IPRO 338: The Effects of Green Technology on Electrical Contractors.

Sponsor:

Electrical Contractors´ Association | City of Chicago

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Team Members:

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Abstract

Background
Environmentally friendly products continue to become more reliable and inexpensive. More developers demand these products and building techniques be used in construction. However, information on these products is often confusing and incomplete. There is high demand for a tool that can help assist in bringing about a well informed transition from industry standard building practices and products, to green alternatives, as well as cut down on miscommunication between architects and contractors.

Goals
- Develop a website to host a user-friendly online database of green technology information for the Electrical Contractors' Association (ECA) of the City of Chicago.
- Developing a template for the website was the primary focus for the first semester, due to the time constraint.
- Provide data on green electrical products with cut sheets, pricing and distributor information, return on investment projections, and Leadership in Energy and Environmental Design (LEED) certification facts.
- Set the ground work in research and industry contacts to facilitate completion in future semesters.

Methodology
There were two major components involved with completing the goals for this semester. The first was accumulation of data and the second was organizing the data into a workable template for a website. The team accomplished the task of accumulating the needed information by dividing into five sub-teams. These teams were lighting, power distribution, heating/ventilation/air conditioning, waste management, and the LEED certification process itself. In order to design the website the entire team created a flow chart, and then each sub team entered information where appropriate. A final team was then created which was responsible for the web page design and to create the initial website. Also, throughout the semester, each member took on individual roles and assignments which best suited his or her talents.

Obstacles
- Determining specific goal that would benefit the electrical contractors in the process of going green.
- Establishing scope of work for timeframe established.
- Grasping the terminology and the concept of the project by individuals not familiar with construction industry.
- Obtaining pricing and return on investment for products because so much of the industry uses job specific bidding.

In order to resolve these issues, research was done on LEED and on green technology. Discussions during team meetings with group sponsors and members helped the team establish a clear goal.

Accomplishments & Recommendations
This team has successfully organized a model from which future teams can expand. At this time a number of important industry contacts have been made and a template for future research is available. The ECA is already fully involved, but it is recommended that future teams attempt to gain the support of other industry players such as architects and general contractors. This will make the website more comprehensive and create a tool to help the entire construction industry move to more environmentally friendly practices.

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1 Introduction

The following is a description of the methodologies and achievements of IPRO 338 at Illinois Institute of Technology during the spring 2008 semester. A research team was organized to focus on the effects that green technologies have had on electrical contractors in the city of Chicago, and create a tool to help them transition from traditional construction practices to environmentally friendly ones.

1.1 Background

The environment has become one of the most prominent topics in our society. Every business and politician expresses how important it is to protect our planet and the construction industry is no exception.

In April of 2000 the United States Green Building Council (USGBC) introduced the Leadership in Energy and Environmental Design (LEED) system. The LEED rating system quickly became the nationally accepted method of evaluating the impact that the construction and operation of a building would have on the environment. Today, the majority of building owners are familiar with LEED, and as this familiarity grows, the system becomes more accepted. At the same time, the reliability of green technologies has increased while up-front costs for these technologies are decreasing. This has caused the demand for green buildings, and LEED certification in construction, to increase dramatically. Construction firms who do not possess the know how to carry out green projects will soon be at a dramatic competitive disadvantage in an industry that has always been very competitive.

1.2 Purpose

Green technologies have grown in popularity very quickly but the market for these products is still only in its infancy. This has created a situation in which LEED certification is often required by building owners and developers, but contractors lack the knowledge to deliver on this requirement. Data on green products and methods are scattered, incomplete and confusing. Also, there is a growing disconnect between architects, general contractors, and other sub-contractors in relation to the best methods for achieving LEED standards.

Realizing the potential problems, the Electrical Contractors Association of the City of Chicago (ECA) sponsored this project. It is a primary goal of this undertaking to create a competitive advantage for the ECA in the market. Another goal is to help create a well informed transition from standard to green building practices and reduce miscommunication and redundancies in the green construction process.

The best method to reach these goals was determined to be the development of a website to host a user-friendly on-line database of green technology for the ECA. This website will provide a great deal of information in one place. This information includes:

- Data on products with cut sheets.
- Pricing.
- Suppliers/Distributors.
- Return on investment (ROI).
- LEED facts and certification assistance.

1.3 Scope of Work

This will be an ongoing project. In the first 16 week period it was determined that the amount of data and the intricacies involved with construction made it impossible to compile the information needed and create an operating website within the timeframe. The ECA has already committed to future support for the project, and efforts have been made to gain support from other building trade organizations, as well as from architectural associations and environmental groups.

The first phase in development had these specific goals:

- Establish the scope and usefulness of the project.
- Collect research and data.
- Initiate industry contacts.
- Develop a template for the website.
- Create a mock up of the website to demonstrate how the final product will work.

2 Implementation

At inception, the team anticipated the project implementation would require a systematic approach. The execution of the project can be divided into four areas of consideration: The Methodology, Team Assignments, Obstacles Encountered, and Ethical Issues.

2.1 Methodology

The team began the term by establishing a simple chart of tasks with milestones that needed to be completed within the timeframe allowed. The basic chart was followed throughout the semester with no major deviation. The major milestones are detailed more thoroughly below.

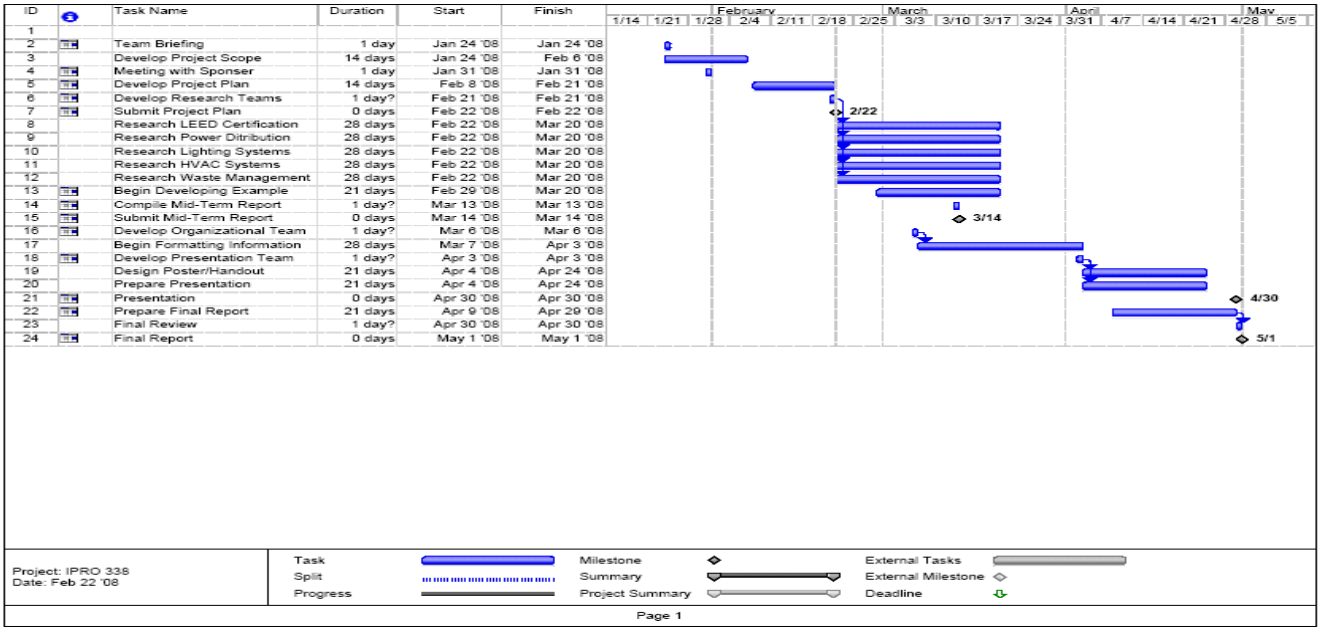

Chart 1: Project Gantt Chart

The first step in the process was to establish the scope of the work. In order to accomplish this, the group spoke to representatives of the ECA to gain knowledge and understanding of industry and establish useful goals. This was important in order to ensure that the project was on course to create a valuable product for our sponsors.

Once the goals and timetable were established, the next step in the process was to create research teams. These teams were responsible for gathering all the information that would ultimately go on the website. The process of finding and disseminating all the information available on green products is the primary focus of this project. This process will need to continue next semester until a full data base is available for activation in a live website. With the speed at which new technologies are developed this will most certainly be a continuing effort, throughout the lifespan of the website.

The initial five research teams and their primary area of concern are as follows:

Lighting

- Find product and manufacturer information for lighting systems that contribute to meeting LEED standards.
- Discover how these systems contribute to meeting LEED standards.
- Investigate price and return on investment of systems.

Heating, Ventilation and Air Conditioning (HVAC)

- Find product and manufacturer information for HVAC equipment and systems that contribute to meeting LEED standards.
- Discover how the products and systems contribute to meeting LEED standards.
- Investigate price and return on investment of products and systems.

Power Distribution

- Find methods of reducing power consumption.
- Find any products that contribute to lower power consumption in power distribution systems, and include manufacturer information.
- Discover how specific products contribute to meeting LEED standards.
- Investigate pricing and return on investment of systems and methods.

Waste Management

- Find methods of waste separation and removal that meet LEED requirements.
- Investigate variations in waste management methods of different contractors.

LEED

- Investigate the LEED system
- Determine which points are achievable by electrical systems and related areas.
- Effectively communicate the LEED principles and requirements.

The results of the team research were compiled and saved in an organized database. This database can be expanded by future teams to create a more complete final product.

The final focus for this phase of the project was to create a template for the website and generate a working model for the site. This model wouldn't be fully functioning, but it would give the user an idea of how the final product would look and work. The website needed to be user friendly and intuitive. Much of the information on the site is available throughout the internet. This site will make finding and understanding all the information quick and simple.

2.2 Assignments

The team assigned each member with certain roles early in the process. These assignments were based upon each team member's abilities, and where they felt that they could make the greatest contribution to the project.

- Giuseppe Marrari was the team leader. He created meeting agendas and promoted productivity in all team meetings. He also was the sub team leader for the Lighting Research group.
- David Boonstra was the co-team leader. He assisted Giuseppe with leadership responsibilities and brought a great deal of professional knowledge of the electrical field to team discussions.
- Sarah Althoff served as the team secretary. She created detailed and accurate minutes of the team meetings, discussions and decisions. She was also responsible for organizing individual team members' weekly timesheets.

- Andrew Dilger was the team time keeper and project planner. He monitored the progress of meetings, as well as the overall progress of the project. Andrew also took on the role of web developer. He programmed the model website submitted for the project.
- Sabeen Haque was in charge of the team iGroups communications. She encouraged the team to make full use of the iGroups site and kept it organized and updated. She also worked to build communication with contacts at the USGBC.
- Amit Kamdar headed the sub group assigned to Power Distribution Research. In addition to completing his own research, he compiled and organized the research of the other team members on the research team. Amit also was assigned to the poster design team for IPRO presentation day.
- Jason Mitchell was the sub group leader for the Waste Management Research team. In addition to completing his own research, he compiled and organized the research of the other team members on the research team.
- Vrudhdhi Patel was one of the team's ethics co-advisors, which is deemed an essential function because ethics plays a major role in balancing between the demands of industry and environment.
- Jeremy Saulog was the sub group leader for the HVAC Research team. In addition to completing his own research, he compiled and organized the research of the other team members on the research team.
- In Seok Sin also served as a team ethics advisors, which was deemed an essential function because ethics plays a major role in balancing between the demands of industry and environment. In Seok assisted Amit with the posters as well.
- James Wright was the sub group leader for the LEED Research team. This was one alteration in a key role since James began doing research on low-voltage communication systems. Due to lack of relevant information, the topic of this research group switched to LEED certification research, since this area needed to be researched as well. In addition to completing his own research, he compiled and organized the research of the other team members on the research team. James also headed the design team for the website flow chart.

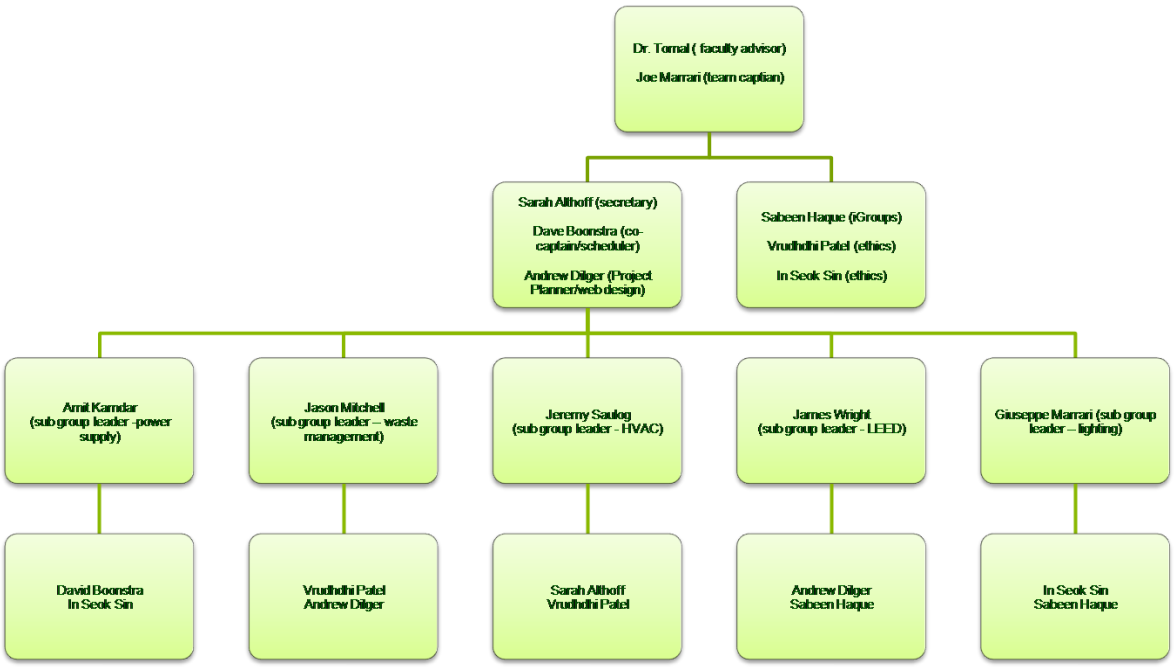

Chart 2: Team Organizational Flowchart.

2.3 Obstacles

As with any task, there were a number of problems encountered while completing the task. The team had anticipated problems and was well equipped to deal with them.

The first obstacle faced in this project was determining exactly what the goal for the project would be. Since this was a new project, there were no existing goals. The team had to develop a specific goal related to going green that would benefit the ECA in a meaningful way. Many of the members had no background in electricity or engineering, and none of the team members had a background in LEED. The lack of understanding of the industry made it difficult to determine if what was created would be helpful.

In order to resolve this, research was done on LEED and on green technology. Discussions during team meetings were held with group sponsors and members who were more familiar with electrical contracting. This helped everyone on the team better understand the purpose of the IPRO.

Once the decision was made to develop a searchable data base, other obstacles quickly arose. No one on the team had a computer science background. This fact coupled with the large amount of programming required to create a functioning website of this scale obviously made this goal out of reach for one semester. The team recommends that future IPRO teams continue the work of building a functioning website.

A stated goal of the project is to provide pricing and ROI information for a wide variety of green products and systems. This proved difficult due to the tendency for many items to be job specific. Often, these products are designed and specified according to the job and then submitted for bid to many possible suppliers. For the purpose of this semester, links and contact information was assembled for as many suppliers as possible. Also the site was designed with an application that makes it possible to enter job specific information which will then be distributed to the appropriate suppliers for bidding. This application is only designed in theory, again because the current team lacks the programming ability to establish a live application.

Another obstacle was to balance the compilation of all of the requirements needed to present the project, while still working on the project itself. These barriers were overcome by working together as a team. Solutions were found together during meetings, much in the same way previous obstacles were overcome. The team members also took responsibility for completing specific tasks thoroughly and efficiently throughout the timeframe of the project.

2.4 Ethical Behavior

Overarching standard

To facilitate environmental stewardship by providing a resource to help Chicagoland electrical contractors meet Leadership in Energy and Environmental Design (LEED) and United States Green Building Council (USGBC) standards.

Ethical issues faced during project

In order to help electrical contractors in the Chicago area, the team researched LEED requirements and USGBC standards. It was found that in some cases, requirements were too complex and would require extra costs. This resulted in pressure to rearrange the information. The team avoided ethical pitfalls by following LEED and Chicago building guidelines, and by establishing new methods and standards that were as appealing as, or more desirable than the old standards.

Also, in the process of carrying out the project, every team member had different backgrounds and experience. Some members were not familiar with electrical systems or LEED requirements. This lack of experience caused some pressure to understand the project and complete tasks in a timely manor. Therefore some individuals felt that they had an unjustly heavy work load and were not appreciated. This

problem was overcome through strong teamwork and appropriate distribution of tasks to maximize each individual's strong points.

3 Conclusions

The team has had a successful first semester. There have been a number of notable achievements made and the basic groundwork has been done for future teams to continue. The team has assembled a list of recommendations for future teams to consider.

3.1 Results

A graphic representation of the basic model for the website can be seen in the flow chart below.

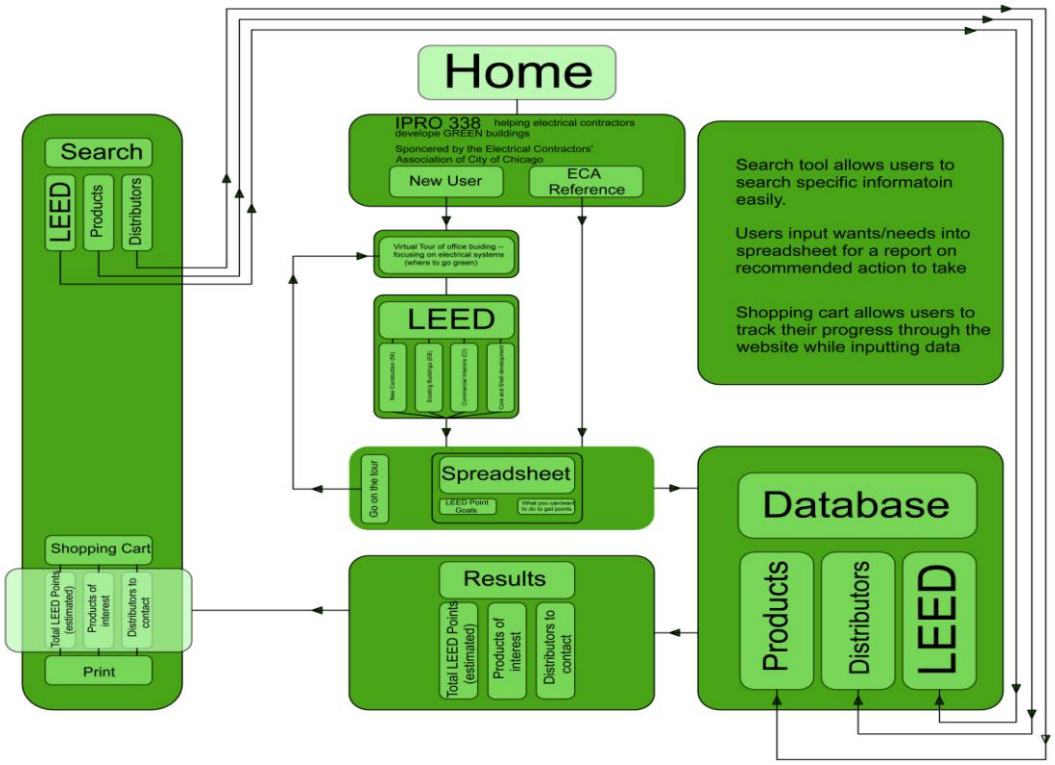

Chart 3: Website Flowchart.

This flow chart was developed based on the web design for the project. The site will walk first time users or those unfamiliar with LEED certification and green products through a tutorial on how to use the site. Information on what LEED is and how certification is achieved is the primary focus. After the introduction and tutorial the user can begin searching the site for products and vendors.

For those users who have experience with LEED and have specific needs already in mind, the site can be used directly as a search tool. The site makes it possible to find products and the theoretical LEED point value of each product. The points are accumulated and a running total is kept.

The team has accumulated a great deal of LEED research. The point system used in accreditation was an important part of the project. Also a number a benefits to building green were found. Some of this has been grouped together in Appendix A.

The web site is not fully operational at this point, but the team has designed a basic format and has laid out a number of the pages. The following picture shows a page in the tutorial section of the site. Here the user has chosen to explore residential construction of a multi family residence. The screen shows a basic room and by rolling across different aspects of the room the user can find information of various products and links to more information on the products.

Picture 1: Screen Shot of Mock Web Site.

In addition to LEED research and contacts, each sub-team also assembled a large amount of material. Again, some of this research in summarized in Appendix B. All of the completed research will be stored and made available to future IPRO groups.

3.2 Recommendations

The following is a list of goal for future teams to address.

- Attempt to gain the support of other industry players such as architects, general contractors, other trade organizations, and environmental advocacy groups. This will make the website more comprehensive and create a tool to help the entire construction industry make the transition to more environmentally friendly practices.
- Create a team capable of developing a live interactive website. The basic layout and format of the website has been established already. Adding an application that will facilitate contact with vendors would be very helpful. A log-in feature, in which the site would remember and track an individual project and progress, would also be advised.
- Research the application process for LEED accreditation further, and add standard forms that would aid in the LEED application process.
- Continue the effort to find competitive pricing and ROI information on green products.
- Continue to expand on the current database of products and vendors and update the data already available as new products are introduced.

4 Acknowledgements

IPRO 338 would like to give special recognition to a few who played a particularly helpful role in bringing about this project.

- The Electrical Contractors' Association of the City of Chicago. Specifically Mr. Tim Taylor who was a tremendous help throughout the semester.
- Huen Electric Inc. Specifically Mike Donnellan, Gregory Johnson, and Rob Koss.
- Trump International Hotel

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Appendix A. LEED Research

What is LEED?

- United States Green Building Council
- Non Profit organization working to make green buildings accessible to everyone
- Leadership in Energy and Environmental Design
- Encourage adoption of sustainable green building development practices
- Different Levels of certification based on points earned through various building practices
  - Certified 26-32 points
  - Silver 33-38 points
  - Gold 39-51 points
  - Platinum 52-69 points

Facts and Figures

- High levels of certification can be achieved at little additional cost
- US buildings account for 136 million tons of annual construction and demolition waste
- US buildings use 65% of total electricity consumption
- LEED and USGBC work to greatly reduce these numbers by every certified building

Benefits

- Improve the health and productivity of occupants
- Reduce life-cycle energy and operating costs
- Set example in community
- Meet growing demands of tenants

Appendix B. Sub-Team Research

HVAC

- The systems used must meet the standards as established by the ASHRAE/IESNA Standards 90.1-2004 or the local energy code, which ever is more stringent
- Refrigerant must not be CFC based
- Indoor air quality (IAQ) must meet standards set by ASHRAE Standard 62-2004

HVAC LEED POINTS

Energy and Atmosphere

- 15% more efficient ASHRAE 90.1-2004 (1 point)
- 30% more efficient (2 points)

Indoor Environmental Quality

- IAQ 30% higher ventilation rates than those set by ASHRAE 62.1-2004 (1 points)
- IAQ management plan
  - During construction (1 point)
  - Before occupancy (1 point)
- High level of thermal and ventilation control (point 1)
- Thermal comfort
  - Meet ASHRAE standard 55-2004 (1 point)
  - Permanent monitoring system and process for corrective action (1 point)

Waste Management

Objectives:

A. Research and compile data on current systems, methods, technology, and innovations in electrical waste management.
B. Analyze the information
C. Develop strategic models for electrical contractors to efficiently obtain the necessary credits for all electrical LEED certification.

LEED: Materials & Resources (MR)

2 Credits: Construction Waste Management- Jobsite recycling will be priority. Construction waste removed from the jobsite will need to be tracked consistently by weight or volume for the entire jobsite.
3 Credits: Material Reuse- Salvaged materials are used with target of 5% of total project cost. The most common source for EC is the re-lamping and re-use of light fixtures. MEP equipment is typically not included in this calculation.
4 Credits: Recycled Content- Post-consumer and post-industrial recycled content may be requested of copper and aluminum suppliers. Electrical contractors may need to work with suppliers to document recycled content.
50-75% of all waste must be diverted from waste landfills

Obstacles:

A. Finding methods for testing the models
B. Converting data models into practical procedures

Research:

A. U.S. Environmental Waste Compliance Procedures
B. Responsible Electronics Recycling

C. Copperhead Wire Recyclers
D. WEEE (Waste Electrical and Electronic Equipment Regulations)
E. Universal lamp disposal
F. Procedures for Product packaging disposal and recycling
G. Various innovative procedures of contractors, such as Pepper Construction, are being researched

Status:

Research and data organization is still priority and ongoing. Based on collected data thus far, procedural models have been developed, and obstacles are being weighed.

Procedures:

1. The weight of all product packaging to be used on site should be known prior to job
- Weight of packaging can be provided by suppliers
- This allows for the weight of packaging waste to be tracked by product inventory

2. Waste bins designated for wires, paper, and etc. should be provided from supplier such as *Waste Management Inc.*
3. All waste should be sorted prior to placement in bins for the following:
- Reusability
- Proper placement in bins

4. All waste management procedures should be documented and verifiable.

Lighting

Lighting is generally associated with overall building performance. A few key steps in achieving LEED points are as follows:

- Adaptive lighting controls
- Task Lights
- Alternatives to Incandescent
- Daylight dimming

Power Distribution

Achieve increasing levels of energy performance above the baseline in the prerequisite standard to reduce environmental and economic impacts associated with excessive energy use.

Requirements

Option 1 Whole Building (1 – 10 points)

Demonstrate via documentation a minimum energy cost savings, compared to ASHREA/IESNA standards. Increased percentage of savings corresponds to great point totals.

Option 2 Prescriptive Compliance (4 points)

- Under 20,000 sq ft.
- Office Occupancy
- Full compliance with all criteria as established in the Advanced Energy Guide for the climate zone in which building is located.

Option 3 Prescriptive Compliance (1 point)

- Full compliance with all criteria as established in the Advanced Buildings Benchmark for the climate zone in which building is located.

Example Products and How They Help

- APOGEE by Siemens: Unit Conditioner Controller, this improves building rating by having efficiency maximization
- APOGEE by Siemens: Insight Report Scheduling Option, Insight Base Software; aids in the organization of materials which ultimately lead to more efficiency

Appendix C. Index to Charts, Graphs, Tables, and Pictures

Appendix D. Useful Web links

Electrical Contractors' Association of the City of Chicago, Inc.	www.ecachicago.com
Huen Electric Inc.	www.huenelectric.com
Illinois Institute of Technology	www.iit.edu
International Brotherhood of Electrical Workers	www.ibew.org
Lutron Inc.	www.lutron.com
McGraw Hill Companies, Inc.	www.mcgraw-hill.com
McQuay International	www.mcquay.com
National Electrical Contractors' Association	www.necanet.org
Siemens Inc.	www.usa.siemens.com
United States Green Building Council	www.usgbc.org