list of construction topics that were to be given a ranking from one (1) to five (5), with one (1) being "Not Important" and (5) being Extremely Important.

The results of the survey returned twenty-seven (27) topics that are of high importance to a construction management program. Of these twenty-seven items, the curriculum of MSU's construction management program encompasses thirteen of the topics, or forty-eight percent. Of the fourteen items that were not already covered in the curriculum, six could be covered in existing courses through revisions to the syllabi and content. Another two topics could be covered in existing Industrial and

Engineering courses through the same revisions. Two of the topics, "Construction Law" and "Ethics", could be covered together with the development of one construction management course or through implementing these in each of the existing construction management courses in a way that is applicable to each course. Two other topics, "Accounting" and "Business Management", could be covered by requiring construction management students to take existing courses through other departments at Morehead State. The final topic that is high importance to a construction management program could be covered through the development of a sustainable (or green) construction course for the Construction management program.

Nineteen of the other topics returned results that determined they were moderately important in a construction management program. Of these 19 topics, seven are already incorporated into the construction management curriculum at Morehead State University. Nine of the topics in the survey could be covered in existing construction management courses through revisions to the syllabi and content. One other topic could be covered in existing Industrial and Engineering Technology courses through the same revisions. The topic "Leadership in Energy and Environmental Design" could be added to the sustainable construction course that would be developed in the list of high importance topics. Morehead State's curriculum already has a "Residential Architectural Design" class that introduces Building Information Modeling software to the construction management students. This course could be developed more fully into a course that teaches the aspects of the subject that will align the course with industry standards.

There were only four of the topics out of the fifty that were included in the survey that returned a result of low importance in a construction management program. Because there are construction management positions in industry that may require students to understand basics of these topics, it is possible to incorporate these final four topics into the existing construction management core.

4.3 Recommendations

The existing construction management courses should be revised to include the construction topics that were returned by the survey as being of high importance or moderately important to a construction management program. This revision of the core content is one of the main goals of this study. By incorporating these topics into the curriculum of the construction management program at Morehead State University, the department of Industrial and Engineering Technology would make the program current with industry. The topics and the existing courses that would b e suitable for each of the topics are listed in Table 4.3.

The courses that should be developed for the construction management program include a course titled "Sustainable Construction" as well as a course titled "Construction Law and Ethics. These two courses would both encompass more than one topic and could also incorporate some of the information covered in the existing construction management courses in an effort to build upon the foundation that already exists in the program.

Table 4.3 – Construction topics and their relevant existing courses

Topic	Course(s)
Construction Bidding Processes	ITCM 204 & ITCM 205
Construction Economics	IET 320
Design-Bid-Build Projects	ITCM 204 & ITCM 205
Safety Management	IET 422
Site Layout	ITCM 304 & ITCD 405
Design-Build Projects	ITCM 204 & ITCM 205
Soils and Foundations	ITCM 202 & ITCM 203
Construction Trades	ITCM 101
Quality Management (TQM)	IET 319 & IET 419
Labor Relations	ITCM 101
Mechanical Basics & Safety	ITCM 101
ADA Requirements	ITCM 204
Electrical Basics & Safety	ITCM 101
Plumbing Basics & Safety	ITCM 101
Space Planning	ITCD 405
Historic Preservation	ITCM 101

The sustainable construction course should be an upper (300 or 400) level course as students should have a good background in construction management basics. The students should have knowledge of standard construction practices and materials before taking this course, making ITCM 203 a prerequisite for this course. A combination of sustainable construction and an introduction to Leadership in Energy and Efficient Design (LEED) principles should be the content covered in the course. The following are the learning outcomes for the course:

- Basic knowledge from design to construction in the emerging field of sustainable construction and technology.
- Integrated thinking skills for optimizing design parameters

- Basic leadership and teamwork skills in managing and completing interdisciplinary projects.
- Presentation and communication skills
- Life-long learning skills to pursue further study or advance the career in green building related fields.
- Basic knowledge about LEED rating systems for all ot the different structures that can be LEED certified.
- Understanding of how LEED is incorporated into a building's lifecycle.

Educational videos from trusted sources and authorities on the subject should be included in the course curriculum. The assessment techniques for this course should include a mixture of exams, quizzes, homework, portfolio, and research papers. The professor of the course should determine the appropriate number of each assessment technique for the course and arrange them in a way that ensures students will learn the basics of sustainability before study of the LEED principles begins.

The second course that should be added to the construction management program is a course in Construction Law. The course should be an introduction to the different ways that law and judicial procedures relate to construction management. The topics covered in the course would include bonds, contracts, bonds, professional ethics, professional liability, liens, bidding procedures, and product liability. An emphasis should be placed on the development of critical thinking process, abstract problem analysis, and evaluation of situations that deal with laws and judicial

processes that impact construction. This course covers legal issues from the formation of the contract to the final payment, and is designed to assist construction professionals and their lawyers in day-to-day business activities.The following are the learning outcomes for the course:

- Examine claims arising from construction
- Basic knowledge of the roles and obligations of all parties of the contract
- Knowledge of the protections built into construction contracts
- Special risk and liability issues
- Determine type of contract that suits the delivery method

The assessment techniques for this course should include a mixture of exams, quizzes, in-class assignments, homework, portfolio, and research papers. The professor of the course should determine the appropriate number of each assessment technique for the course and arrange them in a way that ensures students will learn the basics of construction law in an easily understandable order.

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Appendix A

Survey Letter

Date

Dear Sir/Madam:

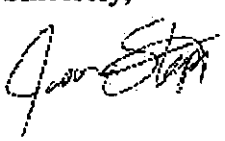
I am a graduate student in the Department of Industrial and Engineering Technology at Morehead State University. To fulfill the thesis option requirement of my degree, I am conducting a study of the curriculum content of the Construction Management option of the Industrial Technology bachelor degree. The study is an attempt to make sure that the content introduced to students is current and meets the requirements of the construction industry. The intent of this study is to prioritize the content that should be included in the curriculum of the Construction Management program.

To receive a bachelor degree in this program, students are required to complete 48 semester credit hours of General Education coursework, 39 semester credit hours of coursework in the Industrial Technology core, and 36 semester credit hours of coursework in the construction management core.

The published data analysis for this survey will be based on group responses and individual responses to this survey will be kept confidential. Completing this survey, located at (Web Link), will be helpful in my effort to improve the Construction Management curriculum as well as the knowledge of the graduates. I am hopeful that you will take 20 minutes from your very busy schedule to complete this survey and would be grateful if you would complete it by March 24, 2010. Please feel free to add any additional comments regarding the survey. Thank you for your time, cooperation, and consideration.

Again, please go to (Web Link) to complete this survey.

Sincerely,



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Appendix B

Construction Faculty Pilot Survey

Construction Management Curriculum Content Survey

Pilot Survey For Construction Faculty

To help us gather information for comparative purposes and determine the relevant courses for our construction management program, please complete this survey and return it by **(date)**. For each question below, circle the number to the right of the statement that best fits your opinion on the importance of the issue. Use the scale below to match your opinion.

University Information	**Give the appropriate answer to each question.**
What is the average number of construction students in your program per year?	
What is the average number of construction graduates from your program per year?	
What is the average number of construction courses you teach per semester?	
What is the number of courses in your program's construction core?	
How many faculty members are in the program at your University?	
How many FTE faculty members are in the program?	
What are the backgrounds of the FTE faculty members in the program (i.e. Ph.D., Ed.D., MS)?	
Do you have any program concentrations (i.e. Heavy, Civil, Residential, Mechanical)?	
What is your program accreditation (i.e. ABET, ACCE, ATMAE)?	

Construction Topics		**Please rate the topics according to importance: Use the scale below to match your opinion.**				
N=Not at all NV=Not Very I=Indifferent S=Somewhat E=Extremely						
		N	**NV**	**I**	**S**	**E**
1.	Accounting	1	2	3	4	5
2.	ADA Requirements	1	2	3	4	5
3.	Best Practices	1	2	3	4	5
4.	Blueprint Reading	1	2	3	4	5
5.	Building Information Modeling (BIM)	1	2	3	4	5
6.	Business Management	1	2	3	4	5
7.	Civil Drafting	1	2	3	4	5
8.	Codes	1	2	3	4	5
9.	Computer Aided Drafting	1	2	3	4	5
10.	Computers in Construction	1	2	3	4	5
11.	Concrete	1	2	3	4	5
12.	Construction Bidding Processes	1	2	3	4	5
13.	Construction Economics	1	2	3	4	5
14.	Construction Law	1	2	3	4	5
15	Construction Management Projects	1	2	3	4	5
16.	Construction Research	1	2	3	4	5
17.	Construction Trades	1	2	3	4	5
18.	Contracts	1	2	3	4	5

19.	Design-Bid-Build Projects	1	2	3	4	5
20.	Design-Build Projects	1	2	3	4	5
21.	Electrical Basics & Safety	1	2	3	4	5
22.	Environmental Issues	1	2	3	4	5
23.	Estimating	1	2	3	4	5
24.	Ethics	1	2	3	4	5
25.	Green/Sustainable Construction	1	2	3	4	5
26.	Historic Preservation	1	2	3	4	5
27.	Historical Architecture	1	2	3	4	5
28.	Hydrology	1	2	3	4	5
29.	Interior Design	1	2	3	4	5
30.	Labor Relations	1	2	3	4	5
31.	Landscape Architecture	1	2	3	4	5
32.	Legal Issues	1	2	3	4	5
33.	Leadership in Energy & Environmental Design (LEED)	1	2	3	4	5
34.	Materials	1	2	3	4	5
35.	Mechanical Basics & Safety	1	2	3	4	5
36.	Methods	1	2	3	4	5
37.	Occupational Safety	1	2	3	4	5
38.	Plumbing Basics & Safety	1	2	3	4	5
39.	Quality Management (TQM)	1	2	3	4	5
40.	Residential Architectural Design	1	2	3	4	5
41.	Safety Management	1	2	3	4	5
42.	Scheduling	1	2	3	4	5
43.	Site Layout	1	2	3	4	5
44.	Soils and Foundations	1	2	3	4	5
45.	Space Planning	1	2	3	4	5
46.	Specifications	1	2	3	4	5
47.	Statics & Strength of Materials	1	2	3	4	5
48.	Structural Design	1	2	3	4	5
49.	Surveying	1	2	3	4	5
50.	Written and Oral Communications	1	2	3	4	5

Additional Comments	**Please use this section to add any comments you feel are important to the construction topics listed above. Feel free to add any topics not listed above and the topics that could be combined.**

Appendix C

Construction Professionals Survey

Construction Management Curriculum Content Survey

For Construction Professionals

To help us gather information for comparative purposes and determine the relevant courses for our construction management program, please complete this survey and return it by **(date)**. For each question below, circle the number to the right of the statement that best fits your opinion on the importance of the issue. Use the scale below to match your opinion.

Company Information	**Give the appropriate answer to each question.**
What is your Company's area of specialization?	
Are you a MBE or WBE?	
How many employees does your company have?	
How many of your employees have earned a degree from a construction program?	
How many of your employees have some sort of professional certification?	
How many employees have earned a degree from a Kentucky University?	
How many professional organization memberships does your company have?	

Construction Topics		**Please rate the topics according to importance: Use the scale below to match your opinion.**				
N=Not at all NV=Not Very I=Indifferent S=Somewhat E=Extremely						
		N	**NV**	**I**	**S**	**E**
1.	Accounting	1	2	3	4	5
2.	ADA Requirements	1	2	3	4	5
3.	Best Practices	1	2	3	4	5
4.	Blueprint Reading	1	2	3	4	5
5.	Building Information Modeling (BIM)	1	2	3	4	5
6.	Business Management	1	2	3	4	5
7.	Civil Drafting	1	2	3	4	5
8.	Codes	1	2	3	4	5
9.	Computer Aided Drafting	1	2	3	4	5
10.	Computers in Construction	1	2	3	4	5
11.	Concrete	1	2	3	4	5
12.	Construction Bidding Processes	1	2	3	4	5
13.	Construction Economics	1	2	3	4	5
14.	Construction Law	1	2	3	4	5
15	Construction Management Projects	1	2	3	4	5
16.	Construction Research	1	2	3	4	5
17.	Construction Trades	1	2	3	4	5
18.	Contracts	1	2	3	4	5
19.	Design-Bid-Build Projects	1	2	3	4	5
20.	Design-Build Projects	1	2	3	4	5
21.	Electrical Basics & Safety	1	2	3	4	5

22.	Environmental Issues	1	2	3	4	5
23.	Estimating	1	2	3	4	5
24.	Ethics	1	2	3	4	5
25.	Green/Sustainable Construction	1	2	3	4	5
26.	Historic Preservation	1	2	3	4	5
27.	Historical Architecture	1	2	3	4	5
28.	Hydrology	1	2	3	4	5
29.	Interior Design	1	2	3	4	5
30.	Labor Relations	1	2	3	4	5
31.	Landscape Architecture	1	2	3	4	5
32.	Legal Issues	1	2	3	4	5
33.	Leadership in Energy & Environmental Design (LEED)	1	2	3	4	5
34.	Materials	1	2	3	4	5
35.	Mechanical Basics & Safety	1	2	3	4	5
36.	Methods	1	2	3	4	5
37.	Occupational Safety	1	2	3	4	5
38.	Plumbing Basics & Safety	1	2	3	4	5
39.	Quality Management (TQM)	1	2	3	4	5
40.	Residential Architectural Design	1	2	3	4	5
41.	Safety Management	1	2	3	4	5
42.	Scheduling	1	2	3	4	5
43.	Site Layout	1	2	3	4	5
44.	Soils and Foundations	1	2	3	4	5
45.	Space Planning	1	2	3	4	5
46.	Specifications	1	2	3	4	5
47.	Statics & Strength of Materials	1	2	3	4	5
48.	Structural Design	1	2	3	4	5
49.	Surveying	1	2	3	4	5
50.	Written and Oral Communication	1	2	3	4	5

Additional Comments	**Please use this section to add any comments you feel are important to the construction topics listed above. Feel free to add any topics not listed above and the topics that could be combined.**

Appendix D – Pilot Test Survey Results

	Construction Professio			
	Not at All	%	Not Very	%
	1		2	
4. Blueprint Reading	0	0.0%	0	0.0%
23. Estimating	0	0.0%	1	1.9%
12. Construction Bidding Processes	0	0.0%	0	0.0%
42. Scheduling	1	1.9%	0	0.0%
50. Written and Oral Communications	0	0.0%	0	0.0%
15 Construction Management Projects	0	0.0%	1	1.9%
18. Contracts	1	1.9%	1	1.9%
24. Ethics	0	0.0%	0	0.0%
37. Occupational Safety	0	0.0%	3	5.6%
13. Construction Economics	0	0.0%	0	0.0%
6. Business Management	0	0.0%	0	0.0%
10. Computers in Construction	1	1.9%	0	0.0%
46. Specifications	0	0.0%	0	0.0%
19. Design-Bid-Build Projects	2	3.7%	0	0.0%
3. Best Practices	0	0.0%	0	0.0%
41. Safety Management	2	3.7%	2	3.7%
11. Concrete	2	3.7%	1	1.9%
14. Construction Law	0	0.0%	2	3.7%
34. Materials	0	0.0%	0	0.0%
43. Site Layout	1	1.9%	1	1.9%
8. Codes	0	0.0%	4	7.4%
20. Design-Build Projects	2	3.7%	0	0.0%
1. Accounting	0	0.0%	2	3.7%
44. Soils and Foundations	0	0.0%	2	3.7%
25. Green/Sustainable Construction	0	0.0%	2	3.7%
17. Construction Trades	1	1.9%	3	5.6%
36. Methods	0	0.0%	1	1.9%
33. Leadership in Energy & Environmental Design (LEED)	1	1.9%	1	1.9%
39. Quality Management (TQM)	0	0.0%	4	7.4%
22. Environmental Issues	1	1.9%	3	5.6%

32. Legal Issues	1	1.9%	2	3.7%
49. Surveying	0	0.0%	6	11.1%
48. Structural Design	1	1.9%	5	9.3%
5. Building Information Modeling (BIM)	0	0.0%	4	7.4%
9. Computer Aided Drafting	3	5.6%	4	7.4%
30. Labor Relations	3	5.6%	2	3.7%
35. Mechanical Basics & Safety	2	3.7%	3	5.6%
47. Statics & Strength of Materials	2	3.7%	5	9.3%
2. ADA Requirements	1	1.9%	7	13.0%
16. Construction Research	2	3.7%	7	13.0%
21. Electrical Basics & Safety	4	7.4%	4	7.4%
38. Plumbing Basics & Safety	4	7.4%	4	7.4%
7. Civil Drafting	4	7.4%	3	5.6%
28. Hydrology	4	7.4%	9	16.7%
45. Space Planning	9	16.7%	8	14.8%
26. Historic Preservation	4	7.4%	9	16.7%
27. Historical Architecture	7	13.0%	9	16.7%
31. Landscape Architecture	7	13.0%	10	18.5%
40. Residential Architectural Design	13	24.1%	8	14.8%

Construction Topic Ratings – Faculty Pilot Test	
	Rating Average
4. Blueprint Reading	5.00
23. Estimating	5.00
10. Computers in Construction	4.80
11. Concrete	4.80
12. Construction Bidding Processes	4.80
13. Construction Economics	4.80
15 Construction Management Projects	4.80
18. Contracts	4.80
24. Ethics	4.80
25. Green/Sustainable Construction	4.80
36. Methods	4.80

43. Site Layout	4.80
44. Soils and Foundations	4.80
8. Codes	4.60
14. Construction Law	4.60
20. Design-Build Projects	4.60
46. Specifications	4.60
48. Structural Design	4.60
49. Surveying	4.60
3. Best Practices	4.40
5. Building Information Modeling (BIM)	4.40
6. Business Management	4.40
19. Design-Bid-Build Projects	4.40
34. Materials	4.40
41. Safety Management	4.40
47. Statics & Strength of Materials	4.40
7. Civil Drafting	4.20
22. Environmental Issues	4.20
32. Legal Issues	4.20
33. Leadership in Energy & Environmental Design (LEED)	4.20
37. Occupational Safety	4.20
38. Plumbing Basics & Safety	4.20
40. Residential Architectural Design	4.20
1. Accounting	4.00
2. ADA Requirements	4.00
21. Electrical Basics & Safety	4.00
28. Hydrology	4.00
30. Labor Relations	4.00
35. Mechanical Basics & Safety	4.00
42. Scheduling	4.00
50. Written and Oral Communications	4.00
9. Computer Aided Drafting	3.80
45. Space Planning	3.80
39. Quality Management (TQM)	3.60
16. Construction Research	3.40
17. Construction Trades	3.40

27. Historical Architecture	3.40
29. Interior Design	3.40
31. Landscape Architecture	3.40
26. Historic Preservation	3.20

Appendix E – Construction Professionals Survey Results

Construction Professionals Survey Results		
	Rating Average	**Score Total**
4. Blueprint Reading	4.85	262
23. Estimating	4.69	253
12. Construction Bidding Processes	4.67	252
42. Scheduling	4.65	251
50. Written and Oral Communications	4.65	251
15 Construction Management Projects	4.61	249
18. Contracts	4.48	242
24. Ethics	4.46	241
37. Occupational Safety	4.44	240
13. Construction Economics	4.43	239
6. Business Management	4.41	238
10. Computers in Construction	4.39	237
46. Specifications	4.39	237
19. Design-Bid-Build Projects	4.37	236
3. Best Practices	4.35	235
41. Safety Management	4.28	231
11. Concrete	4.26	230
14. Construction Law	4.26	230
34. Materials	4.26	230
43. Site Layout	4.26	230
8. Codes	4.24	229
20. Design-Build Projects	4.24	229
1. Accounting	4.20	227
44. Soils and Foundations	4.11	222
25. Green/Sustainable Construction	4.09	221
17. Construction Trades	4.04	218
36. Methods	4.04	218
33. Leadership in Energy & Environmental Design (LEED)	3.98	215
39. Quality Management (TQM)	3.94	213
22. Environmental Issues	3.93	212
32. Legal Issues	3.93	212
49. Surveying	3.89	210

48. Structural Design	3.80	205
5. Building Information Modeling (BIM)	3.78	204
9. Computer Aided Drafting	3.76	203
30. Labor Relations	3.70	200
35. Mechanical Basics & Safety	3.69	199
47. Statics & Strength of Materials	3.69	199
2. ADA Requirements	3.65	197
16. Construction Research	3.56	192
21. Electrical Basics & Safety	3.56	192
38. Plumbing Basics & Safety	3.54	191
7. Civil Drafting	3.48	188
28. Hydrology	3.24	175
45. Space Planning	3.24	175
26. Historic Preservation	3.17	171
27. Historical Architecture	2.94	159
31. Landscape Architecture	2.91	157
40. Residential Architectural Design	2.70	146

Appendix F – Construction Professionals Survey Comments

1. There should be more emphasis on educating people on how to build. There are people running construction projects that cannot swing a hammer. This results in lower levels of respect from tradesmen on the job. In addition, without the practical knowledge gained from actually building, the trades will walk all over you. They will tell you things are impossible when they are not.
2. time management, speech and communications
3. Hope this helps.
4. 1 Course for estimators covering: Allowances, Sales Tax exemption methods, various prevailing wage determinations, DBE/MBE/WBE inclusion, Strategies for Alternates, bid form completion, bonding, Checking insurance requirements, Identifying who is responsible for all general condition items, locating and covering testing/special inspection/commissioning requirements and responsibilities, reading and understanding geotech reports, clarifying rock clauses, listing preinstallation requirements. THEN report production of the above job specific conclusions for distribution to project managers, superintendents, subcontractors, and back to A/E/Owner for confirmation.
5. Concrete and LEED?GREEN
6. The KCPA is a non profit promotional association made up of Contractors, Concrete Suppliers, Admixture Suppliers, and Cement Companies. Its primary purpose is to promote, educate, and offer technical assistance for the use of Portland Cement Concrete in All Pavements in Kentucky.
7. Character and Self Motivation.

8. None.

9. Accounting should be a seperate course. Computer Aided Drafting & Computers in Construction should be combined. Business Management seperate course. Several of the others could be combined in the same course study.

10. I think one very important piece to preparing students for their career is a co-op in the related field. Also we see that there needs to be more structure put around blue print reading.

11. Please keep in mind; my views are driven by my field of work, OSHA. However, I did spend 10 years in the construction industry. I don't feel I know enough about your program to make qualitative judgments on it. It seems to me these questions are quite broad. I understand the direction; however, I don't know the goal of your program. If it is your intention to create engineers' v project managers v architects, well, obviously the types of training should be more specific to these trades. It is my opinion the knowledge base required of each of these is too detailed and varied to create students that have the skill-set required for each.

12. Eastern students seem to be the best prepared.

13. I would reccommend that you add a section for energy efficiency and sustainable building practices and materials. I would also reccommend that you add a section for time management.

14. Class to combine:

1)Blueprint reading, Residential Architectural Design, Site Layout

2)Design-Bid-Build projects, Design-Build Projects, Estimating

3)Environmental Issues, Leadership in Energy & Environmental Design

4)Codes, Contracts, Legal Issues.

Classes to Emphasize on:

Business Management - Relating to Construction

New Codes relating to OSHA and safety standards.

Green Build and Design

Ideas:

Professional certifications such as:

CAPS (Certified ageing in place)

CGP (Certified Green Professional)

CGR (Certified graduate remodeler)

CGB (Certified graduate builder)

All these designations are attainable through the National Home Builders Association. I am not sure about receiving these designations without working for an member company. They may have a program for accredited Universities. Worth looking into. Also, most of my answers are based on residential remodeling/building. We do not do much commercial construction.

15. Construction safety is probably one of the most important subjects for every company. Most of the other subjects vary their importance depending on your specific job with each company.

16. Again, I am speaking from work and real life experiences. What I chose is very IMPORTANT because it's what we use most in the field. Some more than others; Dr. Patrick knew what we needed to know!!! I very much think these classes's need to remain or considered to be placed in the curriculum! Jason Stepp also knows what and how these classes are designed to help the learning curve thus gaining and having experience and confidence that one need's when graduation comes for the real world opportunities!
17. While all of the topics listed are important for a construction professional to be aware of; some are more important than others. Some subjects must be mastered to become an accomplished and high-ranking member of a crew. There's lots of principles that must a person must know in order to interpret 'the whole picture'.
18. In the construction industry one must adapt or create a culture that becomes second nature. My experience has taught me that Safety, Construction Integrity, and Customer Satisfaction are the key components to staying competitive. The following courses are my recommendations:

    Business Management

    Contracts

    Construction Safety

    Construction Management Projects

    Scheduling

    Blue Print Reading

Estimating

Combined Topics

Blue Print Reading, estimating, space planning, quality control, materials, and safety

19. I feel strongly about the program at Morehead State. However I do believe that more emphasis needs to placed in blueprint reading, scheduling, specifications, and codes. In my construction management experience there was a great need in being familiar with spec books, and reading and understanding construction drawings that I feel that I was not prepared well enough with in the program.

20. The topics that could be combined to make a good solid foundation is blueprint reading, codes, and specifications all in one course due to they are co-dependent in usual construction.

    Another course combined with the topics would be construction management, construction trades, contracts, design bid build projects and design build projects. These topics are very crucial to working on industrial projects.

    I would spend more emphasis on communication of construction documents such as RFI's, Specs., and safety. There is a big emphasis on all of this on industrial projects and the ability to record all of your necessary documentation that goes along with this.

Documentation of training and the general paperwork of jobs is something that is overlooked until in the actually working field. This needs to be incorporated in all classes so that this becomes second nature.

Safety training and implementation is also a large task on construction projects. Safety is often a big factor that can either make a job go smooth or can delay the job and throw it off schedule. The ability to interpret safety standards like OSHA and to engineer different methods to complete the work without having to implement complicated safety systems will help to make a job go much smoother and faster. i.e. having a scaffold 16 inches off the face of the work being done which requires 100% tie off as compared to being 14 inches from the face which would allow the workers to move much more freely without a harness on.

21. MSU needs to get their stuff together or drop saying they have a construction management degree... I had 5 classes that I could say were really construction management... I feel I am so ill prepared for life after college it isnt funny... and being laid off doesn't boost that confidence right now... Yay life... should have went to U of L.

22. It seemed like a lot of the focus in my major was for Residential Construction and not Commercial/Industrial Construction. I think there should be more focus put towards general contrracting on a larger scale like commercial or industrial. There was only 1 scheduling class and in my career I have to look and work with a schedule almost every day. I think there should be an

emphasis to make scheduling 2 classes instaed of 1. There is no class that teaches you on customer relations and this is a huge part of construction. Overall it seems that the focus was more on processes and materials and not about management of people.

23. Computer Technology is a skill that is being required by many contracting firms. Learning to use programs such as Suretrak, P3, On Screen Takeoff, and Quick Bid are skills that will help college graduates land jobs. Accounting, Contract management, Specifications, scheduling, estimating, and blueprint reading should receive the main focus and skills that every construction manager should have. CAD and Civil drafing are good skills, but should not require multile courses.

    I also feel that the Morehead State Construction Program needs to work more closely with local and nationwide contracting firms. Since I have been in the business, other recent graduates from other Universities were offered more opportunities to meet and work with local General Contractors and Subcontractors. This opened doors for multiple summer internship offers and multiple career offers at the time of graduation. I think working with local contractors will also help develop a curriculum that the contracting community is looking for. Having internship experience will give Morehead State Graduates a better chance of landing a job in a very competitive market.

24. Blueprint reading should be a prerequisite of most construction classes. Most importantly estimating. Without understanding the prints, it is impossible to

conduct an estimate. Residential Architectural Design should be a requirement for all construction students. Interior Design is not really important to construction managers since this is typically done by a professional within that particular industry. However it is important to understand that this is actually a part of the construction process though.

25. The more Blue Print reading a student can get is better, because in my short experience in the Construction field, I have seen alot of jobs go under because someone missed an important item on the drawings and that can have an enormous impact of a bid or management of a build. I would also teach every part of the drawings so they have a basic understanding of each component of blueprints and what they are and where they are.

26. In my line of work (underground utility construction), some main things that I believe to be more important than others are: Hydrology is one of the most needed classes for my profession, a few other very important classes are surveying, blue prints, bidding, scheduling, estimating, quality control, and management. I use each and every one of these skills in my every day jobs. I honestly didn't think I would be using these many skills in my everyday job until I graduated college and started working full time. Within the past 2 years I have probably covered most of the topics listed on the previous page but the ones I have listed have been the ones I have used time and time again or a regular basis. They have really helped me improve not only as a worker but as a foreman and manager for our company...